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Renewable Natural Resources Planning for Regional Development with special reference to Kashmir

A thesis submitted for the degree of
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PREFACE

Over a decade back, on the basis of my 'past academic record and the recommendations' of my kind Professor - E.C. Mobbs of Wales University, I was offered a fellowship for a Ph.D. programme at New York State University, Syracuse. The topic of research was the regeneration problem of hardwood-conifer forests in New York State. I am happy that I have instead lent myself to research which is concerned directly with the development of my land - Kashmir.

I am hopeful that such research may contribute to the alleviation of poverty in Kashmir. Being the first case-study of its kind, it may unfold some fruitful avenues for further research in Kashmir as well as for replicating similar studies elsewhere. It is also hoped that it may draw attention to the importance and scope of investigations of the kind attempted here; for these have hitherto received little consideration in development research and planning in the poor areas of the world.

The decision to forgo the Syracause offer was primarily the outcome of two consecutive articles by me on the watershed management problems of Kashmir published in 1959, only weeks before I was due in Syracuse. The local response was such that it appeared to me that planning the renewable resources for an efficient management is a priority problem in Kashmir. Yet this problem has only been vaguely understood and no systematic thought has so far been applied to solving it.

Watershed management in Kashmir involves not merely silviculture, or range management, but the interdependence of the social and the renewable resource systems. This is because Kashmir is by itself a composite watershed. It includes pasture, forest and arable lands as well as the people of Kashmir within one whole. This is the valley of Kashmir, whose economy is dominated by renewable resources, with which the valley is more richly endowed than anything else. These aspects of Kashmir and its claim as a suitable planning unit are analysed in section 4, chapter III.

The above two articles may be conceived as the incipient birth of this thesis. Preliminary thinking was initiated about the subject only a little after their publication and ever since the collection of data and first-hand

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grateful to Mr. Naqushbund and the State Government for selecting me to the charge of this division, in which capacity I worked for three years - till one day before I left for this country. This work - onerous though it was with the additional charge of the State Planning Cell for forestry, gave me a grounding in the local problems of planning and allocation in the renewable resource sector. The extensive tours with the Chief Conservator and the discussions with him, with the Agricultural Production Commissioner, heads of sister departments (e.g. animal husbandry, and horticulture) and Finance and Planning ministries were a useful experience.

In September, 1967, I took up a British Commonwealth Scholarship under the aegis of the Association of Commonwealth Universities, London for research at Oxford. I wish to record my thanks to the Association and the British Commonwealth Scholarship Commission, to the Government of India (Ministry of Education) who sponsored me in my personal capacity, and, once again, to Mr. Naqushbund and the State Government who released me 'on deputation'.

Thanks are due also to the Oxford University for a substantial grant for computer data card punching. Dr. W.R.C. Handley, then acting Professor of Forest Science was helpful in this. The thousands of cards that were required to be punched for processing of the data would have involved a high opportunity cost to me in terms of thinking-time, which the grant obviated.

Many others in India and at Oxford have helped by furnishing data and by rendering their advice. They include Dr. P.S. Lokanathan, the Director, National Council of Applied Economic Research at Delhi, Dr. M. Gane, now the Director, Project Planning Centre at Bradford, and Mr. B.G. Jackson of Linacre College, Oxford. The last named was particularly helpful in enabling me to use the fastest available computer in Great Britain, IBM, MPS 360/75, recently installed at High Energy Research Laboratory, Harwell. The assistance of the Forestry department computing section for data tape punching, and in particular of Mr. H.L. Wright in programming for the use of the University's English Electric KDF 9 computer was invaluable.

Last but not the least is Ranjna's contribution to this thesis. She was an excellent companion in hours of distress and strain arising out of

computer failures and the like. She endured the task of rearing three boys whose father, afflicted by scholarship, had little time for them over a period of three years.

M.K.Muthoo

A B S T R A C T

Natural resources are part of the social capital. It is useful to classify them in relation to their use by man. Renewable resources can be used and yet perpetuated at a given level of quantity and quality. They include the attributes of soil and landscape, the biotic and water resources. Minerals and fossil fuels, on the other hand are depleted through use. They are non-renewable resources.

Renewable resources, together with man, comprise a dynamic bio-system. Any usage of resources affects the system and, in turn, society and vice versa. The resource uses considered here are agriculture, horticulture, forestry, grazing, and watershed protection. These uses embrace an area's rural sector. This includes that part of the output of goods and services and of employment in the economy which depends on the use of land conceived as a natural resource. A conjoint consideration of all the above uses is required to adapt an area's resource-use pattern to society's needs. For this, case studies are needed. This investigation pertains to Kashmir valley in north India.

The role of renewable resources in development is analysed in chapter II. This provides a conceptual background.

In a poor region like Kashmir, renewable resources have an important place in catalysing development. This involves the transformation of the available renewable resource capital, such as forests, into more productive forms. Additionally, the effects of the increasing man/land ratio can be offset through an intensification of land-use.

A conservationist policy, which impedes the above process, is unhelpful to economic development. The policy should be to economize

on scarce man-made capital and skills. They may be combined with larger doses of underutilized renewable resources and unskilled labour. The question in development is not of locking up the social capital for posterity or of canalising society's limited resources into one or the other sector. It is of allocating resources to most productive opportunities.

The planning method evolved here consists of synthesising bio-technical, economic and institutional analyses. The analytical stages do not rigidly follow this order; for, in practice, one analysis has feed-back effects on another.

The bio-technical analysis enables the identification of what is possible. This involves ecological considerations, contingent upon which is the amenability to manipulate an area's renewable resource-use pattern. The economic analysis shows what is socially profitable and what is not. It also ranks the various investment options socio-economically. The institutional analysis indicates which opportunities are adoptable and which are not, depending upon society's developmental stage.

The results of the above three analyses are collated to produce a plan consistent with developmental objectives. Finally, the plan is so presented that the decision-maker can judge it.

The planning begins with an inventory of an area's renewable resources, after identifying a suitable planning region. The valley of Kashmir is one such region. Its historical, economic, socio-cultural and geographic features, including climate and natural endowments, are distinct from its neighbours'.

The trade among intra-national regions is likely to be based on absolute advantage. This widens regional imbalances, to the detriment of a lagging region like Kashmir. Such a situation can be averted by a stocktaking of the region's endowments and by planning resource-use on the basis of comparative advantage that could emanate from them.

The above inventory involved the survey and mapping of the present renewable resource-use pattern, the location of problem spots such as of erosion, and collection of the data regarding Kashmir's socio-economy and institutions. These data provide the benchmark and an overall view of the scope for innovating the renewable resource-use pattern. Such a view is a guide for the planning strategy. Among other things, the scope is circumscribed by certain impediments to change. These may stem from the religions and the socio-culture of a region. To exemplify, the slaughter of the scrub cattle is not included in any range-management option.

The assessment of an area's bio-technical potential is made for all the possible production processes. The latter include the product lines and the production techniques that are possible of implementation, i.e., those which fall within the overall scope for making changes. The method evolved for assessing the use-possibility of renewable resources is one of evaluating the extent of areas suitable for each production process on the different sites or land-types.

The land-types are classified from their suitability for various possible uses. This is ascertained by correlating climatic, physio-graphic-cum-vegetational and soil characteristics. From these are devised site groups which reflect the slope, the kind of soil, its erosion and erodibility as well as the drainage conditions.

The variations in the site factors that are critical for the production of different commodities are dovetailed into each other according to their constraining influence. By juxtaposing all the possible uses against the climatic, altitudinal and the site groups in a descending order, some uses are successively eliminated. This leaves those which are possible on the different sites. The mutual exclusiveness of the production processes on a site is ignored at this stage. This is to avoid excluding an option without its economic evaluation.

The options for using renewable resources are evaluated by a social benefit-cost analysis. The options are the various present uses as well as their possible alternatives. The analysis is designed to appraise objectively all those consequences of an action which affect the economy.

The consequences are assessed consistently by contrasting the course of development with and without a particular investment. This involves counting the costs and benefits of an option that accrue to society. These include the linkage-effects and technological externalities of the various production processes. The purely income-transfer effects and the pecuniary spillovers, which do not affect the economy as a whole, are excluded at this stage.

The evaluation criterion is a social benefit to cost ratio. This measures the relative efficiency of options in using resources. The criterion is applied on two assumptions: that resources at society's command are limited; and that the renewable resource system is part of, and not apart from, the economic system. With such a criterion, resources are so allocated among competing investment opportunities that the net social benefit is maximised. The other criteria in use may fail to achieve this.

The social discount rate is derived from society's time preference as embodied in national policy. It is assumed that the time preference is reflected by the growth rate target set for a planned economy. The present savings rate required for investments for benefits in the future can be deduced from the above target. A model has been devised which links these parameters with the discount rate. The relevant rate has been calculated with this model and used for discounting the benefit-cost time streams.

Time preference changes as the economy grows, especially from a level as low as in India; a discount rate varying through time is more realistic than a constant rate. Thus two discount rates change from a higher level in the first 15 years to a lower level for the later 15 years of the 30 years' planning horizon adopted here. The latter is unconventionally short for some renewable resources. But it is more satisfactory than longer planning horizons, which are beset with immense uncertainty. It is the highest common factor for the production cycles of the various renewable resource-uses, including the high-forest rotations. These are accommodated by applying the sustained-yield concept.

The various resources and products are valued at their social-opportunity costs. The principle of comparative advantage is incorporated in these valuations by deriving them from the relevant world prices. For Kashmir, the international border prices of India are applied, with the necessary adjustments for transport costs to or from the nearest port. For traded goods the c.i.f. and the f.o.b. foreign exchange prices are used for imports and exports, respectively. The prices for non-traded goods are based on their effects in substituting imports or releasing alternative commodities for export.

Four categories of labour are recognised. A non-wage, unskilled subsistence worker's existing consumption has no social

opportunity cost. The opportunity cost of employing one such man-day unit outside the subsistence system is valued at the extra foreign exchange cost in the economy that ensues from his gainful employment. This is lower than the social opportunity cost of employing a wage-paid, unskilled worker, whose consumption basket is different. The semi-skilled labour is valued proportionately to the wage-paid, unskilled labour. The former's social opportunity cost is about thrice the latter's, depending upon the relative prevalent wage incomes. The existing wages of the skilled personnel are not adjusted for a social valuation.

Consistency is ensured between the regional resource allocation and the national economic configuration by using the above logic for social discounting and social pricing. The latter also obviates the shadow-pricing of foreign exchange. However, the method for reckoning the effects which defy the monetary measure, e.g. erosion and watershed protection, is different. It employs the cost of substitution principle. Such effects are translated directly into an efficiency index, ranging from zero to unity. In this way, the benefit-cost analyses include the non-market effects too, and no subjective values are assigned to them.

The number of options appraised in the above manner, with the help of the English Electric KDF9 computer, is 1187. It is not possible to make their selection optimally from their benefit-cost ranking order. This is because of the incompatibility and inter-dependence of the options. Another difficulty is that some options are linked, i.e., the choice of one depends upon that of its related options. Farm-forestry and farming are an example. A direct selection of the component options, or the production processes,

of a renewable resource system does not bring to bear upon the benefit-cost analysis the other analyses of the system, viz, bio-technical and institutional. Such a choice would fail to encompass the full range of the systems analysis that is required for optimising the systems design.

The above difficulties are met in this thesis by applying a linear programming technique with the aid of an IBM 360/75 computer. Its underlying principle is of the marginal analysis. It identifies the best adoptable combination of the options. The 'best' implies a plan which contributes the most to social aims. The objective function is socio-economic resource-use efficiency. This is subject to the constraints of the various types of land, labour and capital availability. The other restrictions indicated by subsidiary objectives and institutional considerations are also included. Among these are the maintenance of a high employment level, meeting the demand or the requirement of certain commodities such as food-grains, and enhancing the total income - of the poorer classes in particular. In brief, the above is an iterative procedure. It explores the effects of incremental changes in the levels of production processes on the outputs, resource uses and the system's efficiency. At each iteration the institutional, policy and other constraints are obeyed. An iteration which exhausts the possibility to improve the attainment of the objective yields the optimal plan. It shows the best combination of the production processes, the areas assigned to them on the different land-types, and the quantities of the complementary resources.

The dynamic scheduling of the optimal resource-use adjustments is also considered. This involves additional production processes. These are compounded of the present and the new uses. The former are continued on a particular land-type for one or more years till the sixteenth year of the planning horizon. The initiation of a new

use is postponed correspondingly. Thus the sequential effects on the efficiency and the 'loosening' of the constraints, notably of budget and labour, are incorporated in the procedure. The various constraint levels are specified for five year periods for phasing the adjustments in conformity with the state five year plans. The annual fluctuations in labour-use are considered, so that the plan does not require more peak-season labour than the total available work-force.

The sensitivity analysis of the process combinations is done by a parametric analysis of the budget and the ranging of the other constraints within their upper and lower bounds. This shows the effect on the solution of varying the assumptions about resource levels and the various constraints. The use of five different discount rates also contributes to this analysis. A solution which is stable over a wide range as well as conforms to the likely resource and demand patterns is chosen as the optimal plan. Moreover, the program is available for revisions in the light of any unforeseen changes in the future.

The plan prepared for Kashmir's renewable resource system leads to a three-fold improvement in resource-use efficiency from the socio-economic viewpoint. However, the results of the plan need to be translated into the usual lingua-franca. This is because the above planning is only part of the decision-making process. Ultimately, the choice requires value-judgements. On the other hand, the plan is based on facts marshalled by the analyst objectively, i.e., without a conscious infusion of anyone's value-judgement.

To enable a reasoned decision to be made from this factual basis, an impact analysis of the plan is made by preparing interindustry

input-output tables for Kashmir. From it, the effects on the economy are pinpointed. The scope to diversify the rural sector and to establish or expand the processing industries is exposed. The commodity outputs, budget and revenue, income, employment, and trade likely with and without the plan are quantified. The plan for Kashmir contributes to the developmental objectives in all these respects.

Yet, a change in emphasis in relation to one or the other policy objective may be desired. This can easily be done by modifying the assumptions and hence the constraint levels, or the choice of the objective function, in the programming procedure. This yields another optimal plan attuned to the value-judgements. The policy-maker entrusted with value-judgements is led to face them openly; for he decides only after being confronted with the analytical results.

This completes the planning. But it will fructify only with the policy-maker's support for instituting the fiscal, legislative and administrative measures that may be required for a co-ordinated implementation of the plan, its control and follow-up.

The application of the foregoing planning theory to empiricism may appear too academic for dealing with practical problems. But criteria evolved on such theoretical considerations help to rationalise resource allocation. This is necessary when an economy is planned to achieve defined objectives in the face of limited resources.

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CHAPTER I

THE PROBLEM

1. Introduction

This thesis is devoted to the topic of planning the use of renewable natural resources. The problem is viewed from the economy of a region and its development through efficient resource use. The investigation is oriented to socio-economic, and not merely private, interests.

The region specifically chosen is Kashmir - as a bio-economic entity in the Indian national economy. The resources considered for planning are the land-based natural resources of soil, forest and pasture. Among the various activities involved in such planning are agriculture, horticulture, grazing and livestock-rearing, sericulture, forestry, and watershed protection.

2. Resources and Society.

Resources as a whole have two essential characteristics. Firstly, they are generally limited in quantity. Secondly, resources are versatile in so far as they can be used to produce different goods and services and can be combined in varying proportions to produce a given commodity.

Resources may be classified into two main types: human and non-human resources. Renewable natural resources fall into the latter category.

Non-human resources are often classed as capital and land. The distinction may be that 'land is a free gift of nature while capital is man-made and represents past savings and

stored-up production' (Barlowe, 1961, p.9). Such a distinction is unnecessary. Land, or the natural environment, in the economic sense is the sum total of natural and man-made resources. Only by developing it from its natural state does land become an economic resource, the costs and services of which accrue to man and which may be marketed for meeting demand.

The economic characteristics of land are similar to those of capital. Both 'our capital goods and our natural resources are indeed the constituents of our social capital' (Scott, 1955), and the origin of the capital does not matter in deciding its use for man's benefit. However, in treating land as capital, there are differences in degrees of certain emphases. Chief among these is that renewable resources lend themselves to sustained use in perpetuity, if desired. Another obvious difference is that their usage is much influenced by their location and by ecological considerations, as discussed in appendix 2.

Together with the quantity and quality of resources in existence, techniques of production limit the level of want satisfaction an economy can achieve. Applying a technique of production involves know-how and the physical means of transforming resources into want-satisfying forms.

The development of human resources, e.g., through advances in organization and acquisition of skills, widens the scope of using an existing, or potential,[1] resource. It induces innovation and application of new techniques. This suggests

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1. Some resources are potential only or inaccessible at present. To qualify as a resource, they need to have access to factors and markets.

that human capabilities and institutions also circumscribe the use of an area's resource endowment, e.g., property may be a 'most important institution which affects the use and income of land' (Ely and Wehrewein, 1964). Motivations are important too. The mere existence of unsatisfied needs or desires for products is not enough; resources are made accessible to the economy if people have the ability and willingness to develop them and to pay for their products.

3. Production and Efficiency

Man lives and must work to supply his needs in an environment that is both social and physical. All the land in an area could be made to produce, but there is none that will yield without labour. What land will be used at any moment, with what techniques, and with what success, depends upon the level of social and economic pressures, as well as upon the physical environment. Every time the economic and social conditions change, a new physical problem is created; each time a new technique is considered, a new economic question appears.

Two main questions emerge from the above. How do changes in techniques and production affect the economy? How does a desired structural change, such as economic development, condition the choice of techniques and commodities? These questions involve interacting relationships - between economic goals, bio-technical possibilities of production, and opportunities for social change. For no area have they been brought together in an integrated socio-economic evaluation of the possibilities, although development theory has provided a conceptual framework. Nor has a method been proposed to coordinate the diverse facets of production from land within an area's overall socio-economy. It may, therefore,

be a substantial step forward to attempt to resolve these deficiencies.

A production process converts given resources, e.g. natural forests, into other forms and locations - the latter including the dimension of time. The purpose of production is future consumption, directly or after further processing. The low living standard of poor areas could be improved through efficient combination of the means of production, viz., labour, natural resources, and other forms of capital, which are scarce.

Basically economic efficiency implies asking only one question about a resource situation: whether there are ways of making a greater contribution to total output of the economy. This is the problem of resource allocation.

4. Resource Allocation

Choice is a fundamental economic problem. There is a symmetry between the choices of consumption and production. The principle of diminishing marginal rate of substitution enables the consumer to attain the most preferred position by arriving at that combination of goods at which their price-ratios are equal to the ratios of marginal utilities, i.e., their marginal rate of substitution. Likewise, the principle of diminishing marginal productivity enables the producer to attain the most preferred position by arriving at that combination of factors at which their price-ratios are equal to the ratios of their marginal rate of transformation. The problem of the allocation of freely variable resources would thus appear to be solvable by following the rule that each production unit must employ that quantity of the factor at which the marginal product equals the price of the factor.

Resources would be correctly allocated for maximising the contribution to net national product only when the price of the product is equal to the marginal cost of production and the price of the factor equals the value of the marginal product. Hence the conclusion that the 'optimum general welfare corresponds to the sale of everything at marginal cost' (Hotelling, 1938). Only if competition in product and resource markets were to prevail would resources automatically be allocated to maximize net national product in the above sense; also only if all factors are freely divisible and mobile and thereby freely variable.

Monopoly and monopsony are not uncommon. Laissez-faire exists nowhere. The conditions of pure competition and of freely variable resources may not be met, especially in the short run. The effective functioning of the pricing-mechanism is necessary for resource allocation on the marginal principle. This is not so in developing countries. They have large areas outside the money economy. Producers and consumers lack a full knowledge of the terms on which alternatives are offered. This knowledge is essential for any rational exercising of choice on the above principle, but it is not obtainable through the pricing mechanism.

While marginal analysis is the relevant guiding tool for the most economic use of productive resources, the application of the marginal-cost pricing principle is not applicable to all situations (Ruggles, 1968). Even with pure competition, this principle is unhelpful in the face of 'market-failure'. The latter arises from any cause that leads to inefficient resource allocation under perfect competition, e.g., internal economies of scale, external effects in production and consumption, collective-goods, and commodities with no price in terms of which benefits may be calculated.

The foregoing suggests recourse to a technique which provides an adequate measurement of social costs and benefits of an action. Such a 'cost-benefit analysis is an attempt to do explicitly what the price mechanism does implicitly' (Blaug, 1968a). In applying this analysis one has to face the problem of evaluating costs and benefits from society's viewpoint without relying on the market mechanism.

The above problem exists because government activity, though usually arising 'in the first place as a response to market failure' (ibid), may not satisfy the conditions for competitive pricing. Intervention may even add to distortions. Also, if supposedly all the necessary conditions for perfect competition were met, this problem still persists if the distribution of income is not considered socially optimal. This is likely to be the case in an economy like India's with supply of labour infinitely elastic at institutionally determined minimum wages (Marglin, 1967a).

In addition to other renewable resource uses 'agriculture and forestry, as the major users of land are inter-related' (Westermack, 1969); the 'competition, co-existence and complementary relationships' among the various uses of land (MacGregor, 1957) pose yet another problem. This is the interdependence of alternative resource uses.

The above problem arises from, among other reasons, the limited availability of land and other resources, so that many alternatives are mutually exclusive. The marginal or the 'traditional' cost-benefit analyses are incapable of considering the interdependencies (c.f. appendix II, section II). Additionally, there are constraints on resource-use other than the restricted availability of the factors of production, e.g., budget and institutional limitations, income distribution and employment effects.

Thus resource allocation has to reckon with the twin problems of the efficient utilization of society's resources on the lines of the marginal principle, and of satisfying constraints on the use of an area's renewable resources. Besides an efficiency criterion for a social cost-benefit analysis, an optimization technique is required for combining the various possible resource uses in a feasible manner. This transforms the problem of resource allocation into a problem of appropriately synthesizing benefit-cost and optimization analyses.

5. Holistic Planning

All persons and groups attempt to plan and economize. This is in so far as they try to make the 'most'of their resources, as they conceive of 'most'. Man's needs are diverse, his tastes varied, and usually his prejudices are fixed. So often, therefore, in spite of a knowledge of the capabilities of a resource base, such methods of use are employed that are not commensurate with society's overall needs.

Formal planning in order to alleviate the nation's poverty has been practised in India and Kashmir since 1951. But no plans have ever been made for renewable resources as a whole. Such coherent plans would harmonize the opportunities and conflicts in a region's resource-use.

The approach adopted in the past has been to accept a specific problem as it appears and work directly towards a solution. This is a narrow and ad-hoc approach. It does not formalise the interactions among the various complementary, or incompatible, resource uses. Nor is it capable of illuminating problems before they acquire importance in an economy.

One part of the problem-solving approach is the analysis of the problem itself. So is the assessment of whether and how far the problem can be broken down into component parts without affecting the solution. The planning problem can be divested of the exaggeration of one or the underestimation of another aspect when confronted without the usual isolation of its component parts. The system's approach used in this thesis represents a departure from the trend of independent analyses and plans for fragments of a total problem.

The need for detailed research of what may be considered as the more important 'bits and pieces' of a problem cannot be denied. But, by ignoring the social nexus of renewable resources, such research, or the application of its results, may lead to misallocation. The practice of drawing up management programmes 'more concerned with the resource itself than with the people whose livelihood depends on that resource' is a 'blind spot' in scientific analyses (Black,1967).

A change, apparently good on its own, may cause such a stress elsewhere that it has an overwhelming deleterious social effect. To avoid this, the problem requires to be anatomized to relevant extent, i.e., without misplaced isolation and unnecessary aggregation. All the technically possible and socially adoptable means and ends, alternatives and overall choices of renewable resource production need to be identified and evaluated conjointly. For doing so, a problem analysis of planning the use of renewable resources has been made in appendix 1.

6. Kashmir

In South Asia 'the man/land ratio, together with the utilization of the land and of the labor available to work it, is of crucial importance for the prospects of development and the problems of planning for development' (Myrdal, 1968, p.414). This may well be true for Kashmir, though, like any other area of South Asia, it has its own environmental, including socio-economic, features.

An investigation into the scope for fostering Kashmir's economic development through the use of its renewable resource endowment is an important subject. In this poor region, no industrial mineral has been discovered so far. Mining is restricted to quarrying, and there are only a few medium-scale industries. These and all the cottage and service industries are based mainly on renewable resource commodities.

Apart from labour, renewable resources embody an obvious potentiality for Kashmir's development. Also the region's prevalent rural economy and culture are intimately related to these resources, because of their physical and visual preponderance.

7. Resume

The questions that this thesis has set out to answer are: what, how much, where and for which end use should Kashmir produce from its renewable resources? The answers, which may involve adjustments in the present use pattern, will yield a plan for the development and use of these resources. The plan will be the first of its kind. It will consider the problem of integrating a wide spectrum of interdependent renewable resource uses with economic development. The planning method will be oriented to subserve society's aims in a poor region of the world.

CHAPTER II

RENEWABLE RESOURCES AND DEVELOPMENT

1. Introduction

In the earliest stages of organized society, economic activity is entirely dependent on natural resources. As society develops, the role of other resources, such as man-made capital, skills and organisation comes into play. In this chapter, we will examine the problem of development in relation to the place of natural resources, with emphasis on those that are renewable.

2. Development

i. Backwardness. Poor countries are backward in the sense that besides economic, they have demographic, cultural, institutional, political and technological features which are different from those in the richer countries. All these features may not cause economic poverty; some may be the effects. Nevertheless, they generally go hand in hand. It is, as such, not useful to isolate or ignore one or the other feature. They may be interrelated and mutually reinforcing.

Leibenstein (1965, pp. 40-41) lists 35 characteristics of backwardness. The list could be extended to reflect the kaleidoscope of the social structure in the poor world. An attempt is made below to survey the more universal features of backwardness.

Human resource:

Quantitative

Generally no paucity; comparatively high population growth; dependent mainly on primary pursuits, viz., exploitation of natural resources and working the land in an

agrarian framework; long-run scope for releasing surplus rural work force.

Qualitative

High percentage of illiterate and tradition-bound people; limited entrepreneurship, skills and mobility; inefficient organization and administration; bottleneck-oriented (as opposed to production-oriented) institutions; political uncertainty; employment of low-productive techniques.

Non-human resource:

Quantitative

Generally deficiently available; low incomes, largely originating in the primary sector; negligible savings for the majority comprising the peasantry, with their main expenditure on foodstuffs and subsistence commodities; bulk of the foreign exchange accrues from the export of few land-sector commodities.

Qualitative

Poor infrastructure; limited industrialization; general lack of economies of scale in the use of capital; widespread subsistence-oriented production and unmonetized economy; weak credit and marketing facilities for production and exchange of goods and services; taxation mostly indirect and relatively light on agriculture, with proportionately small contribution to national income; wide income inequalities and areal imbalances.

The above list encompasses the salience of backwardness. But, individual countries have different socio-cultural and political features. The quality and quantity of their natural, human and other capital resources differ too. For an analysis of the problem of the poverty of different areas, there is, therefore, the need for case-studies, so that inept generalised

solutions, are avoided. In recognition of this requirement, the socio-economic problems in a large country like India seem better dealt with by bio-economic regions.

ii. Developing and developed. Among the various synonyms for the poor or the third world, 'backward' seems to be appropriate. It connotes that societies in question are far behind their 'rising expectations' or what they are aiming at, e.g., higher standard of living and the concomitant institutions and infrastructure.

The term 'developing countries' because they 'are already in the process of economic development' (U.N., ECAFE, 1963) is misleading; for they may actually be stagnating. Also because richer countries too are developing their economies. Higgins (1968, p.7), therefore, prefers the term 'underdeveloped' to 'developing', suggesting that the latter 'would apply more clearly to the U.S.,Canada and Australia than to Asian or African countries'.

To call the backward countries as 'underdeveloped' or 'less-developed' is no less ambiguous. Even in the richer countries, there are regions which are not developed from their natural state any more than in the poor countries, Myint (1963) advocates the term 'underdeveloped' for underdeveloped resources and the term 'backward' for the people of an area, for such a 'distinction is fundamental to the understanding of the nature of economic backwardness'.

These definitions yield a starting distinction between man, on the one hand, and his environment on the other. In this way, the 'economic struggle' of the peoples implies 'the continuous process of mutual adaptation between wants, activities, and environment' (ibid). Such a definition forces attention on the underdevelopment of natural resources

and the backwardness of people as two distinct phenomena, which may or may not coexist.

That the poor world is now hardly referred to as 'backward' is an outcome of euphemism and, what Myrdal (1968, pp. 1839-42) calls, diplomacy by terminology. But reason and sentiment are antithetical. The economies of old countries like China, Egypt and India cannot be improved by reminiscing over their ancestors' achievements and cultural heritage. Culture is difficult to evaluate, and 'if a society is to enter modern world, there must also be a change from the traditional culture to' economic culture (Boulding, 1961).

The above is not a mere semantic discussion. It emphasises that in the differences among various countries, people's relationship with the environment in which they live is the dominant aspect, i.e., the relative backwardness or advancement of a <u>society</u> is most important. The discussion also indicates that the degree of advancement being dependent solely on a natural endowment may be a <u>nonsequitur</u>. Nonetheless, to fall in line with the current terminology, but in awareness of what has been said in the foregoing, we will hereinafter use the terms 'developing' and 'developed' to refer to the poor, or the backward, and the rich, or the advanced, countries respectively.

iii. <u>Continuum of economies</u>. The various economic stages are a continuum from the lowest to the highest. The continuum may be imagined as an inverse conifer crown spearheaded towards the goal of a better economy. Its spine is the path of economic improvement on which the various countries are poised like shoots. The developed economies have reached the tip or are nearer it and the others are at the base or nearer it. If, for instance, per capita income were an index of

the levels of economies, USA. would be at the top end and Nepal at the bottom. The distance between consecutive nodes is not constant but reflects the levels of economies between any two successive countries. In this sense, the U.K. is less advanced than the U.S.A., but decidedly more than Venezuela or India.

On the assumption that all countries desire economic improvement, they can be imagined on a march towards higher nodes. The country spearheading the march will have a new horizon as its goal, so that the continuum, as a whole, continually shifts from its present position as do all the economies within it. This may be likened to a never-ending march spearheading towards an ever-changing and an ever-widening goal.

The crown may elongate, contract or remain uniform in length, depending upon the relative changes in the speeds of march, the current trend being towards elongation. If all were to march in a constantly regimented manner, there would be no change in the relative positions of the various countries, though the continuum continuously undergoes the shift. But, usually, some steal the march thereby getting more advanced than those at the nodes over which they jump. Overtaking could occur by marching faster than before while those at higher nodes continue at previous rates, or by continuing at a steady pace while those higher up slacken down. The developing countries, clustered markedly closer to each other at the lower end of the crown will remain so unless they march faster.

iv. Economic development. Development is a dynamic process involving change in the position of a country, so that it would come to occupy a higher node in the continuum of economies. This need not imply that development aims at closing the gap between its node and those of the advanced countries. The important matter is the low absolute level of income rather than the size of the relative incomes gap among countries. The gap, so long as the rate of growth in the rich nations is high, is widening rather than narrowing. But 'what counts is whether the underdeveloped country is growing at all'. (Kindleberger 1965, p.387).

On the other hand, the major problem in the world is often stated to be the economic problem of the widening gap between developed and developing countries. Das-Gupta (1965) stresses that no matter is more significant'than the state of imbalance in the level of economic development and rate of economic growth' between nations. Ward (1968) warns that 'the gap between the rich.. and poor would continue', leading to 'creeping anarchy'. Similar voices are raised in diplomatic parlours and international conferences.

These statements overlook the need for direct confrontation of the development problem, by simplifying it as a matter of international economic imbalance. This confuses the issue by merging two distinct problems, the objective problem of poverty 'which may be measured by the absolute level of per capita income and the subjective problem of the discontent of underdeveloped countries with their present economic status' (Myint, 1964, p.19). It would appear practical to view the development issue in the light of a country's problems rather than the affluence of the developed countries. No country can 'march' at rates beyond it can. Aiming at closing the gap is merely

a slogan - unless it implies halting the pace of advancement in the developed world!

Development appears to be a complex process, beset with many difficulties and bottlenecks. This is because it involves peering through a mesh of interlocking vicious circles and understanding which ones 'are more vicious than others' (Hirschman, 1966, p.11). The process is complex, because the 'vicious circle of poverty' is oriented to perpetuating poverty (Nurske, 1953, p.4). It embodies 'circular causations' (Krause, 1961 p.20), so that development faces a chain of problems represented by a 'low-level equilibrium', which is not merely self-reinforcing but may also lead to cumulative downward movement of a poor economy (c.f. appendix 20; also subsection vii infra).

It is thus that Myrdal (1968, pp. 1859-78) argues that the situation should be viewed as a 'social system' with a number of causally interrelated conditions, viz., of output and incomes, production, levels of living, attitudes, institutions, and policies (c.f. subsection i supra). 'The movement of the whole system upward is what all of us in fact mean by development' (ibid, p.1868), i.e., though changes in per capita income are easy to measure, it is the upward change in the entire range of the socio-economic conditions that connotes development.

Development, entails a simultaneous change in the structure of the socio-economy, including the institutions, to facilitate the economy's expansion and to enable continued growth as an ongoing process. This transformation of the economy, which took centuries in the developed countries, is sought to be compressed into relatively short time spans through the process of development. As latecomers, the developing countries have the advantage of drawing upon the experience of the developed countries in an effort to

circumvent the painful and lengthy procedure involved in this process. However, it seems that sacrifice by the present generation and reconcilement among conflicting social objectives in a developing country may be inevitable. Also 'invention, innovation an substitution' of commodities and ingredients of development will have to be tailored to suit the environment of the developing countries.

The approach, the difficulties, and success or failure will vary considerably from one developing country to another because of the heterogeneity in their natural endowments, demographic factors, present level and structure of the economy, institutional and socio-cultural features. Positive economic analysis will be required, among other things, to evolve developmental policies attuned to the set of conditions characterising each country's'social system'. This is not the explicit objective of this thesis. It is not concerned with policy planning and analysis. Instead, it deals with the problem of strategy; in doing so the present socio-economic status of the economy in question cannot be ignored however. As such, this thesis will essentially involve normative analyses to evaluate and identify the scope for contributing to economic development, while keeping in view the macro-economic objectives.

v. <u>Economic stages</u>. The first stage theory could be ascribed to Aristotle (Sombart, 1929). Clark (1957, pp.492-3) traces the distinction between primary, secondary and tertiary industries to Petty, the modern version of which was developed by Fisher (1933). There is a variegated exposition of stage theories of the German historical school from Knies and Roscher to Sombart (op.cit.). And the inevitable

sequence of feudalism, capitalism and socialism is an essential feature of the Marxian doctrine.

In most stage theories, the stages are defined by the prevalent economic activity. One example is Smith's (1937) stages: nation of 'hunters', of 'shepherds', of 'husbandmen' who have little foreign commerce and produce only coarse 'manufactures' for own use, and, finally, 'a country of which a greater part of the inhabitants are artificers and manufacturers'. Another example is List's stages: fishing and hunting, the agriculture state, the agriculture-manufacture state, and the agriculture-manufacture-commerce state (Giersch, 1955).

In some theories the size of the market is the main characteristic of each stage; e.g. Buecher's sequence: household economy, town economy, regional economy and world economy (ibid). Gras' (1922) sequence combines the characteristic of economic activity and the market. Hildebrand's sequence emphasizes institutional aspects (Giersch, op.cit).

Irrespective of the merits of these theories, the stage sequences reveal, either directly or by implication, the growing independence of economic activity from a specific localized resource base. The role of natural resources through the successive stages may be looked at as being affected by two sets of forces.

One is the changing ends of economic activity. Tertiary activities become relatively more important. This leads to a decline in the demand for inputs of material resource. When a growing proportion of economic well-being accrues from the aesthetic enjoyment, personal services and leisure, the proportion of resource inputs to total consumption declines.

Second is the declining amount of natural resource inputs relative to total inputs. Soil fertility, minerals, climate and location are increasingly supplemented by the inputs of other factors. The first additional input is human energy, supplemented, and gradually replaced, by animal energy. But while the supply of animal energy depends in the first instance on natural resources, the additions of other inputs may not; improvements in the use of resources, and inventions leading to the use of new resources constitute a net addition to inputs.

During the above process, particularly by the industrial stage, resources hitherto not valuable, because they had no or limited economic use, become important inputs. They partly replace other resources and partly constitute new additions to them, e.g., coal replacing firewood but becoming subsequently also an important raw material for the chemical industry. Another example is the 'increase' in the area and the 'durability' of agricultural lands through fertilization and improvements in technique.

vi. Economic take-off. According to Rostow (1963), an economy undergoes five stages: the traditional society, the preconditions for take-off, the take-off, the drive to maturity, and the age of high mass consumption.

Like the other stage theories, it is not possible to say exactly at which point in time one stage ends and the next one begins; there are periods of transition when the dominant features of the earlier stage may fade out and those of the next one take hold. The transition itself may be long-lived. Also there are periods during which the economy may be quiescent and others when it exhibits spurts of change. Nor is it inevitable that every country should pass through the

same developmental path, especially if it is the one charted by erstwhile unplanned economies. Oceania, for instance, has escaped the middle part of the process, moving shortly after take-off to the age of high mass-consumption. Indeed the timing of the successive stages seems questionable.

Nevertheless, two basic notions underlie the theory. One that the study of economic development is facilitated by dividing the observed process of advancement. Two, that such a division is conceivable.

Take-off is the decisive land-mark, when the final points of resistance to development are destroyed. This stage is said to last for about two decades, but in India it seems to be requiring a longer time because she is believed to have reached it for about two decades now (Rostow, 1961, p.185). In fact, it is difficult to discern the stage in which India is, because she seems to satisfy many conditions of all the stages but for the last, though the drive to maturity seems to be weak and nascent. However, Kashmir as an entity seems largely in the first stage, seeking a foothold in the pre-conditions for take-off. The latter stage, therefore, seems of importance for Kashmir's development not only for breaking away from the past but also for working towards the take-off.

The preconditions for take-off represent a transitional stage comparable to late seventeenth and early eighteenth century Great Britain. The transition requires marked development in two non-industrial sectors: agriculture and social overheads, notably transport. The latter sector calls for government initiative (c.f.appendix 21). Also there is need for breaking through traditional institutions and social organisational barriers (ibid).

During the transition, agriculture is considered to play a three-fold role.[1] Firstly, it must supply more food to meet population increases, especially those in urban areas. Secondly, on the demand side, it has to provide expanded markets in order to support industry. Thirdly, on the financial side, it has to devote a substantial part of its surplus income to the other sectors of the economy.

The first role of agriculture seems to have been catalyzed recently by using additional and new inputs, e.g. hybrid seeds, fertilizers, pesticides and irrigation and the extension of 'package programme' to Kashmir. The need for extra agricultural inputs, and the increased demand for inputs to labour (mainly peasant owners) created by higher income would enable agriculture to play the second role too.

The third role assigned to agriculture has led to policies against investment in agriculture. McFarquhar (1963) recommends that it is 'not necessary to spend scarce developmental capital on schemes to increase food production'. FAO (1963) exhorts that agriculture must 'provide much of the investment and other resources for industrialization .. (and) there can be no question of giving the extensive financial and other assistance to agriculture from other sectors of the economy'. Such interpretation of the third role and the consequent lack of feed-backs into agriculture conflicts with its first two roles. The neglect of agriculture in this way is held as the root of shortfalls and the economic problems of India in the sixties. (Streeten and Lipton, 1968).

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[1] Besides the ensuing discussion in this subsection, these aspects will be elucidated in section 4 infra.

It seems that to establish an agricultural sector capable of supporting the preconditions, resources need to flow into this sector rather than be squeezed out of it (Ishikawa,1967). The latter is difficult of implementation too, because of the prevailing low subsistence level and the need to develop the human capital through investment in it (c.f. appendix 7).

The question that arises is about the source of investment resources for transforming the traditional subsistence agriculture and for the social overhead capital. It is in reply to this question that the above conflict may be resolved. Besides foreign aid, or central government assistance in Kashmir, domestic resources could be mobilized by the exploitation of existing natural resources. That is during the transition state, the third role assigned to agriculture could be less unrealistic if agriculture is viewed as a part of the natural resource sector. It would also be conceptually useful to regard agricultural production comprising production of food for local consumption and of food and other commodities for export. The latter would include cash-crops such as saffron, and horticultural produce such as apples.

When the renewable resource sector is viewed as composed of the above two aspects of agricultural production as well as of other uses of soil such as wood and animal production, it may be conceived that the sector is capable of yielding resources for a transition in Kashmir's economy.

It is indicative of the subordinate role which resource endowment plays in Rostow's analysis that it contains hardly any references to resources. This appears to be an oversight as they are not unimportant: they offer a quick yield of

increased productivity to new techniques[1] and permit the application of the hitherto unexploited backlog of innovations which increase output and provide means to service capital imports.

Rostow's own comment is pertinent in implying the usefulness of natural resources: 'so many nations are seeking take-off...But few nations have been endowed with a Pennsylvania, a Ruhr, a Black Country or a Ukraine. Most have some narrower range of natural resources whose vigorous exploitation, in a world market, can do the 'trick' (Economist, 1959). This may be applicable to Kashmir. There the range is confined to renewable resources. Besides tourism these are capable of yielding commodities in addition to food and which can be exported (c.f. 7 paragraphs before the last 5 paragraphs in appendix 13).

vii. Big push. Various factors, such as factor immobility, ignorance of markets, population growth, rigid social structure and lack of specialization, lead to a low level of productivity and subsistence-orientated production characteristic of a traditional society. This causes a low real income and thus low savings and investment leading to capital deficiency and the 'vicious circle' of poverty (c.f. subsection iv. supra). Some differentiate two other circles (Meier and Baldwin, 1957). One emphasizes the low

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1. Japan'was able to raise agricultural productivity without a significant reduction in the total agricultural work-force, and within the system of small-scale farming' (Ogura, 1963). This could be possible in Kashmir too, provided the various rural institutions are made conducive to productivity increases as they were in Japan, e.g., a productivity outlook, efficient research and extension, communal harmony, sense of national purpose (Dore, 1968).

level of demand due to low incomes, which leads to low investment; the other exhibits the effect of the under-employment of natural and human resources on each other. Actually the two are interrelated. A big change in one, say through increased utilization of natural resources, may set the other on an upward spiral reinforcing the original change. To come out of the vicious circle, a 'big push' or a 'critical minimum effort' (Leibenstein, 1965) may be required, i.e. 'there is a minimum level of resources that must be devoted to..a development program if it is to have any chance of success' (Rosenstein-Rodan, 1961).

Conceptually, there are two patterns of allocating resources for achieving the big push. These may be concentrated in special fields (akin to Rostow's leading sectors). This would cause large imbalances, calling forth development as a corrective process. On the other hand, it may be useful to exercise care in achieving a balance from the very beginning. For this, investment has to be made in various directions simultaneously. This would take account of the complementarity of demand and help capture intersectoral externalities. If only one or two industries expand, their outputs cannot be consumed by their own workers and other industries would not have enough workers to consume them. The argument is that significant 'discontinuities' or lumps exist in production functions, and demand and a simultaneous expansion is necessary before the product of one industry can be demanded by the workers of others (Nurske, 1953). As such, balanced growth appears a plausible development strategy.

Hirschman (1966) and Streeten (1959) reject the balanced growth approach, mainly because such a big expansion requires a large amount of decision-making capacity which is

scarce in developing countries. They favour unbalanced growth. However, this too requires decision-making for creating strategic unbalances which will induce easily made responses. Actually, the balanced and unbalanced growth is not so divergent in practice as it appears in concept. Balanced growth does not mean equal growth in all industries, but more in some and less in others. It is like a balanced diet which includes different items in proper, and not equal, quantities. This is very much the same as unbalanced growth (Sutcliffe, 1964). Both doctrines are an acceptance of the need for a 'big push' in economic development.

viii. Social and economic links. For generating the preconditions for a take-off or a big push, of one or the other kind, two complex variables are involved. These are the human behaviour and resources. The latter includes natural resources, capital, and scientific, technical and organisational knowledge. The availability of each of these can be altered by human behaviour. This itself is related to resources.

Prima facie, more resources per man should mean more income per head. This is not necessarily so, for other things may be unequal. These include the will of the people to get most out of a given situation. A society will have higher per capita income if it makes greater efforts to economize, both given the same resource endowments. An important factor in this is the will to economize. Yet, situations can exist where the will to economize and resource endowment may be similar but knowledge available may be different. The per capita income will be higher where greater knowledge is available and applied in production.

The availability of resources depends on the effort to economize, the level of knowledge as well as original endowment of nature. The problem of increasing the availability can be studied by economists. But to be complete, a study is required of the 'causes' and the 'causes of causes' of the effort to economize and the level of knowledge. This study may be important but is beyond the scope of economists, calling for interdisciplinary approach to overall development problems.

While attempting to increase resources per head, it is necessary not to waste skills and energy in increasing those commodities which are plentiful. Those items must be increased, which are scarce as compared to those which are plentiful and with which they must be combined to form products that people want. It is the comparatively scarce resources that must be economized in the short run and the availability of which must be increased in the long-run.

We will adopt the above principle in treating Kashmir's renewable resources as a form of capital available to society for combination with other available resources, some more scarce, some less so. Such an operation can assume various forms and policies in different countries.[1] The differences in human and other resources between nations are so great that it may be impossible to have one general theory of development applicable to all developing areas (Galbraith, 1964). By following the above principle, it will be possible to focus on the contribution possible of renewable resources on increasing society's overall resources in the socio-economic conditions obtained in Kashmir. This will not

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1. These aspects focusing on complementary social and institutional features are discussed in appendix 21.

involve transplanting a general development theory inapplicable to the region in question.

3. Natural Resources and Economic Change

(i) Natural endowment and resource scarcity. Concern about the availability of land and natural resource is centuries old. It became substantial early in the nineteenth century. Ricardo made the limitation of the supply of land the major determinant of both the trend of per capita output and the functional distribution of aggregate output in a world in which population is growing and technical progress plays a minor role. This kind of emphasis was reinforced by such statements that 'it is never the question whether a country will produce any more but whether it may be made to produce a sufficiency to keep pace with a nearly unchecked increase of people' (Malthus, 1890).

The concerns of Ricardo and Malthus underwent some relaxation in the course of the nineteenth century, because of improvements observed to be taking place and the stress placed on the 'progress of civilization.' Nevertheless, fear persisted that land famine might yet smite with a double-edged sword. The rise of the conservation movement bears testimony to this[1] (Pinchot, 1910). The overpopulated developing countries still harbour this fear. This is often on the lines of assertions made in the nineteenth century about the disparities in incomes among countries: the land-man ratio, or the overall resource endowment, of some countries is superior to that of others.

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1. So viable was the idea of scarcity that it entered the theory of natural selection when Darwin, after reading Malthus, saw competition for limited means of survival as the determinant of biological evolution (Bettany,1890).

Kindleberger (1965, pp.62-67) says that 'an underdeveloped conntry's level of income and growth is dependent upon.. natural resources. The existence of..abundant resources.. helps..(development) begin and support the ongoing process'. Viner(1963) emphasizes that 'much..depends on the 'quality'.. of the natural resources..such..as the character of soil, the forest resources, topography..rainfall and temperatures'. But the levels in the continuum of economies is not in consonance with their natural endowments (c.f. appendix,22). Meier (1965, p.34) comments that 'countries that were expected to develop most rapidly - those with relatively abundant natural resources - have not fared well'. The important point for us is not whether natural resources in these countries have or have not played an important role but whether they can or cannot do so. Such an evaluation cannot be made from what has actually been happening in the developing countries; some of them may not be (actively) interested in development, or the role that these resources can play may have been suppressed or restricted by an adverse nature of other factors, including the non-economic. The reasons for the lack of development despite relatively bountiful resources may mostly 'fall into the category of internal political problems. The multipliers and accelerators that were expected to bring about progress have not taken hold in this environment' (ibid). Taboos in India lead to a severe competition between human beings and pests, which are encouraged (Kapp, 1963).

The problem is of finding ways and means for the creation of a climate conducive to the process of development rather than of a lack of scope or otherwise on account of the available land. Tinbergen and Bos (1962) say that 'land does not

need so much attention in a study of development, because in time the quantity of land proper hardly changes'. But, the quantity, available as an economic factor is flexible, being dependent upon its 'quality' and 'accessibility', availability of complementary factors and demand. Mere occurrence of natural resources, even if accessible, is not enough. If their quantity be large and quality be high, that will not automatically lead to development. Other factors are involved; apart from motivation, important is the employment of 'resources in a different way, in doing new things with them, irrespective of whether these resources increase or not' (Schumpeter, 1949).

It is believed that 'countries poorly endowed with natural resources can achieve high levels of per capita output and income' (Hirschman, 1966, p.2). Great Britain is quoted as an example where natural resources are supposed to have been unimportant (obstacles due to their paucity) in the process of development. While more 'accessible' resources are better than less as seems to be indicated by 'a high correlation between resource level and the level of per capita income' (Meier, 1965, pp.19-21), absolute poverty of natural endowments does not reflect the economic position of a country, backward or advanced. Resources are what is made of them. Sahara reflects niggardliness of resources in Jordan but not in Israel. Mountains, that act as a barrier to the development of Kashmir, are used as a resource that contributes to the Swiss economy however poorly endowed the latter otherwise appears to be.

Essentially, therefore, an absolute niggardliness of resources is not a useful concept. Even if natural endowments may be relatively poor, a country can achieve high income if it manipulates available resources skilfully, including

through trade and specialization. This signifies to do 'more' and differently when endowment is relatively less; also that 'lesser' resources are more important and valuable in the development process than 'more'. This is a relevant point for an 'overpopulated' developing country like India. Great Britain's development is related to such factors in no small measure; her success story seems to be hinged much on the use of her 'available' domestic resources in a skilful manner. The assumption about resource poverty in this country does not hold also because (i) her industrial revolution succeeded an 'agricultural' one, when the land sector played a 'leading' role in development, among other things by savings and entrepreneurship of landowners and by releasing labour for other sectors following the enclosure movement; (ii) coal and iron ore were 'plentiful', when coal, in particular, was an important resource; and (iii) she, as the greatest colonial power, had access to markets over an empire over which sun never set.

The above indicates that while the absolute endowment of natural resources is not crucial for development, their abundance or scarcity is diagnostic of the path for economic progress, i.e., the modus operandi for a successful 'take-off' is affected. Higgins (1959, p.21-23) classifies developing countries into four categories, mainly from their natural endowments, viz. those 'which have unutilized known resources'; 'which do not appear to have abundant resources relative to size of population'; 'which are relatively rich in resources'; and 'which are poor in resources', with the suggestion that India could be included in the last named category (ibid , p.40). A classification by resource endowments may not be commensurate with the capacity of the various countries to develop, because of the conditions of their

'social systems'; it would be inappropriate to gauge a country's development potential merely from its natural endowments. While an abundance may be helpful and scarce availability of resources may constrain development, the role of a natural endowment will depend upon how efficiently it is utilized for promoting development. It is in this light that the planning of renewable natural resources of an area would be useful.

ii. Technological progress. The Malthusian doctrine of increasing resource scarcity with population growth, and the Ricardian version of increasing costs through depletion of higher grades of land, assume socio-technical constancy. But resources can only be defined in terms of known technology. Half a century ago air was for breathing and burning; now it is also a natural resource for the chemical industry. Assuming a continuing technological progress, Barnett and Morse (1963) conclude that natural resources impose problems neither of quantity nor of subsistence. They argue that the 'social heritage consists far more of knowledge, equipment, institutions, and far less of natural resources, than it once did' (ibid., pp. 11-12).

Marxian doctrine too rejects that economic progress and related historical development is determined by geographical environment or the growth of population. Schultz (1951) believes that land is the least important economic factor and ascribes differences in 'poor' and 'good' land solely to variation in spatial orientation with reference to centres of economic development. Plath (1952) on the other hand, says that 'over large areas, the capital and labor markets may be largely at fault, but within spatial limits the land factor plays a major role.'

Land, though fixed in geographical extent, is not so in an economic sense. By increasing the proportion of complementary factors of production, the products obtainable from land can be increased without the necessity to increase its area. The area of land, in an economic sense, is liable to increase. This poses no conceptual difficulty. Thus land as an economic factor has now been generally neglected. As Hirschman (1966, p.1) puts it, natural resources held 'the center of the stage only until about 1920s, after which capital came to be considered the principal agent of development, and the supply of entrepreneurial and managerial abilities now occupies 'a position of pre-eminence.'

The shifting emphases are based on observations and experiences of countries which are advanced. The 'richer countries can make substitutes for many natural resource products ..(and) trade skill and capital for Nature' (Clawson, 1964). In this way, these countries mitigate scarcity that could have led to diminishing returns. This assumes the availability or the capacity to make available capital (with embodied new technology) to enable substitution of additional land resources required to meet the increasing demand. But this may be inapplicable to poor areas like Kashmir, where 'capital is scarce, manpower is unskilled and entrepreneurship is weak. Lacking these other assets, the low-income countries are specially concerned to appraise their resources, to ascertain the ways in which fuller use of the natural resource endowment may lead them to prosperity' (ibid). The developing economies, therefore, need a different approach wherein land and other related resources are not relegated to the background.

The economic flexibility of land and the ability to cope with rapidly increasing populations depends 'on the resilient capacity of technology to discover new sources of raw materials, or substitutes for vanishing raw materials' (Osborne, 1967). Dawkins (1969) believes in this, hypothesizing that wood will no longer be required as cellulose raw material because of the commercial substitution by products obtainable from the basic sources of aluminium, iron, silicon and calcium. But the need for natural resources, one or the other continues. However, because of changes in their relative importance, technological progress may invalidate policies directed towards the conservation of a particular natural resource. Even such an outlook is fraught with risk and uncertainty - about the 'resilience' of technology to ensure satisfactory substitution. If technology is assumed ultimately not to fail in yielding substitutes for a natural resource e.g., wood, the time horizon of such a development cannot be predicted with certainty. This assumes greater importance in developing countries, where the permeation of new technology takes time and instantaneous scrapping of processing facilities based on older raw-materials may not be economical.

iii. Resources through development. Man can be described both as cooperating with and as being pitted against Nature, which behaves sometimes benignly and sometimes malignantly. This relationship appears less dominant as societies progress technologically; that is the role played by land and other natural resources declines as development goes forward.

Technological progress may be represented as augmenting the supply of the services of natural resources about as

rapidly as it augments the demand for these services at real prices not markedly different from those prevailing somewhat earlier (Barnett and Morse, 1963). In this context the point of view permeating the classical political economy is altered. Three main features are implicit in the changing relationships between man and natural resources: 1). In the realm of natural resources man is confronted by chains of substitutes; although these are imperfect, one can always be made to take the place of its scarce neighbour. 2) Should the chain be broken and a link prove to be missing, the gap may usually be repaired through trade and/or through appropriate technology. 3) The modern alchemy is at hand, and with it an increasing capacity to increase the output of resource services per unit of resource, and to decrease the input of resource-services per unit of final product.

Schultz (1964) argues from American experience that 'the role of land in economic growth is no longer nearly as important as it appeared to Ricardo and his contemporaries'. As a country progresses, the share of natural resources in income diminishes. The ratio of natural resources to all income-producing physical assets declines. Because newer forms of capital embody technology superior to older forms, their capacity to increase output, when combined with land, tends to rise, rather than fall, so long as the economy is technically progressive. In a dynamic economy, the price of the services of land may fall despite continuing population growth. The arguments imply that the real costs would not be rising even though the marginal propensity to consume agricultural, forestry and other resource products remained unchanged.

The general application of the above to developing countries may not be tenable. They may not be able to reduce the relative importance of primary production so markedly as did presently developed countries; e.g., they may be compelled to replace primary-products of foreign origin, such as food in India. Moreover, as Dales (1964) argues, the ratio of income originating from a sector may not be a valid measure of its importance in development. He concludes that 'good soil resources for food supplies, good coal or hydraulic resources, and,,certain features of climate and water supply are all natural resources that are of very great importance to economic development.'

The developmental role of natural resources was important in the past even though it is no longer so significant. The decline in their importance is associated with the rise of modern technology, which is often inaccessible to developing areas. A region must have access to technological equipment requisite for the development of its resources. Also it should have a social structure conducive to its use so as to reduce the existing dependence on a resource base. If this can be achieved, a society in question cannot be characterised as underdeveloped.

At certain periods of time, a particular resource, e.g. coal, has come into its own and helped to shape a country's socio-economic structure, sometimes may be even to the country's disadvantage. This period gives way to another when the significance of the resource in question changes. In this way, the developmental history of a country reflects its resource-based stages; its experience during each such stage leaves a deposit in its socio-economic structure and thereby conditions the country's subsequent development.

Kashmir can be said to have remained bound with a scant use of her renewable resources. To come out of the stage of land-based dominance of the economy, the development of renewable resources itself seems important because she has few other resources to look to; i.e., she needs to convert the existing natural resources into other more productive forms. This is how most of the material progress has been achieved (Scott, 1955). This also indicates that the composition of economic development is affected by the availability of resources. However, it may not necessarily affect the rate of growth; the investment resources for developing land might well be devoted equally profitably to some other use, e.g. concentrated efforts in promoting tourism or setting up of a watch industry as in Switzerland, which is comparable in some aspects of the landscape.

The analogy with Switzerland does not suggest that Kashmir would be economically better or equally so even if the development of her resource endowment is ignored. That would be hypothetical only; Switzerland's location as well as the stage of development and people are different from Kashmir's. On the other hand, the development of economy rooted in her resource base (including tourism) seems plausible, because the economic development of almost every country has been somewhat distinctive in consequence of the unique character of its resource endowment. For, this endowment is a component of the environment of obstacles and opportunities confronting the inhabitants of an area.

Natural endowment not only sets limits to what a people may accomplish at any particular time, given its technology, commercial relations, and institutions; it also helps shape a people's culture and thereby conditions its future behaviour,

economic and otherwise. It is true that progress in technology and commerce abates restraints imposed by resource endowment. But all such restraints are not eliminated. Nor may a people's cultural deposits, present as a consequence of past responses to its resource endowment be entirely removed, even though they may be considerably modified through a'cultural revolution'.

A priori, the prospect for economic development is better in some regions of the world endowed with richer natural resources, e.g., Northern America and the Soviet Union, than in others. These differences may be accentuated by the fact that the rate of population growth is higher in regions like South Asia where the land:man ratio is lower (c.f. subsection vi infra). The shortage of natural resources may retard economic progress in three mainways. The shortage may hold down productivity, income, savings and internal investment. It may limit the capacity to export raw materials in exchange for the ingredients of economic development. Resource shortage may handicap the continued development of a country which must rely in significant part, in its domestic consumption and/or in the export sector, upon produce and raw materials of foreign provenance.[1]

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1. These aspects of natural resources, with special reference to renewable land-based resources, are discussed in Section 4 infra. Here it may suffice to conclude that a weak resource sector may retard development while its efficient organisation and high productivity can contribute significantly to development, especially in the earlier stages.

iv. Resource conservation. There are what may be called 'pessimistic and optimistic' views concerning the aspects of resource scarcity on social welfare (Cotner, 1969). A static and a changing technology are the theoretical underpinnings of the two views respectively.

In the foregoing subsections, we have discussed how scarcity can be staved off through technological process and innovations. Resource creation and intensive utilization, both through discovery and improved use of existing resources, are the key elements of a natural resource policy. The pessimistic views are not helpful to a developmental role of resources. For, a conservationist dominated policy may hamper such a bio-technically feasible production from an area's natural endowment that would help in the alleviation of economic poverty. This is discussed in appendix 3.

Nevertheless, the pessimistic views still persist 'both as a concept of conservation based on the threat of exhaustion of limited natural resources and a concomitant philosophy that proposes restriction of the use of rich resources' (Gannon, 1969). From the economic standpoint, conservation is essentially concerned with the 'optimal intertemporal utilization of fixed natural resource stocks' (Krutilla, 1967). This aspect is taken care of in section 9, chapter V, in terms of society's indifference between present and the future.

However, there is more to conservation in its recent revival in the affluent countries. It is related to the welfare of men already born. Mishan's (1967, 1969) satire on 'growth-mania' captures the range of issues conservation in its broad sense is concerned about, e.g., pollution, congestion, noise, obscenity.

Besides seeking to ameliorate the impact of a rapacious industrialism on a parsimonious Nature, conservation philosophy may harmonize extreme actions, which have made resource conservation appear outmoded in all its forms. The following two statements indicate the need for harmony in the conflict of views, which gives rises to the conservation outlook.

> Economic growth has little to do with natural endowment, because its 'building blocks are now to a large extent atoms and molecules. Nature's input should now be conceived as units of mass and energy, not acres and tons' (Barnett and Morse, 1963, p.238).

> As earth is transformed from an illimitable plane to a closed sphere, the appropriate measure of system performance in the future will not be consumption and production throughput, such as GNP, 'at all, but the nature, extent, quality, and complexity of the total capital stock, including in this the state of the human bodies and minds included in the system' (Boulding,1966).

The recent conservation movement is concerned with providing ~~the~~ 'the amenities associated with unspoiled natural environments, for which the market fails to make adequate provision' (Krutilla,op.cit.). This includes the preservation of scenic wonders, wild-lands and threatened species, with which also goes the economic benefit of maintaining a reservoir of variegated germ plasm. There is an assymetry in the implications of technological progress for the production of goods and services from a natural resource base, and the production of natural phenomena which give rise to utility without undergoing fabrication or further processing (Wantrup, 1963).

The above concern has two intertwined features observed to go hand in hand with economic progress, especially in the stage of high mass consumption (see subsection 2. vi, supra): One, the growth in demand for the services of natural

phenomena, and two, the relative lack of technological advance in the production of those same services of the phenomena. The effect is that 'natural environments will represent irreplaceable assets of appreciating value with the passage of time' (Krutilla, op.cit).

Gannon (1969) states that in the U.S.A. the growth in consumer demand for natural resources is about 10 per cent a year; this swamps any productivity advance in the natural services sector possible due to improved accessibility and land (and consumer) management. Such a conclusion is similar to that of Malthus: a stagnant agricultural sector is replaced by a stagnant natural services sector. This is because productivity increase in this sector is unlikely to be large, for 'it is improbable that technology will advance to a point at which the grand geomorphologic wonders could be replicated, or extinct species resurrected. Nor is it obvious that fabricated replicas, were they even possible, would have a value equivalent to that of the originals' (Krutilla, op.cit.).

The above suggests that in appraising alternative uses of resources from a socio-economic viewpoint, the conservation aspects dealing with environmental quality require to be considered. This implies that investments for resource development must be compared with social benefit stream created (Cotner, 1969). The temporal and spatial externalities are common in natural resource markets. There is a lack of organized market for the services of natural environment. As such, the market is not a useful reference point for evaluating environmental effects of various resource uses. These features pose a unique problem in comparing investment opportunities which may improve the use of resources. This problem will be dealt with in section 7, Chapter V.

v. Underemployed resources. In advanced countries, during depressions, unemployed labour and un- or undered-utilized capital equipment lie side by side. Deficit spending and other Keynesian remedies aim at combining these factors of production, so that unemployment is removed and economy stabilized. The economy of a developing country may be likened to a perpetual state of depression. The difference, however, is that these economies have little or no under-utilized capital equipment with which the labour could be combined; instead these countries could take resort to the alternative which lies in their natural resource endowments. By using these resources most optimally they may generate other forms of capital required to bring them out of stagnation.

But, since capital, technical know-how, and other requisite ingredients are scarce, land resources acquire a fixity as against flexibility; there would be a limit beyond which the combination of additional labour would not yield increasing returns from the given land resource. This limit would approach scarcity as population increases and result into a Malthusian subsistence trap with increasing diminution of standards of living brought about by obviating 'positive checks'.

This, apparently contradcits the last paragraph. Actually there need be no contradiction and both the agruments are valid.

The developing countries have their 'lands in restrictive environments...and lands already densely populated may reach a saturation point' (Langdon White,1964). The restrictive environments may be conceived of as a circumscribed horizon of 'combinability' of labour with a given land resource because of the prevailing conditions. The

limits are imposed because natural resources 'derive their actual or potential value from economic accessibility and the configuration of prices' (Bauer and Yamey, 1957). Physical inaccessibility of resources for instance, limits their combination with the complementary factors of production. For such reasons, diminishing returns down to a limit beyond which the absolute addition to production may be zero or even ~~native~~ negative may be reached despite the availability of a surplus physical potential of both natural and labour resources. Thus, it may be stated that Malthusian subsistence economy, through the operation of diminishing returns and scarcity, operates in developing countries; and yet there are un- and under -utilized natural resources which could be combined with currently un- and under-employed labour (c.f. subsection 4. iv. infra).

vi. Population: Land ratio. It is argued that the development problem is of 'population-resources ratio where pressures of large numbers upon scarce natural resources lays a restraining hand on increasing per capita production' (Osborne, 1958). The situation is viewed as one where 'the numerator can be defined as "resources of the earth" and the denominator as "numbers of people". The numerator is relatively fixed and only partially subject to control by man. The denominator is subject...to control by man'. (Osborne, 1953). This may be a narrow view in that the numerator can be defined as not only the "resources of the earth" but also the man-made capital and the ingenuity of man, which accord flexibility to the economic availability and use of these resources. Nonetheless, the situation depicted may approximate reality in a framework where, among other things, unless population control is 'included, other means are certain to fail'

(Vogt, 1948 p.264). Coale and Hoover (1959) estimate for India, that unless birth rate falls by 50 per cent between 1956 and 1986, escape from the Malthusian trap would be even more difficult than it was in 1956. On the other hand, if such a decline were to materialize, then by 1986 income per consumer would be increasing (by about four times faster), even allowing for the projected increase in life expectancy from 32 to 52 years.

The situation appears as one where preventive checks are necessary in order to retard the increases in man/land ratio. Fisher and Potter (1964 p.68), after examining the 'possibilities of future resource demand and supply in the less developed countries', also conclude that prospective rates of population increase 'do not afford much assurance that living levels can be increased very rapidly'.

India has launched a massive programme for minimising population increase. However, an immediate impact is unlikely because of the age-composition, ignorance and enhanced life-expectancy. The increase in population has been caused by a sharp fall in the mortality rate without any significant change in the birth rate. The latter 'appears to have remained unchanged around 41 per thousand population during the greater part of the past two decades up to 1965/6', but, perhaps largely due to governmental efforts, since then 'has come down to 39 per thousand for the country as a whole' (Planning Commission, 1969).

It remains that 'Indian birth rates have fallen less during the past twenty five years than those of most Asian countries', the live birth rate in Japan being half that in India (Robinson, 1970). The rate is 'higher in rural areas than in the urban' (Planning Commission, op.cit.). Because of 'the existing pressure of the population on land, improvement

in the organisation of agriculture becomes increasingly difficult as long as large annual additions to the working population have to be supported on land' (Government of India, 1968, pp. 13.14). This calls for the diversification of the rural base, e.g. rural industries and commodity processing plants (c.f. subsection 4.1 infra), for and through, among other things, the improvement of agricultural productivity.

It seems that the pressure on land in the existing situation is such that 'there is not time' (Vogt, 1948, p.282) to wait for the effects of the birth control measures. Yet, the need for an immediate confrontation of the population problem cannot be overlooked, either by viewing it from the population-land ratios achieved in densely populated developed countries, or by comprehending it in global terms as Clark (1963) does when he says: 'Now the limitations of the Law of Diminishing Returns are more widely understood...Any foreseeable rate of population increase in any part of the world can be economically provided for a satisfactory and rising standard of real income...' No doubt, it would be technically possible to feed a larger population than the world now holds and sources of energy and raw materials provided to meet the growing needs. But, for a developing region this may be possible only with free emigration, free world markets and external assistance. Not only that, the increases in production that are actually likely are much smaller than those which are technically possible so that the level of living may be depressed as numbers increase. This is because 'ignorance, greed, strife, superstition, and blind adherence to tradition prevent men from accomplishing the works which are in their power even though the alternatives may be misery and starvation' (U.N., 1953).

The demand from population growth progresses at about the same pace as population, whereas the income elasticity of demand associated with the growth of per capita income tends to fall. This tendency in turn makes increasingly easy the formation of that capital and information whereon escape from resource-shortages must largely rest. The sets of goals underlying the two kinds of demand for resource services differ. One emphasizes growth of population, and the other growth of per capita income. These objectives are in conflict, unless population growth releases over-riding external or scale economies (Coale, 1960). The latter type of advantage does not appear wanting in India (Reddaway,1963).

The existence of the above conflict raises a normative issue. Since man lives in a finite world and population growth is usually irreversible, the range of choice, already narrow in developing countries, will become more narrow should population growth continue unabated. Geometric increase, at whatever rate, is incompatible with finitude (Coale & Hoover, 1959, pp. 330-31). The goals in developing societies require to be accommodated to this incompatibility. Probably rightly, therefore, the Indian Planning Commission (1969) warns that if the 2.5 per cent annual rate of growth of population assumed for the fourth plan continues, it will have a 'crippling' effect on development.

When a natural resource is limited in amount, e.g. habitable land, and not very dispensable, its growing scarcity may operate in time to make living standards lower than they otherwise would have been. The technological and other responses can partly offset such growing scarcity, but they may not prevent its exercising an effect upon living standards, unless tastes change appropriately.

The natural resources problem in an economy like India's is two-faced. One concerns the population-resources ratio and the other concerns the role of the resources in development. Both the development of natural resources and the reduction of population increases for improving poor economies need to be tackled simultaneously. It is the former that is dealt with in this thesis; the latter issue would take us far afield.[1]

4. Place of the Land Sector.[2]

i. Industrialisation. It is a general belief that industrialisation is the motorway that leads speedily to a developed state of the economy, industrial advancement having seemingly freed the developed countries from disadvantages that could be associated with any niggardliness of natural resources (Sutcliffe, 1970). But this could be akin to the

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1. This would be so because an integrated population theory is no less lacking (David and Huang, 1969) than a theory for the integrated use of renewable natural resource. However, this does not at all imply that we will ignore the demographic-economic factors relevant to the latter subject. Moreover, as will become clear before this chapter closes, an explicit consideration of the population problem is not crucial to our approach. The latter is based on the argument that the world's solution of population-resource problems lies not so much in reducing population to a static level of resource productivity. Contrarily, much of the solution lies in expanding man's knowledge of the use of resources and in applying this knowledge to make resources serve the expanding needs of a growing population. It appears that natural resources are expansible in productivity, for otherwise the 'United States was overpopulated by Malthusian standards in 1942' (Timmons, 1961).

2. Land sector connotes the land-based renewable resource sector, of which agriculture is usually the dominant part in developing countries. In this section, we will use the abbreviation LS for this sector. It may be considered synonymous with the rural sector, i.e., 'that part of the output of goods and services and of employment within the economy which depends directly or indirectly on the exploitation of land conceived as a natural resource' (Singh,1968). Thus, crop production, horticulture, animal husbandry, and forestry will constitute the rural sector, which would include primary production and processing in rural areas (ibid).

misconception of a poor man who goes out to buy an expensive cigar because 'rich men smoke expensive cigars' (Samuelson, 1967, p.745).

It cannot be denied that industrialization is a concomitant of economic advance and complements productivity in the LS. But what is important is that priority to industrialization at the cost of the LS may not off-set set-backs of the development process. (Sutcliffe, 1970, p.184). The latter has been witnessed in India at the end of third five year plan when 'take-off' has been followed by 'crash-landing' and led to 'a recession...With shortfall in agricultural production, there was a slump in industry and some...factories had to close down' (India News, 1968).

The establishment of the LS-based industries could be helpful in enhancing the sector's productivity through backward-linkage effects (c.f. subsection 6 infra) and in increasing incomes in the LS through the multiplier effect.[1] The early course of industrialisation, of necessity, lies in the use of resources currently accessible to a developing economy, in contrast to capital and technological resources with which it is poorly endowed. Thus 'the most suitable industries for establishment in such conditions are those that maximize total output and returns to these scarce factors in combination with as much as possible of the abundant raw materials and unskilled labor' (FAO 1967a, pp. 14-15). These industries should permit availability of goods, for which there is the greatest domestic demand at the developmental stage, after addition of value locally as

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1. This effect is subject however, to the special features of inelastic supply conditions in developing countries (c.f. ~~footnote-to-~~subsection xii infra).

well as the export of LS commodities and through them the unskilled and semi-skilled labour. Such industries would process foods, wood, fibre, plant latex and alkaloids, hides, skins and other plant and animal products.

Most of these industries are particularly suitable because of the lower capital intensity and requirement of 'skilled labor and high degree of linkage with other industries' (ibid). These industries can generally be organised in smaller viable economic units. This facilitates their dispersal in rural areas and overcomes the problems of costly handling and transportation of materials and products and evens out disadvantage, if any, of small size by providing more gainful employment. The higher cost that may be apparent in this way is in the form of wages to labour which otherwise would be un- or under-employed. Additionally, as a survey in India, Pakistan and Phillipines (U.N. ECAFE, 1965) shows, these industries are not only less capital intensive but have a higher output-capital ratio than other industries. In Asia, including India, the contribution of the LS industries is over 55 and 66 per cent and increase in all the developing countries during 1953-58 has been 37 and 4 per cent in the value added and numbers employed respectively (ibid).

An increase in the LS productivity can be ensured, among other things, by using inputs which complement labour[1]. Fertilisers, water pumping sets, improved hand tools and implements, transportation aids, including improved logging equipment, are notable items. Pesticides are important too; these could be based largely on domestically available plant and animal material, including the biological control methods.

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1. Other complementary measures, such as the establishment of markets, institutions and infrastructure, are discussed in appendix 21.

Sacks, shooks and other packaging material are also increasingly required as the LS is modernized; these also can be derived from the sector itself.

Though in recent years the most rapid increase in fertilizer use has been in the developing countries, their consumption is still about 10% of the world total' (FAO 1966a). The inputs of industrial origin as percentage of gross value of output in India is only 1.8 as compared with 28.4 in the U.K. To raise output and productivity, in the face of a high man:land ratio,requires increased use of industrial inputs.

India produces a range of the commonly required implements and even exports these including motors, pumps and commodity processing machinery. Most of these do not have any 'overriding economies of scale, and the production of such requisites is...widespread' (FAO 1967a, p.108). Fertilizer manufacture, on the other hand, is capital intensive and requires a wide industrial base, especially of intermediate manufacturing. The feasibility of setting up and expansion of fertilizer industries needs careful examination as do some other LS based industries such as pulping (Manne,1967). The various considerations involved are the raw materials and resource supplies, costs, effective demand, and for fertilizers the projected increase in farm-output vis-a-vis capital outlays, the costs and difficulties in distribution and marketing.

The need for considerably enhanced use of fertilizers in the long-run is paramount but immediately the expansion of production capacity needs to be matched by the essential accompaniments such as assured water supply, responsive seeds and knowledge of soils and plant requirements. The attitude of the producers aside, the feasibility should be

studied with the background of such paradoxes as the estimated annual production of 250 million tonnes dry weight of cowdung in India, equivalent to 3 million tonnes of ammonium-sulphate and 1.5m. tonnes of phosphate fertiliser, 75% of which is either completely wasted or burnt (NCAER, 1959) and which could be harnessed as a superior substitute to important fertilizers.

The LS provides an overwhelming proportion of industrial raw materials. 40 per cent of Indian industries are based directly on raw materials derived from the farm sub-sector (Shastry, 1967). Forests are no less important for many industries, including plyboards, pulping, construction and railways. Further expansion apart, continued existence of these industries and related activities is largely dependent upon the assured supply of the LS commodities.

With the concentration of population in the LS, demand for industrial goods is closely tied to purchasing power in this sector. Increased productivity and incomes could afford a stimulus for the expansion of industrial output and operation of economies of sale in the urban-industrial sector. This feature could be used for creating a 'stimulus circle' by concentrating expansion selectively in industries which process LS products and which provide inputs for enhancing land productivity leading to ever more industrial expansion and output from land.

The foregoing suggests the need for developing a virile LS in the context of industrisation too. This is analogous to the need to learn to walk before trying to run. No developed country has been able to undertake a smooth industrial advancement without a substantial agricultural base to back it. The relative importance of the LS, no doubt, declines as sustained growth leading the economy to higher nodes has been generated. But this is a long-run feature. During the development phase, the LS may play a strategic role and its absolute importance enhances as development proceeds.

ii. Benefits of dynamic character. An argument against the role of the LS in development is that manufacturing industries 'provide the growing points for increased technical knowledge' (Singer, 1950), offering 'benefits of a dynamic character' for changing the traditional structure of the economy (Meier, 1964 p.284).

No doubt, 'Growth of population and of industry and cities and town extends the market for agricultural products and creates the basis for the rapid development of agriculture and rural sector. But this will bear fruit in the measure in which the central problem of increasing agricultural productivity is dealt with' simultaneously (Singh, 1968,p.6). An increased demand for manufactures can be sustained only if matched by increasing the purchasing power of the potential customers, the bulk of whom are in the LS. And urbanisation in developing countries is not usually a concomitant of development. It may occur not because of a pull-effect from the urban centres but because of a push-effect from a deteriorating and 'overcrowded' rural sector leading to greater squalor and slums in the cities.

It is undeniable that change in traditional features that are inimical to the process of development are essential. For this, it is the development of the most suitable institutional environment itself, such as 'social, political and cultural growth', which is crucial (Meier, 1965,pp.v ff.) This may be attained by a variety of measures, e.g., strong extension services, changes in land tenure and organisation, credit and input supplies, research and development, imparting of new skills and mass 'education', provision of an adequate infrastructure, including markets, communications and warehousing. An emphasis on these aspects of India's rural sector is required to counteract the 'urban bias' in resource

allocation, which through the consequence of 'an underdeveloped agriculture can stultify industrial development' (Lipton,1968).

iii. Capital productivity and diminishing returns. The role of the LS in development is underscored by assuming it to suffer from low-productivity. It is argued that 'the proportion of total labour force in agriculture is virtually a measure of the degree of underdevelopment, the more people in agriculture, the more underdeveloped the country' (Higgins, 1959, p.341). The related argument is that in developing countries 'the pressure of population increase on their given natural resources will result in conditions of diminishing returns to scale for the expansion of the economy as a whole' (Myint 1964, p.94).

There is a high proportion of labour force in the LS of developing countries. But low productivity is not an inherent feature of this sector. It is 'not true that the greatest productivity advances of the last century have been in industry rather than agriculture' (Samuelson 1967 ,p.745). The alleged correlation between the strength of labour force in the LS and stage of development is not borne out by empirical evidence (c.f. appendix 23). Denmark, with the highest productivity (and though comparatively well industrialised) shares the range of labour force engaged on land with Syria and Turkey.

Nevertheless, assuming unchanged techniques, the population pressure on a resource base will result in diminishing returns 'for the expansion of the economy as whole', because of the relatively large size of the LS in developing countries. Tapping of the extreme Ricardian plateau of land is reflected in their subsistence areas, where the ever increasing population leads to reduction of the

average product per person. Economies conform to such a situation strikingly where settled forms of land-use emerged earlier. There, stagnation has set in because of the perpetuation of old techniques on frontiers most of which have been occupied long since. Through the process of 'wearing-out', the different grades of land under such conditions of stagnation slip lower on the productivity level, so that ultimately even the total product falls.

It is, as such, valid that low productivity is associated with the LS under the assumptions of unchanged techniques and non-availability of 'accessible' new land. The latter is nearly true for India but it is remediable through intensification. The former could apply also to other sectors and any economy, because static techniques would result in diminishing returns even in industry. The crux of the problem, therefore, is not the supposed inherent disability of the LS but the need to apply Schumpetrian advances of technology and innovations (c.f. subsection 3. i. supra).

Arguments favouring other sectors assume comparatively limited scope for increasing productivity in the LS. But the existing low productivity provides scope for increasing productivity in this sector. Though Italy has a relatively low productivity and ranks along with India in the concentration of labour force on land, productivity can be doubled in India by adopting techniques just on the Italian plane (c.f. appendix 23).

It is often asserted that the LS in developing economies suffers from institutional and structural rigidities, e.g. fragmented holdings and the lack of response to economic incentives, that throttle increased productivity (Brewster, 1967; Raup, 1967). A secular existence of the farmer's

non-economic outlook has not been borne out by the recent so-called green-revolution; tangible opportunities to raise output through the combined use of new inputs do not seem to have been missed by the farmers. Though social and institutional factors may cause some regional deviations, Nowshirvani (1970) concludes[1] from an inter-regional investigation that the 'existence of highly significant disparities in the rates of growth of crop yields...suggests the importance of other factors such as the availability of inputs and new techniques' and that on the whole the economic factors 'are more important than the institutional'.

As regards the size of land holdings, Rao's (1967) study shows that if there are no differences in the proportion of area irrigated, gross output per acre is constant for all size-groups. The small size of holdings need not be held against the scope for raising productivity. It may even be that in India, as Sen (1967a) argues, the output per acre is higher on small farms; given the low opportunity cost of family labour (c.f. subsection 8.vii, chap.V) and the scarcity of land, small farms are likely to use more of family owned resources per unit of land and thus achieve a higher intensification.

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1. The conclusion is not necessarily valid for all commodities and all areas in India. Also, there need be no conflict between the need for institutional reforms and for better inputs. The application of the two together would complement each other and lead to even higher response to economic inputs. Hence, to speed up transformation of the LS, institutional, social and other complementary measures deserve attention too (c.f. appendix 21). However, the argument that institutional rigidities are insurmountable or such 'bottlenecks' are a structural feature, so that their removal is a pre-condition, does not carry an inherent validity against the scope to raise productivity in the LS-through economic and non-economic measures.

Leibenstein (1965, pp.262 ff.) underrates the suggestion 'that the greatest marginal productivity of capital lies in agriculture'. But he concedes that urban-industrial role in stimulating growth in contrast to the LS, would come into play only if non-agricultural employment opportunities are created rapidly enough and if industrial sector expands rapidly enough. These qualifications cannot be met with unless enhancement of productivity in the LS takes place; without it the proportion of non-agricultural workers to an agricultural worker cannot increase. Under the limitations of resources, a rapid industrial expansion cannot be undertaken without neglecting the former aspect. This brings out the conflict in such arguments.

Letwin (1963) calls the argument that 'manufacturing is more productive than agriculture' as first 'fallacy' of development. Reddaway (1962) shows that agriculture has the lowest capital:output ratio, viz., 0.9 as against 18.0 for housing and the overall ratio of 2.2 adopted in India's third five-year plan. This may indicate the relatively higher potential to raise productivity per unit of capital and the advantage from concentrating on improving the LS. This cannot be secured by simply aiming at transferring workers to manufacturing sector unless food and other land outputs that form the inputs of industrial workers and industries are greatly increased. The significance of such a role of the LS as a bottleneck to overall development is that the scarce resources be not diverted to other sectors at the cost of diminishing returns in the largest sector.

iv. Surplus labour and marginal productivity. The arguments of 'surplus' labour, very low or negative marginal productivity in the LS, and the inevitability of diversion of labour to

other sectors have been used to underestimate the sector's potential in the process of development. Lewis (1954) argues for an over-riding importance of the capitalist sector on the basis that in 'subsistence agriculture and the traditional sectors the marginal productivity of labour is negligible, zero or even negative'. It is supposed that 'surplus' rural manpower has a zero social opportunity cost and could be employed in new enterprises without affecting output in existing ones, even if production functions therein remain unaltered.

Some relate this concept with the 'optimum population' theory, stating that 'the answer' is to take away some labour from current production for work on capital construction' (Nurkse, 1957). Fei and Ranis (1964) have introduced another connotation, referring to 'disguised unemployment' when the marginal product is less than average product which gives rise to 'redundant labour' when the marginal product falls to zero.

The foregoing arguments are related to the concept of technological dualism. This aims to explain the situation by the differences in production functions between the 'traditional' and 'modern' sectors. The traditional sector is assumed to have variable technical coefficients of production so that, under population pressure, labour substitutes other resources till its marginal productivity falls to zero or lower. Modern sector is believed to have production functions represented by rectilinear isoquants, which, with technological progress would move towards greater capital intensity (Leibenstein, 1960).

All these arguments are based on the chronic occurrence of 'disguised unemployment' in the LS, which is believed to

be remediable through emphasis on other sectors. The foremost objection lies in the concept of 'disguised unemployment' itself. Sen (1968) makes a relevant distinction: 'it is not that too much labour is being spent in the production process, but that too many labourers are spending it'. Disguised unemployment takes the form of a smaller number of working hours per head per year or of lower intensity of work. It is possible to remove so-called surplus labour without fall in output only when those who are left behind work harder and/or longer. This possibility occurs in industrial and other sectors too, even in the developed countries. Practically everybody is a disguised unemployed; each of us will produce more when technology, skill, training, and the capital stock increase.

The 'something for nothing' disguised unemployment approach is not valid in practice. Its social cost cannot be zero because of the need for additional investment in housing and equipment for those who leave the land and positive economic incentives nduce the remaining to work harder. The costs of collection, storage, transport and delivery of food and other commodities to the former cannot be ignored. Nor can the increase, which will result in the consumption both on and away from the land, be overlooked. And, even in overpopulated areas, scarcity of capital has led to such a substitution of capital by labour that the marginal product is not zero; thus a withdrawal of labour will reduce the rural output' (ibid). Also, if immobility of labour, to whatever extent it may occur in the LS, is ascribable to non-economic motivations or the 'rising-backward supply curve' there is no evidence to suggest that these are features only of the LS.

For an empirical evidence of zero marginal productivity, Indian influenza epidemic of 1918-1919 provides a negative 'clinical' test (Schultz, 1964a). The epidemic which suddenly killed about 9 per cent of the labour force, but did not affect animals, brought about a large decline not only in output but also the acreage sown in 1919-20. Sen (1967), however, says that such correlation need not be held as a conclusive evidence, for the drop in acreage may be due to a 'post-epidemic disorder' or some other reason. Schultz (1967) maintains that the data leads to 'a rejection in this case of the doctrine of surplus labour'. Pepelasis and Yotopoulous (1962) have also found that 'surplus labour in Greek agriculture is virtually non-existent'. Kao, Anschel and Eicher (1964) conclude that 'there is little reliable empirical evidence to support the existence of more than token - 5 per cent - disguised unemployment in underdeveloped countries as defined by a zero marginal product of labor and the condition of ceteris paribus'. Mathur (1965) suggests that disguised enemployment in West Bengal is about one third of the rural labour, while Paglin (1965) reports that the marginal product of labour in Indian agriculture is positive.

Most of the above evidence cannot be relied upon for accepting or rejecting the hypothesis of surplus labour, because the evidence centres round land/man norms. These are too gross to distinguish the many aspects, some of them elusive, e.g., units of labour, heterogeneity among labourers, concept of full employment, pattern of agriculture and seasonal fluctuations (Reynolds, 1969). The ceteris paribus assumption does not seem realistic and indeed, there may be several 'types of disguised unemployment' (Robinson,1969). For instance, it may arise from a) low stamina of labour, b) marginal disutility of giving up leisure, c) limited

technical substitutability of factors, d) lack of incentives for increasing productivity and output.

The above analysis makes the concept of disguised unemployment operational in so far as it points out to a) the existence of institutions by which an excess number of workers are employed in the rural sector, though with low average productivity[1] and b) the need to raise labour productivity and the various avenues for doing so - instead of emphasizing the role of one rather than the other sector. In the above context, disguised unemployment is equivalent to low-productively employed labour, whose opportunity cost is not the market wage, because labour may be willing to give up leisure as well as offer itself for more productive employment at a lower wage. Nor can the opportunity cost be zero, for the marginal product in the existing pattern of production, or the social cost, may be positive. These aspects are dealt with in section 8, chapter V. The subsequent usage of the terms disguised or under-employed labour will be made bearing in mind the foregoing discussion.

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1. This is similar to Rao's (1964) conclusion that there are 'as many levels of full employment as...~~are stages of employment~~...are stages of economic development'. Mandal (1967) also concludes differently from Lewis, Nurske, Ranis and Fei (op.cit): in overpopulated agrarian economies, what appears as 'surplus labour' is a case of full-employment equilibrium attained at low levels of productivity, technology and subsistence wage; an effective labour surplus emerges only with the growth of agricultural surplus following agricultural advancement.

v. Employment. An argument for the declining role of the LS is of the proportions of total labour force in the primary, secondary and tertiary sectors at different stages of economic development (Clark, 1957, pp. 490 ff.). Ojala (1952) hypothesises that a 'condition of economic progress' is 'the relative decline in agriculture's contribution to economic welfare', the essential mechanism of which is the diversion of working population to secondary and tertiary industries. This may be corroborated by the proportions of labour force in the primary sector, which vary from about 80 per cent in most developing countries to only about 11-12 per cent in the U.S. and 5 per cent in the U.K. (ILO, 1962).

The long-term significance of sectoral proportions of labour force cannot be denied. But the observations made in developed countries may be inapplicable to developing countries. The workforce in the primary sector in India has not declined but increased from 66 per cent in 1926-41 to 70 per cent in 1951-61 (Government of India, 1965). Not only will a possibility to transfer the labour to other sectors depend on the absorption capacity of the latter, which are comparatively capital intensive, but also on the availability of resources for their growth (and productivity change in the primary sector itself). Technological dualism might be an explanation, but are capital, foreign exchange and other resources available to expand the modern sector 'speedily'? If an economy is able to accumulate capital faster than its population growth and to generate 'linkage effect' by meeting domestically demand for capital equipment, and other goods, it is well up in the 'take-off' stage!

Instead of emphasizing the 'impossible', conditions need to be created in the 'traditional' sector itself so that the under-employed become more productive; emphasis on other sectors will not help directly nor create enough pull to reduce 'overcrowding' in the LS. It would be unrealistic to assume that rapid growth of industry would solve the problem; 'employment in manufacturing has hardly been able to keep upwith the increase in labour force - in spite of 35 years of quite rapid industrialization' in Latin-America (Griffin, 1968). The problem of underemployment may actually be accentuated by 'industrialization without an agricultural revolution' as illustrated by the postwar development of East Germany (Higgins, 1959, p.343). A survey on the impact of Rourkela steel complex on its hinterland adjacent to Bihar in India aims to show that 'disguised unemployment of rural areas was reduced' (Junghams, 1968). But the survey does not compare it with the likely impact if the resources had instead or even partly gone to the LS.

The rate of industrialization in feasible directions is useful. But the fact is that in India, the proportion of work-force and population in the primary as well as in the modern industrial sector has remained constant through 1951 to 1961, with less than 3 per cent in the latter (Dhar and Lydall, 1961), where investment has been concentrated at the cost of jolting food deficits. Thus, Lipton (1968a) argues that the industrial emphasis of Indian planning has worsened unemployment and 'agricultural investment employs more people'. The Japanese experience suggests ~~evidence~~ that to effect removal of labour from the primary sector by any external mechanism is not a 'condition' of development. She 'was able to raise agricultural productivity without a

significant reduction in the total agricultural workforce' during the development phase of 1878-1912 (Ogura, 1963).

With about two thirds of the workforce in primary sector, its role is of import per se. The proportion may ultimately decline but because of sheer size of populations in the overpopulated developing countries, the absolute numbers are unlikely to fall in the near future. Nor would expulsion of the labour from this sector aid development because that would deprive it of livelihood and may reduce the total output in the absence of reorganisation, however low- or un-productively it is employed. Such expulsion, wrongly advocated as a means of improving productivity, is not feasible; that would add to the pool of openly unemployed labour in urban areas where increase in population is faster. This is evidenced in India; over the census decade, 1951-1961, the rate of urban growth has been 26.4 as compared to 20.6 per cent in the rural population (Government of India, 1964). The urban (-industrial) growth has been unable to keep pace even with urban increase despite the diversion of resources to industrialisation during the decade. Though creation of diverse avenues for absorbing additional manpower is necessary, capital-intensive industries do not provide the best solution.

Robinson (1968) has warned that the spectre of the 1970s will be 'large-scale unemployment and the attendant threats to the political order.' Such a situation is already at hand in India.[1] The expansion of the labour absorbing LS

1. The role of the rural sector is twofold in this respect, because 'in India the amount of employment is an important determinant of the breadth of income distribution' and since the beginning of the first five-year plan, 'the rural sector has absorbed over three-quarters of India's total population growth' (Mellor, 1968).

including development of natural resources and processing of commodities, would help in averting mass unemployment. The use of intermediate technology, to which the LS is suited, is relevant for this (McRobie, 1968).

The 'most important single factor influencing a developing country's ability to absorb a growing labor force into productive employment is the type of strategy pursued for developing its agricultural sector' (Johnston and Cownie, 1969). The strategy would be on the lines of agricultural developments in Japan (in contrast to Mexico), i.e. labour-using, capital-saving innovations with its implications for employment opportunities both in agriculture and in the nonfarm sector. The recent seed-fertilizer, or 'green', revolution seems to make the strategy realizable. The yield increasing innovations are neutral to scale and consistent with the existing system of small-scale agriculture (subsection iii supra).

In this way the problem of fast growing 'population and labour force in the underdeveloped countries now appear to be manageable' (ibid). However, the difficulty remains of recognizing the role of and implementing measures for strengthening the rural base. The 'preoccupation with manufacturing has led to relative neglect of other possibilities. Substantial amounts of labour can be absorbed in such things as development of rural-based small industries'; and, much more, by the adoption of agricultural techniques which, 'in addition to raising output, raise labour requirements more or less proportionately to output' (Reynolds 1969).

vi. Linkage effects. Hirschman (1966, pp. 109-110) considers agriculture to be inferior to manufacturing 'on the count of its lack of direct stimulus to the setting up of new activities through linkage effects: the superiority of manufacturing in this respect is crushing.' But, statistics (c.f. appendix 24) do not substantiate this generalisation. Hirschman (1966, p.105) himself comments that these figures 'can be taken as a general indication of the ranking of these industries' for their 'linkage effects'. Agriculture and forestry rank higher than 8 final manufacture industries, out of 10 in that sector, and a number of intermediate manufacture industries. Grain mill products manufacture based on the LS ranks highest in the sector of final manufactures and only next to petroleum products in the intermediate manufactures sector, wherein it ranks higher than even chemical manufacture. Another LS based industry - paper and products manufacture - is third in the entire list of 29 economic activities.

Agriculture and forestry exhibit particularly high forward linkages, higher than 22 of the other 28 economic activities. It may be argued that backward linkages are more important than forward, the latter being dependent on demand and cannot 'therefore be regarded as an independent inducement mechanism (ibid, p.117). But the independence of inducement runs counter to Hirschman's (1966 p.viii) later reformulation, which embodies the proposal to 'take advantage of' 'the interrelatedness of various economic activities'. The effectiveness of backward linkages depends on supply and these linkages cannot act independently of it.

Reliance on backward linkages may not be so effective at the developmental stage mainly because of weak and inefficient

organisation and money markets. The expansion of sugar manufacturing in India during 3rd. 5 Year Plan in disregard of the primary sector and rest of the economy led to expansion of sugarcane plantations indiscriminately. Land got diverted from essential food crops and incomes to cane growers lowered through a glut in production. The consequences were so baneful that Government had to step in, impose area and other restrictions in cane cultivation, and introduce controls in sugar production and prices.

The establishment of conifer plantations in Ushutu, Swaziland, is a striking example of inducement mechanism arising in the primary sector. The reaching of the plantations to thinning stage was so strong an inducement mechanism that it resulted in the development of a new pulp-mill design with an internal water recycling system to overcome the hurdle of local water scarcity. More recently, the special property of charcoal obtainable from rubber tree wood has led to the installation of Malaysia's largest industry at Prai for manufacture of high quality steel for which the charcoal is a principal raw material.

The interdependence in the input-output sense between primary production and manufacturing is a sine-qua-non. At the developmental stage, advantages that flow from the forward linkage effects of the primary sector are relevant and can be 'used' effectively to fit in with the need of the economy.[1]

vii. Leading sectors. Rostow (1961) nominates 'the development of one or more substantial manufacturing sectors, with a high rate of growth' as an essential condition of 'take-off'.

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1. This thesis will provide a first example at an attempt to incorporate linkage-effects in the evaluation of economic opportunities (c.f. subsection 8.iii, chapter V).

The notion of an exclusive reliance on the role of a leading sector is problematic. For instance, cotton-textiles, railroad and consumer goods industries are said to have acted as leading sectors in Great Britain, the U.S.A., Germany, and Australia. But these very industries have been developed on fairly large scales in India, Pakistan and China. A sustained 'take-off' failed there but not for want of a substantial manufacturing sector; perhaps because of a stagnant primary sector, to the improvement of which these industries contributed precious little. Industries have functioned like enclaves in their dominant LS economies.

Without reforming the structure of the major sphere of the economy, the establishment of an industrial island is unlikely to lead to economic transformation. Industries may contribute and reinforce development in the LS, if suitably oriented. But these may not lead unless (productivity) expansion in the LS becomes an ongoing process. It is not necessary that the sector to emerge as dominant should be heavy-industry oriented or one which is not dependent on the LS. Rostow (1961) concedes that 'raw materials and foodstuffs can play the role of leading sectors in the take-off'. The roles of timber industry in Sweden, meat and dairy products in Denmark and Japanese silk thread are examples. The LS is capable of creating conditions for 'take-off', e.g. by exporting commodities as in the U.S., Canada and Sweden, and/or by channelling of savings as in Japan. In China too, it is believed that throughout the 1950's 'the success of the plans for industry, commerce, consumption or investment all depended on the' 'improved performance of agriculture, which however, involved a 'reform of its institutional framework' (Walker, 1965).

While it is impossible to particularise any sector as a leading one, the advance of developing economies can succeed after removing impediments to growth that weigh heavily due to their large but lagging LS. It is necessary to create suitable preconditions by modernizing this sector. This then appears to be the 'essential engine of economic transformation'. For this role, the LS is qualified as the 'leading sector' in the sense of consolidating the preconditions for and the removal of bottlenecks to take-off.

viii. Terms of trade. The cornerstones of the arguments against the scope of the LS to contribute to development include a declining trend in the world market demand for primary commodities. But projections on demand for the world by Fisher and Potter (1964,pp.40-41) show that the trends in resource consumption during the decade of 1950's will continue for the next four decades and the average per capita level of consumption for the world in the year 2000 is at the level attained in the United States in 1960. This upward trend is reflected in the growing world imports of resource commodities among which 'food' and 'raw materials', including forest products, top the list. Equally significant is the trend in the recent past when over the 12 year period, 1953 to 1965, 'the value of trade in primary products increased by 75%' (Cutajar and Franks 1967, p.20).

That the decline is imminent because of the large shift of economic activity to natural resource rich U.S.A. is not borne out by facts. The absolute volume of the U.S. imports have increased by 44 per cent from 1929 to 1955 during which period the quantum of crude material imports increased by 23 per cent and those of the foodstuffs even more. (Nurske, 1961). The U.S. has been relying to an increasing degree upon

imports of many raw materials, including lumber, and since 1930s the country's position 'as a net exporter of resource products has shifted to that of net importer' (Fisher and Potter 1964, pp.14-15). A decline in demand attributed to substitution and saturation in the demands of resource commodities in developed countries is not a tenable argument. Potter and Christry (1962) show that the per capita commodity consumption in the U.S. from 1870 to 1960 has shown a steady upward trend. While, however, the increasing role of substitution cannot be denied, the fact is that 'the world's consumption of cotton (natural) rubber, jute, butter and other products threatened by substitutes is higher than ever before...The function of the synthetic product has generally been to supplement an inelastic natural supply and meet rapidly expanding industrial requirement rather than to displace the natural product' (Cairncross 1962, p.216).

That agriculture protection policies lead to decline in demand for the resource commodities of poor countries also does not hold because these policies apply to commodities which these countries do not generally trade with developed countries, except notably sugar.

It is the manufactures from the developing countries which are affected most adversely by the tariffs and quantitative restrictions. The U.K., which is the second largest market for the developing countries, for example, allows duty free entry to important primary commodities, especially those from Commonwealth Preferance Area, including raw fibres, tea and tropical hardwoods. Even those primary commodities which are dutiable in the full tariff pay a low rate between 5 and 10 per cent ad valorem. In contrast, 'the full rate on dutiable semi-manufactures is in the range of

10 to 15 per cent, while that on manufacturers rises up to $33\frac{1}{3}$ per cent (Cutajar and Franks 1967 p.89).

Another argument is of the vulnerability to fluctuations of prices, and reliance on only a few export commodities. But there is no evidence of a significant inverse relationship between per capita income and concentration of earnings on a few export commodities; the export earnings of the developing countries do not exhibit fluctuations larger than those in high income countries; nor is there any significant link between instability and per capita income' (Bhagwati 1966). Fluctuations, nevertheless, do occur and may be countered by proper monetary and fiscal policies. 'During booms, primary products rise more in price than manufactures' (Viner 1963); the reduction during depressions could be offset, say, by investing in foreign trade during fat years as practised by New Zealand.

Prebisch (1962) showed that the ratio of prices of primary commodities to those of manufactured goods has fallen from an index of 100 in 1876-80 to 68.7 in 1946-7. This trend is based not on the measurement of prices within the poor countries, but on inferences from the U.K's commodity terms of trade. The import-price index conceals the heterogeneous price movements within and among the broad categories of foodstuffs, raw materials and minerals; no allowance is made for changes in the quality of exports and imports; 'there is inadequate consideration of new commodities, and the recorded terms of trade are not corrected for the substantial decline in transportation costs' (Meier 1964, p.372).

The evidence for Prebisch report of UNCTAD (1964) 'is drawn from a terms-of-trade index based on 1950, a peak year for LDC (less developed countries) export prices, and ending in 1961, a year of depression. A different base date

would tell a different story. (Cutajar and Franks 1967, p.168); and Kindleberger (1964) states that from early 1950's to 1960 'primary producers in Asia and the Middle East recorded overall a slight improvement of terms of trade of 6 per cent'.

Hicks' (1959, pp.180 ff.) idea of the world being divided into 'two distinct types' on the basis of trade is not true. The developed countries provide about half the world's primary exports. In 1953, the share of the third world in the total value of the non-communist world's primary exports was less than half (Yates 1959). Finland, Iceland, New Zealand, Israel, Australia, Sweden (and Ireland) rely on fewer export commodities than India, Morocco, Mexico, Tunisia and Korea. Instead of advocating an (impossible) immediate shift from primary products exports to those dominated by manufacturers, it needs to be realized that if 'you want to make a start, you must use what you have, not lament that the other fellow who is ahead of you is less highly specialized' (Cairncross 1962 p.216). The export of primary commodities is generally not only inescapable but is easier in the development stage; only it needs to be properly geared (c.f. subsection ix below).

While the view that the terms of trade are worsening for the primary producers is most vocal, it is not possible to substantiate the opposite viewpoints[1] either, as advanced by Clark (1942), Jewkes (1951), Lewis (1952) and Aubrey (1957).

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1. Lewis and Hussain (1967) have found that the relative prices of agricultural goods have risen 'very considerably faster' than those of the manufactured goods in Pakistan. Also, the world trend for forest products is one of 'growing markets with stable or rising prices' (Ojala, 1969).

The important point is that trade is a transmission belt for technological progress, skills, entrepreneurship and capital as well as for the benefits of an healthy competition, economies of scale and comparative advantage (c.f. section 3, Chapter III). As Haberler (1966) says: 'no secular tendency for the terms of trade to move one way or the other has become visible so far and there is no theoretical presumption that it will in future'.

ix. Foreign exchange. The introduction or expanded production of primary export products can play a strategic role in providing enlarged supplies of foreign exchange. 'Development of agricultural production is often the fastest method for decreasing needed imports or increasing saleable exports' (Papanek, 1954).

Higgins (1959, pp.349-57) says that 'the only way to earn more foreign exchange in the short run is by expanding traditional exports; therefore, "export-drive policies" are very important', but adds that 'countries with inadequate agricultural resources relative to their population...should export manufactures and import agricultural products. It is impossible to imagine India as a truly efficient agricultural country, but it is easy to see India as an efficient producer of steel and textiles'. Lewis (1954a) too advocates India to increase considerably her export of manufactures to pay for huge 'inevitable' food imports. But there is no reason why agriculture cannot be made more efficient and yield manifold output from its current low level. This sector could climb to such a high level of efficiency, like Japan during her development that her case is referred to as 'revolutionary progress' (Okhawa and Rosovsky, 1960).

In India, efficiency is not very low, even at present (Mellor, 1968), in the production of tea[1], coffee, cotton,

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jute, sugarcane and other commodities, from which nearly half of the foreign earnings accrue. No doubt there is room for higher productivity, much more so in food output, the productivity of rice in isolated areas in Godavari delta and wheat in Punjab equal the highest levels attained in developed countries. Starting from a base in 1949-50 of 58 million tonnes of food grains, India 'easily 'achieved the target of 65.5 million tonnes in 1955-56 because of emphasis on agricultural production during the first 5 Year Plan. During 1967-68, the output exceeded 95 million tonnes because emphasis has been switched back to this sector after second and third five year plans. During the latter periods, efforts were concentrated on other sectors that necessitated food grain imports of about 24 million tonnes during the previous three years, giving rise to severe pressure on balance-of-payments. These facts reveal that the LS does not suffer from any unremediable 'inefficiency', and its neglect on a contrary preconception may retard development.

The advocacy of a heavy reliance on foodgrain imports is inapt for reasons other than the conservation of foreign exchange too. It is not reasonable to expect foreign farm surpluses of the huge magnitude that would be required to make up domestic shortfalls. Thus Ford Foundation (1959) emphasizes that 'no conceivable programme of imports or rationing can meet a crisis of this magnitude.'

The rise in average annual imports of cereals by developing countries from 1954-56 to 1961-63 of about 12 million tons 'is entirely accounted for by PL480 imports..from the United States' and this supply is subject to 'perverse fluctuations..(which) also reflect the great difficulty of operating a programme on the scale necessary for India in

such a way as to co-ordinate supplies from home and abroad' (Lewis and Sandford, 1968). These stocks are running down and 'the era of surpluses has seemed to be drawing to an end' (ibid). If India had relied on a food-import policy through the planning periods, a deficit of 40 million tonnes could arise in any year now, wiping out the entire wheat stocks of the U.S. in a single year. If the U.S. farm support policy is reoriented to direct subsidy to farmers, which is not unlikely, rebuilding up of the surpluses is impossible. Another weakness in relying on such supplies is that the 'activization' of local currencies by the donor would make it more like trade rather than aid, whereby the U.S. would be using otherwise undisposable surplus to acquire local resources and prevent acquisition of foreign exchange by the recipients (Gosh, 1966).

This discussion, however, need not lead to autarchic objectives of self-sufficiency in commodities at all costs. But it does bring out the necessity to minimise shortfalls, within the scope of the LS, and which would alleviate the chronic adverse balance-of-payments situation. This also shows that a shift to new manufacturing export sector/s cannot be an alternative to saving or/and earning of foreign money by increased productivity or/and exports of primary commodities.

The export of manufactures may help but much difficulty is bound to be experienced in making them to play a signficant role during development. The main trade partners of developing countries are and have to be the developed countries with capacity to pay for imports in hard currency or capital equipment required in exchange. As these countries have greater comparative advantage in their established industrial sector which enjoys benefits of economies of scale, entrepreneurship, skills, organisation, advanced techniques and relatively abundant capital, it is difficult for

manufactures from developing countries to make inroads into the established markets. Even if their manufactures do not suffer from a lack of these factors, such as the Indian cotton-textiles, it is not possible to capture world markets because of tariff and quota restrictions.

Increasing their production of primary goods for export is useful from the short term point of view of each developing country. It is, however, important that productivity in export-commodity sector increases unabated, because the developing countries can lose their comparative advantage if they use it 'merely as a milch cow to finance their domestic manufacturing sector' (Myint 1964, p.155). Productivity increases can enable growth in the volume of commodity exports and decline in real costs, which may more than counterbalance any adverse movement of the terms. Contrary to the argument that decreases in costs will benefit only the importers, the exporting country will benefit too, by the ability to obtain a greater volume of imports per unit of factors employed in its exports.

The trend of demand is not so conspicuously upwards for <u>all</u> the commodities. Because of the low income elasticity of demand for some ~~is~~ products in the developed countries, the increase in foreign demand may be proportional only to increase in population in these countries. Though these products in the aggregate are ever more in demand, developing countries may rely on this only provided they exhibit resilience in emphasising or shifting to production of those commodities for which the world market signals relatively greater demand and better future prospects. Diversification of commodity exports will minimise vulnerability due to any decline in either the demand or the prices, will permit flexibility in adjustment to world market trends, and

will enable use of the variety of available resources. The capacity of Indian agriculture to grow either sugarcane, rice or jute in certain areas helps to stabilize prices and provides an escape valve.

Planned diversification on an international plane through inter-regional cooperation, would enable a greater contribution of commodity trade towards development by allowing specialisation on the basis of factor proportions, and by avoiding cut-throat competition, overproduction and dumping in foreign markets. The (adverse) effects of tariffs, whatever these be, would then pale into insignificance by placing the developing countries in a stronger bargaining position.

Single-minded efforts to boost exports of manufactures across barriers particularly severe for them (c.f. subsection supra), would cause diversion of slender resources from existing foreign exchange conserving/earning sectors with detriment to the latter. This would kill the goose without much prospect for eggs from elsewhere. Moreover, the established LS export products enjoy comparative advantage, especially those items which are more exclusive to developing countries, e.g., jute, tea, skins and hides from India, teak from Burma, hardwoods from West Africa, meat from Argentina. What, however, is required is organisational, including marketing, and technological innovations and capital inputs for improvements in productivity and quality to, among other things, retain the comparative advantage.

The improvement, diversification and flexibility in production would add to foreign earnings from the LS. As Grunwald (1964) says, 'one of the major roles of natural resources must continue to be to provide the bulk of foreign exchange..(and) this role must be expanded to the point where natural resource endowment directly furnishes essential support

for industrialization'. In spite of the mining and manufacturing expansion in some countries like India,[1] 'for many years to come agriculture will continue to be the main source of foreign earnings in Asian countries' (Ojala, 1969). The role of the commodity trade is further highlighted by the fact that agricultural imports have been growing in developing countries; both their exports and imports of commodities per capita are bound to grow through development, being about one eighth of those in the developed countries (ibid).

x. Savings for investment. The contribution of the LS in developing countries is about half or more of their national incomes. In India it equals about 46 per cent. This sector could, therefore, be the most important single source of savings for investment, the deficiency of which could constrain the development of industries and social overheads.

Japanese development was accelerated by siphoning off increased savings in agriculture. This could be achieved elsewhere too, provided productivity is enhanced and mechanisms are refined for channeling the savings. Failure to do so and, worse still, a decline in available savings as, for example, from over 20 down to only 9 per cent of tax revenue from land in India from 1939 to 1954 (Wald, 1959) could be a cause for the shortages of investment funds. While a secular decline in the relative share of the LS is likely, its sheer size gives it prominence as a major source of savings during

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1. Agricultural exports comprise about 42 per cent of India's total exports and their rate of growth exceeded 2.6 per cent for the decade ending 1966.

the development stage.

However, in the present circumstances it may not be useful, or even possible, to secure a net outflow of resources from agriculture. The idea of a 'potential development surplus' may not work in practice (c.f. appendix 7, pp. 432-434). This surplus was historically utilised for capital accumulation by means of the 'exploitation of labour' by the present-day developed countries - capitalist as well as communist; such a possibility does not seem to exist in India (Rao, 1964, p.176).

> 'First, in the beginning stages of any concerted effort to"do something" about agriculture, policy may have to accept the fact that any effort to "squeeze" the peasant will be self-defeating. If income and levels of living are already very low, a "surplus" or potential increase in output very likely does exist but it can be tapped only by allowing income and consumption levels to rise rather markedly before any of the "surplus" is appropriated for use by the non-farm sector' (Robinson, 1969).

In order to sustain the recent growth in Indian agricultural production, 'further use of new seeds and of chemical fertilizers, together with increased credit, small irrigation projects, and price supports for agricultural products, will be essential' (IMF, 1970).

Because of the magnitude of the agricultural investments required to expand output to meet the requirements of a growing population, the agricultural sector in the contemporary developing countries may require a sustained net inflow of capital. This difficulty against forcing savings from agriculture need not give rise to a gloomy prospect for

development[1]. As discussed in subsection 2.vi. supra, this emphasises the need for feed-backs into agriculture to make it ultimately and increasingly viable for subsequent contribution to other sectors; and also for considering agriculture's role in conjunction with other LS activities which can make a positive contribution almost ab initio, e.g., through transformation of forest capital into more productive forms for agricultural and industrial development.

The recognition of the above bottleneck forces a cautious optimism about the role of agriculture; i.e.,

> 'the degree to which the agricultural sector can be expected to make a net contribution to the capital requirements for infrastructure, industrial expansion, and the development of educational and other institutions will itself be strongly influenced by the strategy for agricultural development that is pursued.' (Johnston and Cownie, 1969).

The LS deserves increased attention[2], so that it is made to

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1. It may indicate the relative priorities for allocation of the very limited investible resources available at the early stages of development. The diversion of these resources, as discussed in subsection i supra, to industrial sector to the exclusion of the LS may not be useful in the long run. This may be evidenced by the report that in the early seventeenth century, India had a fairly large manufacturing sector - larger than in the west; but because of the lack of reinvestment in the LS, among other things, the process of de-industrialisation got under way and accelerated after 1833 (Kuchhal, 1965).

2. Rosen (1967) also believes that resources cannot be diverted from agriculture until there is an adequate marketable surplus; this will not occur until superior inputs are adopted; that it can be done is possible. This seems increasingly true since the so-called green revolution catalyzed by the combined use of better inputs. From this evidence, subsequent to Rosen's writing, it seems he was right in stating that the subordinate position to which agriculture was relegated was one of the major weaknesses of the second and third five-year plans.

make a greater net contribution to the capital requirements through enhanced productivity and, as such, without reducing the current consumption levels of the majority directly dependent on this sector.

xi. Income elasticity of demand and commodity supply.

Engel's Law is often quoted for the greater importance of and the need for expanding secondary and tertiary sectors. The validity of this law cannot be refuted; however, it can hold on making the assumption that incomes are past the limit beyond which the marginal rates of substitution of food by other consumer items are increasing. Developing countries, where per capita incomes are abysmal, have not reached that limit; the per capita daily consumption of food in terms of calories is only '1950 in India as against an estimated minimum requirement of 2,300-2,500' (Chandrasekhar, 1967). This contrasts with 3000-3500 calories consumed in developed countries, where the intake is comparatively superior in nutriment and 'quality'. The advocacy of the expansion of other sectors in poor countries as a corollary of the income-elasticity-of-demand argument seems to be detached from realism.

Once the starvation level is passed, additional increments of income are observed to be associated with increase of the proportion expended for food. This occurs when the food expense is low. Such is the situation in India (Khan 1961). Ojala (1952) too remarks that in the East and in societies with very low average incomes, family budget studies have not shown results that conformed with Engel's Law. It has been found that as family income rises from very low levels, the proportion of total family outgo spent for food actually increases.

The developing economies are largely in a state where highest propensity to consume lies in commodities derivable from the LS. This is illustrated by the projected income elasticity of 0.9 for food in 1957-59 through 1969-71 in Asia and Far East (excluding China and Japan) as against 0.16 for North America (FAO, 1962).

In these circumstances, the force of the income-elasticity-of-demand argument goes latent. Also, if the output of 'essential' commodities, which include food and firewood in Kashmir, does not increase as rapidly as the demand conditions change, either the pace of economic development will be slowed down or farmers and workers will be forced to pay a relatively high price for the economic growth. 'This price will be a decline in per capita consumption, if the previous level of living makes this possible without increased mortality' (Gale-Johnson 1964).

Apart from their role as wage goods and for price stability (c.f. section xii below), food and various other household commodities are indispensable for subsistence. This warrants the expansion of the LS for meeting the ever-increasing demand of these mostly renewable resource products, whose substitutes, if available, are 'inaccessible' to the majority. Using Okhawa's (1956) formula, $D = p + ng$, where D is the annual rate of increase in demand for food, p and g are the rates of population and per capita income growths respectively and n is the income elasticity of demand, India's demand for foodgrains would about double from the level of 95 million tons in 1967-68 in about fifteen years.

The above conclusion is based on 2.5 and 3 per cent for p and g respectively, and an assumed income elasticity of demand of 0.8. We do not intend to support the validity of these parameters for the future; nor Okhawa's

formula[1], for demand depends on many variables. For a reasonable forecast all these need consideration, including price trends, substitution and income distribution. However, the gross figure is a rough indication of the large increases in output that are required. Such order of magnitude is obvious, if only the absolute population increases for a country like India are considered. Since scope for extending over new areas there is very limited, increased outputs imply increased productivity in the LS. This applies to resource commodities other than foodgrains too, e.g., wood, cotton, animal products, for demand for all the commodities is projected to rise (FAO, 1967). Even if decline in rates of population growth is hoped, substantially increased supplies are required for investment in human capital, which is an important input for development.

With development, the effective demand for the essential commodities will be greater than the erstwhile sub-subsistence level as incomes increase, for 'the ratio of the increase in consumption to increase in income has been constantly rising' in India during fifties (Khan 1961). Matching the demand or nearly so by increased production in the LS satisfies the most urgently felt needs and is the most rapid and dramatic demonstration of progress; such tangible evidence of progress..is essential..to retain support during.. development..' (Papanek 1954).

xii. Price stability and inflation. Price fluctuations in a developing economy are largely a function of the supply and demand position of LS products. If raw material and food

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1. Mellor (1966, p.75) also advocates Okhawa's formula and the USDA (1965) suggest an income elasticity of demand even higher than 0.8, viz. 0.9, for income per head as low as India's. On the basis of the above calculation, the annual growth in demand is 5 per cent as against the actual output growth of 3.5 per cent realized from 1950-51 to 1968-69.

supplies fail to expand in pace with the growth of demand, the result is a substantial rise in their prices leading to pressure on wage rates with consequent adverse effects on industrial profits, investment and economic growth (Johnston and Mellor, 1961). Commenting on the Indian social and economic problems, Dagli (1968) says that 'at the root of these and..other problems..lies the paramount problem of prices.. It is the price inflation which..forced the Government to postpone the 4th 5 Year Plan'. He ascribes the cause of sharp rise in prices to the 'steadily widening gap between supply and demand'. During the 1st 5 Year Plan, which was oriented mainly to agricultural production the prices actually fell by 17.3 per cent. It is only in the subsequent two plans, which emphasised other sectors, that prices rose by 35 and 32.3 per cent. The price rise for the four year period ending 1966-67 is estimated at 57 per cent. This is correlated with the severest foodgrains deficit period in the planning phase.

An undue emphasis on industrialization is unhelpful because investment resources get locked-up on projects with long gestation periods[1]. It may worsen the situation also by inflating demand especially for food by the better-paid workers transferred from land and higher consumption by those who remain behind. Ultimately, the increased food, raw material and labour costs lead to a recession with a fall in general rates of profits to zero. This happened in India

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1. This, once again, is not meant to construe that industrialization is not required for perpetuating development; only that it should not be carried out to the exclusion of transforming the LS, without which the inflationary effects are sharpened. Such role of the LS in the developing economies is discussed in the following paragraphs. Rudra (1967) too discusses the possible effects of a slow growth rate in agriculture. He writes that it will have a retarding influence on an 'arbitrarily' high industrial growth rate through an adverse balance-of-payments and high relative prices of commodities.

in 1966-68 following very low food and other agricultural output (Robinson, 1970, pp.8-9.)

The inflationary effects of heavy outlays (on industries and other long-maturing projects) contrasts with Keynesian tools of deficit financing and public investment for remedying unemployment. This contrast arises because multiplier effects are not relevant to developing countries (Seers, 1967). There the elasticity of local supply conditions is not high. Consequently the secondary waves of purchasing power generate price rises, rather than higher domestic output and employment even though there may be considerable unemployment.

According to Rao (1964), the supply curve in developing countries is not only inelastic, 'but also tends to be backward rising', so that an increase in value of output need not necessarily lead to a subsequent increase in the volume of supply. This means that while money incomesmay increase output does not increase. Further, as agriculturists are themselves the producers of food, the increase that follows in their consumption leads to a reduction in marketable surplus. The tendency therefore for prices to rise without an increase in aggregate real income is strengthened. Even for most of the non-agricultural consumption goods, the position is similar, because of the inelasticity in the supply of raw-materials. In this way, the multiplier works with reference to money and not the real incomes or employment. 'It is not deficit financing as such which has been responsible for inflation; it is the unproductive character of the outlays...and the unsatisfactory response of the community in terms of both work and saving to the increased outlay that is responsible for inflation' (ibid, pp. 109-10.

Reddaway (1963, pp.8-9) alludes to the above saying that the secondary, or the multiplier, consequences of a project, such as road-building,

> 'in the shape of additional demand for consumer goods, mainly serve to increase the demand for food; and the output of food is not limited by the lack of demand, even though there is plenty of underemployed labour attached to agriculture. The extra demand consequently falls on the balance of payments...(and/or) it serves to drive up prices'.

This feature and the foregoing explanation suggest that to curb inflation, increases in the LS output are required to match demand. This implies breaking through the rigidity of an inelastic supply curve and transformation of the LS on a priority basis. The importance of a dynamic LS for keeping down prices, in the interests of industrial expansion, overall economic development and immediate welfare[1] cannot thus be overemphasized.

xiii. Tourism, recreation and wildlife. One of the direct benefits of the outdoor recreation and amenity aspects of land are the maintenance and improvement of human capital for increased efficiency and productivity by contributing to its physical and mental health. The other benefits are provision of employment, distribution of income and siphoning of savings for reinvestment.

The development of amenity and recreation resources can be useful in promoting tourism, which brings in not only valuable foreign money but also permits exchange of ideas. Tourism based on the scenic and other aspects of land takes the affluent and generally influential foreigner deep into relatively more backward areas. This may help to promote a

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1. 'Food prices are the most important part of the cost of living for the working class' (Mellor, 1968).

better appreciation for aid in donor countries and may prompt them to import items otherwise little known outside these areas.

Even at the present stage of development, the role of scenic and recreational resources is significant in many developing countries. Tourism in Kashmir, based on these resources, is a major industry. Similarly, Kenya's ten national parks are the biggest draw for her tourist industry which brought in about £7 million during 1967 from 70,000 visitors making it the country's third largest foreign exchange earner. Additionally, wild-life and flora contribute to the economy by maintaining an ecological balance and by providing food and other essentials to populations inhabiting the deeper hinterland.

The economic contribution possible of some of the currently 'useless' wild-animal and plant resources need not be dismissed; instead investigation is indicated so that these may also contribute materially. Aside their direct contribution to the economy, rare species in their habitat are valued by society, even if materially backward, for the sake of averting their extinction (Mukherjee, 1966). Aid comes forth from International agencies for saving them and maintaining their habitat, so that, besides being an added attraction to scientists, nature lovers and tourists from all over, the country gains in foreign exchange, sympathy, prestige and a richness in variety. Also by maintaining a variety of gene resource, the wild-life and -plant materials contribute both to the economic and socio-cultural development of a country.

xiii. Environmental nexus. Renewable natural resources are organically linked with human activity. They occupy an important place in the economy and its development through the ecological complex that comprises the environment, the chief elements of which, besides man; animals and plants, are the climate, soil, water and space (c.f. appendix 2).

It is argued that climate has no relevance in development (Brown, 1943; Samuelson, 1967, p.740) But apart from the effect of climate and its vagaries that influence day to day economic activity and cropping patterns, it influences the development strategy; e.g. in a region with scant precipitation industrial development has to be oriented to least water consuming techniques. Even in an advanced country like Australia such a limitation for the expansion of her economy is being experienced and is reflected in economic policies, including Land-use.

Another facet of the interrelationship between environment and the economy is the inescapable need to concentrate development effort to compensate the deficiencies of climate to promote overall development. Among others, this includes outlays on schemes of irrigation, prospecting and tapping of underground water, and moisture conservation. Bryson (1967) advocates the revegetating of the Indian Rajasthan desert with grass so that 'there would be more rain'. Apart from such untested claims, trees and shrubs are capable of being grown there (Muthoo 1957), and, if not the climate over a wide range, the microclimate may be made less hostile to development of the concerned localities.

The environment shapes the modus operandi of development, so as to fit in with as well as to modify the effect of its immutable features. Site and its position in the locational matrix, nature of space above and below it, of coastline,

harbours and landform, and their relative suitability for different kinds of development activities are some of such features influencing, among other factors, mobility and transportation, accessibility and values, costs, prices and markets, and indirectly the entire human ecology.

Hoover (1948, p.3) says that 'the most obvious basis for the distribution of industries and people is the distribution of natural resources'. Though this is not necessarily true, for other factors such as proximity to markets and infrastructure also affect, the locational role of resources during development is of importance because 'early stages of production are material oriented' (ibid, p.46). Hicks (1959 p.162) explains the higher development of regions or places in terms of the environmental resources as 'are marked out by geographical advantages, proximity to (resources), or to areas particularly suitable for specialized crops; alternatively they may have naturally good communications'.

In addition to the direct benefits of soil and water resources, environment affects development through the negative economic benefits that arise from erosion and floods. Further interplay of the economy and environment occurs when, for example, measures for erosion and flood control are warranted and undertaken.

The features of environment, such as the nature of climate, watersheds and landscape including soil and water, are thus diagnostic of the problems of the economy, and of the culture of a region. The role of renewable resources cannot be overstated, for the animals and plants that can ordinarily thrive in a locality are determined by the nature of the environment that it provides, and the need to mould the environment itself to meet developmental requirements.

4. Role of Natural Resources in Development.

In this chapter, we have attempted to bring out the various inter-relationships between the availability and use of resources and the process of economic development. Our propositions may now be brought into a synoptic view. This sets the stage for a specific investigation of our problem.

Economic development involves the movement of the whole 'social system' upwards. Many variables are involved[1], so that natural resources by themselves do not explain development.

Ahmad (1960) says that 'a country which possesses a vast backlog of underutilized natural resources has a definite advantage'. But, there is no definite evidence of a direct relationship between natural endowments and material prosperity; the crucial thing is the efficient use of an endowment for promoting development.

No country can be said to be naturally rich or poor in the long run. It all depends on how fast it can put to use its own physical environment and apply technology in overcoming its physical handicaps. Resources are dynamic and shifting; their scarcity or abundance, and consequently their value depends on time and place, technology and discoveries, cultural attitudes of people exploiting natural resources, and changes in tastes at home and abroad.[2]

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1. For instance, Adelman and Morris (1968) list 35 causal relationships, some of which are of the feed-back kind; and Vermeulen (1970) exhorts that since non-economic factors are also important in the development process, a multi-disciplinary 'social technology' is required.

2. That all these factors are involved is implied in the statement of the Sultan of Jogjakarta that the natural resources are 'in abundance...What is lacking is capital and know-how which could be freely imported from outside the region if political conditions were right' (Hameg-Kubuwono, 1968).

A country could enjoy an initial advantage if it has rich natural endowments, e.g., arable land, forests. They could provide a catalyst for development. But this is only a passive or enabling factor and does not put a country on the road to sustained development. Such a passive function of resources makes them the object of improvements rather than as a definite vehicle of development. This may explain the apparent conflict between the subordinate role which the literature attributes to resources in general and the importance which in specific instances and concrete situations is given to the resource endowments of an economy.

It is undeniable that 'in a real sense, the whole economic pyramid rests upon raw materials and environmental resources and realization of their potentialities through the application of science and technology' (Fisher and Revelle, 1964). It may be that 'the natural resources of a country must set the pattern for economic development and, in turn, define the paths along which science and technology should grow within the country in order to serve its essential practical requirements' (Christian, 1964).

Although an economy based on the primary sector is frequently equated with an economically backward economy, Denmark, Australia and New Zealand have developed their economies and increased their per capita incomes to advanced levels mainly on the basis of agricultural industries.[1] Nor is the proportion of population in agriculture a sure guide to economic development. An essence of the latter is the achievement of an increase in the rate of national product

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1. 'The manufacturing sector in Australia, for example, was established in response to the demand of the agricultural sector for manufactured goods and remains largely dependent upon demand from agricultural sector for its continued existence' (Robinson, 1966).

sufficiently large to provide a continuing surplus over the subsistence needs of the economy, and the use of this surplus in a productive manner.[1]

The improvement of the rural base, which embodies the renewable resource sector, is important for letting development go forward. A lagging rural base in a predominantly agrarian country like India, can act as a bottleneck for development. Therefore at the risk of repetition, we may state that productivity increases in agriculture are crucial. A rapid growth in the demand for food and other commodities creates a favourable economic environment for expanding renewable resource production. Equally 'important, India has a natural resource base in agriculture which provides a clear potential for rapid increase in production and high rates of return to investment' (Mellor, 1968).

The above does not imply that all the investment be channelled into the production of renewable resource commodities. Complementary measures, including industrialization, are important too.[2] The question is of selecting priorities according to opportunities and problems of an area. This indicates the need for an attempt to translate broader questions of availability into case studies,

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1. This would involve the exploitation of an area's comparative advantage.

2. The development of the rural base calls for industrial and other economic as well as non-economic inputs. It also involves the diversification of rural economy and the establishment of commodity processing plants. For instance, the role of 'forest industries in the attack on economic underdevelopment' may be substantial (Westoby, 1962), more so in areas like Kashmir which have relatively abundant and accessible forest resources. These resources, unlike mining, provide a basis for continuous activity.

i.e., specific investigations, and subsequently action. Such investigations would show whether in fact possibilities for economic utilization of resources exist, and, if so, in what manner.

Now it may be seen that the problem of development is one of allocating resources into those avenues that will yield the highest value of national product per unit of input of resources. If the allocation of resources in the economy is efficient, the pattern of development will be related to an area's resource endowments, viz., by its physical resources as determined by the quality and quantity of land[1], its labour and its capital available for development activities and by the market available for dispersal of the additional output.

No matter what may be known about the advanced methods of using an area's land resources, many economic and social factors will have a major controlling influence on what can be applied. Therefore, for tapping an area's resource potential, the knowledge of technical and social, institutional and economic resources needs to be collated. In doing so the objective need not be to emphasize one or the other economic activity, but of the allocation of society's bundle of resources, natural and others, to those uses which are efficient and, thereby, contribute to economic development.

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1. Land 'is particularly important to underdeveloped countries with their paucity of capital and innovational skills' (Kindleberger, 1965, p.81).

CHAPTER III

THE REGION

1. Introduction

An attempt is made in this chapter to justify resource planning for Kashmir as a region and to provide a conspectus of its geography and economy.

2. The Regional Concept.

i. Regional characteristics. The face of the earth may be thought of as a mosaic of regions, differing from one another in their natural and man-made features. Thus a region is, first and foremost, a spatial concept with respect to a portion of the earth's surface; notwithstanding that the regional concept in practice may vary according to the purpose for which a region is identified.

Secondly, although the term region has been used in a supranational sense to indicate groups of nations with a community of interests, it also indicates a subnational economy, i.e., a significant portion of a national unit with a recognized common identity. It need not be applied to local areas representing the normal horizon of man in his daily activities, e.g., municipality or district. Instead, the term is reserved for a wider combination of such local areas. In this way, a region is a bridge between the national and a local area interests. It 'inevitably must carry water on both shoulders' (Fisher, 1967).

Thirdly, it is an intellectual framework designed to simplify analysis and provide a basis for action. It may be a somewhat homogeneous area or community of interest

according to one or more criteria. Regions may vary greatly in size. But a region must always have a boundary, so that data may be collected for it.

ii. Administrative regions. In India, geographical areas are divided into states for political and administrative reasons. Durand (1950) regards state as an ideal planning unit because of political unity. It has the advantage of a similarity of government, and plan implementation is facilitated by state arrangements. A chief advantage is that data can be procured more readily for administrative-political regions, so that resources can be studied with a statewide assessment of problems and solutions.

However, state problems transcend state lines. Thus regional boundaries may be carved for reasons other than state politics and history. For instance, in India special problem regions are delimited for different reasons, e.g., 'border areas' for strategy and defence, 'hill development area' for backward mountain regions with nomad populations (Bose, 1968), 'interstate soil conservation' region for Himachal Pradesh and Punjab for coordination in managing Bhakra dam catchment.

The existing administrative regions, such as a state, are often the outcome of history and may not focus attention on problems warranting coordination with contiguous areas or social, economic and geographic variations within the state itself. The latter objection applies to Jammu and Kashmir state, which as a region is so aggregated that it conceals the large differences within its jurisdiction (c.f. section 4 infra).

iii. Economic regions. It may be possible to distinguish between 'economic regions' based on a central area of economic activity, and 'homogeneous regions defined according to the nature of the economy and its problems' (McCrone, 1969, p.14). Friedmann (1966, pp. 41-42) distinguishes five regions: 1. Core regions, characterized by their high promise for economic growth and including one or two, clustered cities. 2. Upward-transitional areas. These include all settled regions whose natural endowments and location relative to core regions suggests the possibility of a greatly intensified use of resources. 'Development corridors connecting two or more core regions represent a special type of upward-transitional areas' (ibid). 3. Resource-frontier regions are zones of new settlement in which virgin territory is occupied and made productive. 4. Downward-transitional areas are old, established settlement regions whose essentially rural economies are stagnant or in decline. 5. Special problem regions, which, because of the peculiarity of their resources or location, demand a specialised development approach.

The last named is analogous to the interstate areas in India (c.f. the above subsection). Friedmann's (op.cit.) first and second types appear as two kinds of 'economic regions', and the third and fourth types of 'homogeneous regions'.

The latters' disadvantage is that they may lead to small fragmented regions and to large areas of a country being left out, because they suffer from no problem or lack homogeneity. To 'press the homogeneity argument too far is to misunderstand the purpose of regional planning' (McCrone, 1969, p.238), for regional planning aims at settling priorities and reconciling the needs of different areas. A region should not exclude areas with different needs and problems. Since

regional problem analysis should embrace local heterogeneity in resources and activities, planning over contiguous areas of large size is 'extremely useful' because 'this gives a chance of selecting the best areas for land development' (International Institute for Land reclamation and Improvement, 1963, p.8). The same argument goes against isolating 'economic regions' for concentrating on 'development poles' (Perroux, 1964) - or 'development corridors' (Friedmann, op.cit). Though a regional division based on an economic unit, e.g., the hinterland of a city or conurbation, may be useful, for example, in market planning, 'it presents some impossible problems in practice' (McCrone, 1969, p.239). It may be difficult to discern the sphere of influence of one city from that of another, which may overlap.

It seems that the delimitation of regions for resource development need not confine to a rigid pattern. It would be more useful to recognize a region for development as a whole. This would include a sizeable area which may embrace local economic variations nonetheless.

iv. Watershed regions. For the development and use of renewable resources, the watershed concept is 'relevant to the solution of a multitude of natural resource problems' (Knetsch and Hart, 1961). It forces consideration of all natural resources of an area, which comprise inseparable parts of a total balance and which cannot be managed piecemeal for attaining highest sum-total benefit to society.

It is argued that watershed or river valley is 'an area where it is usual for a community of interests to prevail. It is in such an area that the dependence of one resource on another can be seen most clearly' as 'reflected

in land use patterns' (Parliamentary Select Committee, Ontario, 1967). In the United States, guidelines for coordinated river basin plans have been laid down by Presidential action for the management of land and related sources 'to serve the highest priority needs of all the people' (Young, 1964). This allows for considering alternative patterns of resource uses in the overall regional context (Weber, 1964).

Sengupta (1962) argues that in a developing country like India where resources are developed 'essentially in an agricultural setting, the river basins tend to be the most important regional unit for resource development'. They are easily delineated areas. Within each basin are found the elements of resource endowments such as landform, soil, vegetation and climate. In addition, 'the running water provides the major sources of energy for inexpensive processing of raw materials' (ibid). These points are relevant to Kashmir, including the last named because of the lack of coal and other mineral energy resources.

One difficulty of physical regions with watershed boundaries is about the extent to which a river basin is included in a region. The tributaries may lie beyond an international frontier, or their economic base may be widely different so that sub-watershed regions may have to be identified. Yet, the concept of watershed regions would not be fully met if all its natural resource catchments are not developed in a coordinated manner. Also in penninsular areas, watersheds may not be effective regions, because in plain tracts they are hardly discernible and such natural distinctions may have been mutilated through man's action. In such areas alternative

criteria, e.g., assured irrigation and transport facilities for location of intensive agricultural districts in India, may prove superior.

v. Physico-economic regions. It seems more true for developing than for developed countries that physical conditions reflect an area's socio-economy. This is because technology has not restrained the hand of natural environment in developing countries (c.f. section 3 Chap. II supra), so that their 'physical geography still controls socio-economic activities. The handicaps of mountainous landscape have been almost overcome in Switzerland, but not in Kashmir' (Chatterjee, 1967). Though not necessarily so in developed countries, it, therefore, may be that 'India affords a good example of a country which could be divided into physico-economic regions for the purposes of planning' (ibid).

As a country develops, such a division may not be universally applicable. This is because the physical barriers may be mitigated in areas where industries and infrastructure are developed or where reliance on natural endowments declines. Such a modification in the impact of environment on a region's socio-economy has not occurred in Kashmir so far. Such societies 'are clearly the most directly concerned with regional organization, partly because of spatial shifts involved in moving from an agrarian to an industrial economy, partly because a large portion of their potential resources are still unutilized' (Friedmann, 1966, p.8). For lagging regions even in a developed country, e.g. Appalachia in the U.S.A., Hirsch (1967) advocates 'planning for regions and subregions'.

vi. Region and space. A region is not synonymous with space.[1] An economic 'region is a continuous and localized area; an economic space is not' (Boudeville, 1966). The points of location and their settlement patterns form a space, their connecting flows and interrelationships in their spatial incidence of economic growth form a region. Thus, region may be regarded as a 'constellation of interrelated forces of activity patterns that have diverse flows and processes of production and distribution' (Wishwakarma, 1969); these processes grow and change with growth and change in demand. In this sense, region is a dynamic concept. Its boundaries, unless coinciding with long-lasting features like a mountain range or a coast, are subject to change as its spatial orientation with location of economic activity evolves into a new pattern. This may be considered as a fifth characteristic of a region (c.f. subsection i, supra).

vii. Region and resources. Since the purpose is to realize the region's development potentialities 'natural resources development is beneficial only as it enables these purposes to be fulfilled' (Fisher, 1967). However, purposes are continually changing in their content as development goes forward and new problems emerge. For this reason, the role of the natural endowments also changes circumspectly in order to realize the region's full development potential.

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1. As McLoughlin (1969, p.133) says, space 'is that which accommodates or may accommodate activities', while a region is a discrete spatial unit.

An area's resource endowment must be continuously redefined in the light of changes in national final and intermediate demand, production technology, and economic organisation (c.f. Chapter II). The relative economic growth of a region is related to its relative advantages in the production of goods and services for the national market; these may result from resource endowment on the one hand, or from a favourable degree of access to the national markets on the other - more generally, from a combination of the two. These advantages would be conditioned by other elements, e.g., the quality of labour supply and relative labour costs. The working out of cumulative advantage is exhibited in the specialised role that a region plays in the national economy.

viii. Synthesis of physical and sectoral planning. The introduction of the dimension of space to the sectoral process of planning for the 'normative ordering' of activities, varying over time and area may be called regional planning (Wishwakarma, 1966). It would be aimed at bringing about such development of natural resources that is commensurate with production-specialization in regions for which they have unique advantages.

India is a large country. Without a regional orientation of planning, the aggregate sectoral plans are mere financial plans, unrelated to physical potential and concealing the facts on which the plan is based. But 'all effective planning is physical planning. Financial and fiscal planning is at best a reflection of physical planning' (Myrdal, 1968, pp. 1919-23). Among the chief defects of the current practice of a sectoral 'financial or fiscal plan' (ibid) is that it tacitly assumes that

finance is the only bottleneck and that physical resources flow smoothly, at constant unit costs, in the direction indicated by money expenditure.

Sectoral planning at national level pays little more than lip service to regional imbalances. 'To spread development efforts more evenly and to ensure that its benefits accrue, at least in some measure to the weaker and poorer sections of the community is an important objective of planning. With us..the only effective course of action is to see that development takes place everywhere' (Government of India, 1968, p.37). This cannot be achieved merely by aggregate planning of sectors. The development of different areas is not an issue of fixing sectoral priorities 'but rather revolves around a region's ability to become integrated into larger markets', through specialization according to the region's natural endowments, character of export industry, and changes in technology and transfer costs (North, 1964).

This involves a recognition of the effect of space and the need for a regional orientation of planning. Such planning would be realistic because enterprises as well as public policy issues are 'place related' (Nourse, 1968), and need to be approached within the context of location. Indeed, the formulation of sectoral plans in India without reference to physical foundations would not seem useful. This is because locational aspects arise only at the implementation stage, when project generation and investment allocation gets tampered by inter-regional claims, which may be inconsistent with assumptions in sectoral aggregates. Spatial analysis at planning stage through regional plans seems useful in dealing realistically in a large country with economic problems of demand, supply, cost,location, competition, markets as well as policy issues, e.g., development of backward areas.

The need is to dovetail regional plans in an overall national context rather than vice versa, as is the case at present. Such a consideration of regions, as the foundation of a nation, would harmonize the existing conflicts between aggregate sectoral targets and regional potentials and needs.

ix. Comprehensive planning. By relating economic sectors and their component activities with each region's resource endowment, natural and otherwise, the planning process becomes comprehensive. The process no longer remains confined to budget allocation and fiscal measures to realize it. For such a planning, a developing country may be divided into physico-economic regions, giving for each 'comprehensive details of resources with indications for its economic development in perspective plan period. Each region exhibits its potential for developing a number of production-cycles, though all may not be of equal importance', e.g., 'wood-energy-processing cycle', and/or 'agriculture-industry cycle' (Sengupta, 1967).

A comprehensive plan would take into account all factors - physical, social and economic - that affect the area of planning concern. Such a plan for a region's renewable resource sector would be multifunctional, relating all land uses with each other. This calls for a systems approach to planning (c.f. chapterVI). To be useful, the plan should encompass an area large enough to cover the problems, e.g. a physico-economic region. However, this approach cannot be adopted for a country of India's dimension and diversity while treating the country as a single region. Theoretically, it may be useful to do so. But practical problems of data capture and processing would not permit a

single region and many sub-regions approach with presently known information media and computational methods.

The recognition and implementation of the theoretical and practical advantages of integrated renewable resource planning for physico-economic regions would be a modest but important step forward from the present day planning practice (c.f. section 3. chapter VII). Such planning would require an interdisciplinary approach to appreciate the many interrelated aspects of renewable resources and development. As MacGregor, (1967), says we need to look 'broadly and synthetically' at land development and to have 'a wider understanding of disciplines' other than one's own. This implies comprehensive planning, for which regions provide a suitable frame of reference.

3. Comparative Advantage.

1. Development theory. The various approaches to development, e.g., balanced or unbalanced growth, bear no reference to an area's comparative advantage and the possibilities of trade, except in so far the stimulus that an increase in exports provides to development or the function of imports as a transmission belt for new products and technology (c.f. sections 3 and 4, chapter II). Such neglect of the implications of comparative advantage prevents the comparison of the opportunity cost of producing a commodity with the price at which it could be imported or exported. But such a comparison is important to enable a country to use her scarce resources for an optimum pattern of production through the consideration of the benefits of trade that may

be open to an economy.[1]

ii. Factor endowments. An approach to evaluating the possibility of energizing development of an economy through the benefits of trade has been provided by Heckscher (1949) and Ohlin (1967). Their model makes international differences in factor endowments the crucial and sole factor determining comparative advantage.[2] The operational significance, in brief, is that

> 'each region is best equipped to produce the goods that require large proportions of the factors relatively abundant there; it is least fit to produce goods requiring large proportions of factors existing within its borders in small quantities or not at all' (ibid. p.7).

The above explains comparative advantage and international trade in terms of differences among countries in their relative endowment of factors of production. However, the Heckscher-Ohlin model specifically focuses on the relative endowments of capital and labour as the primary explanation.

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1. In the Mahalanobis planning frame adopted for Indian national plans, the approach ignores price and demand considerations completely, ignoring the criteria of efficiency and comparative advantage (Komiya, 1959). But even if there may be inelastic demand for traditional Indian exports in contrast to goods presently imported, within the latter category 'the principles of comparative advantage should apply....The comparison of domestic to foreign sources of supply that is implied by comparative advantage is no less relevant to this situation' (Chenery, 1965). Baranson (1967) and Manne (1967), who have analyzed Indian industrialization from two different viewpoints, have also concluded similarly advocating an alternation of emphasis according to comparative advantage and benefits of the economies of scale rather than autarchy and regional dispersion.

2. The Heckscher-Ohlin model is different from the Ricardian model which assumes only one factor and makes factor supply unimportant in determining the trade patterns. However, Viner (1963) argues that the factor endowment approach is to be found in classical writings.

In so doing, it may appear to ignore the role of land resources in general. Yet this third factor may influence international trade patterns.

iii. Nature and capital. Leontief's (1966) empirical finding that the exports of the United States - the world's richest country - were 'labour-intensive' relative to American imports may seem to refute the factor endowments proposition. By confining attention only to labour and capital, to the neglect of natural resources, it is possible that Leontief's results reflected the substitution of capital for natural resources in American import-substituting production (Diab, 1956). This line of reconciliation of these results is reinforced by the contention that the American tariff[1] protects the U.S. labour from foreign competition, and that the associated restriction of her trade allows imports of natural resource products to dominate the results (Travis, 1964; Vanek, 1959).

Another explanation may lie in the differences in the quality of an endowment, such as Leontief's (op.cit.) suggestion that American labour is three times more productive than her trading partners. If, for the sake of theoretical clarity, the concept of differences in labour quality is

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1. The theory of tariff protection demonstrates the potential effectiveness of tariffs in distorting international trade patterns away from what would result from the free play of comparative advantage under competitive conditions and biasing the selection of goods entering international trade towards raw and intermediate materials and capital goods (Travis, op.cit.; Corden, 1966; Johnson, 1965). Besides the assumption of perfect competition, it may be difficult to substantiate always the assumptions of similarity of consumption patterns at different income levels and non-reversibility of factor intensities in production, which underlie differences in relative factor endowments to cause countries to export commodities which use their relatively abundant factors intensively.

restricted to differences in acquired skills and such skills are regarded as capital embodied in human form[1], it appears that the original Leontief test overlooked its variables from the theoretical point of view; the capital value of the contribution of labour skills to production should have been added to the value of the material capital requirements in the estimation of the relative capital and labour intensities of American exports and imports. Kenen (1965) presents a formal model of international trade based on the assumption that capital must be invested in both men and nature to make them productive; the model suggests that when this correction is made, the 'Leontief paradox' - apparently contradicting the relative factor endowments proposition - will disappear.

iv. Technology. The ability to produce superior products and the possession of superior production technology may be regarded to constitute sources of comparative advantage additional, or alternative, to comparative advantage based on relative factor endowment. However, economies of scale as a source of comparative advantage in certain industries for large as compared with smaller countries, or regions,

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1. If, in contrast to traditional distinctions between consumption and investment, we define capital or investment as anything capable of generating a flow of income (c.f. appendix 7), it includes not only material means of production. Besides natural resources, it would include also the human skills and the stock of productive knowledge according to which the human and non-human factors of production are combined in the production process. In this conceptual framework, the condition of underdevelopment may be characterized by the possession of relatively small stocks of the various kinds of capital, and the existence of relatively inefficient mechanisms for maintaining and increasing these stocks. Thus, the intensive use of a region's natural resources if these are relatively abundant, as in Kashmir, while economizing on other scarce forms of capital, may be useful in the process of development.

requires the additional assumption of barriers to international, or interregional, trade, with such economies dependent on location within a large national, or regional, market.[1] Such barriers may be created by tariffs, or regional trade zones as for foodgrains in India. These or any other barrier would induce scales of production appropriate to the size of demand in the national, or regional, markets within which they are located.

A priori the full play of comparative advantage from factor endowments would be restricted by barriers. Even so, it would appear that comparative advantage derived from economies of scale cannot be disentangled from comparative advantage from relative factor abundance or the possession of superior technology (Hufbauer, 1965). The relative endowment model can be adapted to analyse and explain comparative advantage derived from differences in technology, or from differences in the size of a country, or region, in the presence of scale economies.[2] This would be so, because, from an analytical viewpoint, technological differences and scale economies are the same phenomenon; economies of scale being merely a difference in technology linked to a difference in the volume of output (Johnson, 1963).

v. International trade. The footnote to subsection iii supra may provide a foundation for a 'capital-theoretic' approach to the allocation of a nation's capital among the various forms it may take, i.e., to provide a composition of social

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1. An exception exists if economies of scale can only be fully exploited by the use of larger amounts of the factors of production than the smaller countries, or regions, have at their disposal.

2. This is subject to the proviso that scale economies are external to the firm.

capital stock commensurate with the economy's comparative advantage and trading pattern. This may rest on the assumptions that capital and labour are internationally immobile and that the distinguishing characteristics of nations is differences in relative factor endowments.[1]

The major sources of comparative advantage or disadvantage may be indicated for particular products or industries that could exist among countries with the same or similar overall ratio of capital to available human time. First would be endowments of capital as natural resources. This is the classical source of differences in comparative advantage. Second, both socio-cultural differences and governmental policy for research and education could produce differences in the relative amounts of capital embodied in the stock of productive knowledge and the stock of human capital. Third, given the existence of both cultural and commercial policy barriers to trade, differences in the relative economic sizes of countries could give rise to comparative advantage based on differences in the allocation of capital among alternative forms, e.g., the differences in sizes of national markets may create differential opportunities to exploit economies of scale in the production of particular goods.

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1. Already, however, it has been necessary to introduce barriers to international trade as part of the explanation of comparative advantage. This is in recognition of the need to understand contemporary international economic relationships vis-a-vis the existence and nature of the barriers implied by the division of the world into separate nations. The influence of trade barriers will be considered again in this subsection.

Thus it appears that differences in natural endowment, national policies and economic size would figure in an explanation of trade patterns in addition to and in combination with differences in per capita national wealth.[1] To the extent that techniques of production can be taken to be either the same or potentially similar in the different countries, and the possibility of reversals of factor intensity in response to differences in relative factor prices ruled out as exceptional, industries may be ranked globally by their average labour productivities. It may then be possible to identify those industries, e.g., the high labour-productivity industries, in which the capital-rich and labour-scarce economies will have a comparative advantage; similarly those, e.g. the low labour productivity, industries in which the labour-abundant and capital scarce economies have a comparative advantage. Lary (1968) shows that industries can be so ranked by internationally prevalent differences in factor endowments with implications for economic development strategy.

From the foregoing, we may say that the process of economic development involves the investment of resources for accumulating the various forms of capital, and that the economically efficient way to promote such investment is to enlarge rather than to narrow the opportunities for

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1. Krueger (1968) has concluded that differences in factor endowments, mainly of the human resources, account for the differences in per capita income among developing and developed countries; and that in spite of highly restrictive commercial policies, transport costs and unequal factor endowments, the tendency for factor-rent equalisation is highly likely.

investment open to an economy.[1]

The proposition that 'free trade is superior to any trade policy' (Samuelson, 1962) from the viewpoint of international advantage holds when all the first-best assumptions obtain. The trade policies pursued by the various nations do not conform to these assumptions (c.f. last footnote to the preceding subsection). The above proposition will not necessarily hold if there are, say, 'domestic distortions in the economy' (Bhagwati, 1965). Thus both 'foreign' e.g. discriminatory tariffs, as well as domestic imperfections militate against full exploitation of comparative advantage through trade. Among the domestic difficulties are external economies, monopoly in product markets, factor-reward differentials between sectors, factor-price rigidity, and increasing returns to scale[2] (ibid).

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1. This conclusion aimed at exploiting comparative advantage implies a policy for negotiating freer world trade, rather than of sophisticating protectionist measures. The latter have a restraining influence on the volume and a distorting influence on the composition of international trade. In terms of a dynamic evolution of comparative advantage, their general influence is two-fold: they promote the location of production in the country where the market for the product is; they inhibit the transfer of production from higher-cost domestic to lower-cost foreign locations. Such influence can lead to economic waste (c.f. subsection iv ff, section 4, chapter V). Nevertheless, the essence of a dynamic theory of comparative cost is the international migration of production in response to one influence and in spite of the other.

2. These difficulties would deny an explicit postulate of international identity of production functions underlying the Heckscher-Ohlin theorem. Although technologically, the production function for an activity may be identical between countries, the operative segments of it may be intensive in the use of a different factor in each country. Where such 'reversals of factor-intensity' occur, the effect can be similar to that of differences in production functions.

A dynamic modification of comparative advantage to meet above difficulties leads to the following four requirements for the analytical framework in determining comparative advantage in a developing economy, i.e., in order to incorporate the assumptions of development theory without, however, losing its usefulness: (i) recognition of the possibility of structural disequilibrium in factor markets, (ii) the inclusion of indirect effects of expanding a given type of production, (iii) allowance for variations over time, and (iv) simultaneous determination of levels of interrelated activities (Chenery, 1965).

In this thesis, allocation of resources will be evaluated after considering all the above requirements, the first three in chapter V and the last named in chapter VII. Furthermore, by taking comparative advantage as a principle of planning rather than as a result of market forces (c.f. section 4, chapter V), we can include any foreseeable exogenous changes in technology, tastes, or other data without going beyond the framework of comparative statics' (ibid).

vi. Inter-regional trade and development

It would appear that each region has an advantage in the production of commodities into which enter considerable amounts of factors abundant and cheap in that region. However, in this it is the supply of all factors in a region that counts and not merely the renewable resources. The latter's spatial distribution is likely to influence location of certain kinds of economic activity; i.e., industries based on renewable resources may be attracted to resource regions in proportion to a) the difficulty of transportation and weight-loss during processing, b) accessibility to

complementary factors of production and scope for exploiting economies of scale c) location of markets and demand for end products. Since renewable resource location is less subject to change, industries requiring these resources may have a stable location for the production of raw materials as opposed to finished goods. Once ready, raw materials may be transported over long distances for further processing.

The movement of resource products leads to trade among regions. In this way the relative scarcity (and abundance) of productive factors is reduced between the trading regions, with a tendency towards equalization of prices. 'Regions reap certain advantages from specialization, quite independently of any difference in their productive equipment' (Ohlin, 1967, p.36). Specialization makes production on a large scale possible, and this, in turn, encourages inter-regional trade. It reduces the disadvantages of indivisibility and of inequal distribution of productive agents.

It may be convenient 'to think of the world as consisting of a number of large regions, each of which consist of smaller regions, the latter containing a great number of very small districts' (ibid, p.160). But this overlooks the distinction between international trade - as discussed in the last section - and inter-regional trade in a country - under discussion here. The distinction is that interregional trade in the long run may occur on the basis of <u>absolute advantage</u> and not comparative advantage. This, among other reasons, occurs because of the lack of barriers to factor mobility which exist for international trade.

In the early stages of regional development, 'when the systems of communication and transport between the developed and underdeveloped region are scant, trade between these

regions may be possible on the basis of comparative advantage' (Hilhorst, 1969). With the improvement of communications, theoretically the interregional immobility of production factors would tend to disappear, with a consequent decline in factor endowment disparities.[1] The importance of the comparative advantage of the poor region starts to shrink and exporting will only be continued if the comparative advantage nears an absolute advantage' (ibid).

Streeten (1964) and Balassa (1962) argue that inter-regional trade is conducted on the basis of absolute advantage With a nearly complete inter-regional factor mobility, there would be inter-regional equality of factor earnings. Assuming so, trade between regions would take place only as a result of absolute advantage. International trade on the other hand allows for differences in productivity through different factor earnings. Among countries, exchange rates can be adjusted to ensure trade 'on the basis of comparative advantage, and where all participants in trade no matter what their level of efficiency or their endowments may enjoy economic growth' (McCrone, 1969, p.79). This contrasts with inter-regional trade; its pattern on the basis of absolute advantage would cause 'a tendency for regions with below average efficiency to decline while others expand' (ibid).

Kashmir is a less developed region than its neighbouring Punjab and other states of India. The above conclusion would pose a dismal picture for her development. Myrdal (1957, pp. 11-22) argues that regional underdevelopment is self-

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1. Anspach (1968) too argues that 'absolute advantage based on economic resource endowment can exist'.

perpetuating as a result of downward cumulative causation - generated by a net outflow of factors, including labour though the latter is not perfectly mobile. On the other hand, the leading regions continue growing even after their original advantage disappears. The result would be a widening of regional disparities. Social factors too may 'assist this destablising tendency' (Brown, 1969).

Can renewable resource planning play any role in averting the above situation, apart from governmental policies[1] aimed at softening its effects? If so, how?

The key to an answer is that we need to forestall comparative advantage being equated to absolute advantage. If a region, like Kashmir, were to declare independence, this could be achieved;[2] for then she could adjust her exchange rate, raise tariff barriers, invoke suitable commercial policies, and have factor prices matching productivity

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1. In the United States of America, statistical tests show region to be 'a significant independent variable' with respect to most public policy measures and this variable provides 'important clues' about policy determinants (Sharkansky, 1968). In Great Britain, regionalism has 'become' a political matter and all political parties are advocating regional development and..changes in the machinery of the government to put this development into practice' (Smith, 1965, p.19). Though the arguments used are generally less sophisticated, this is so in India too, where 'political tensions arise over policies which increase income at the cost of greater regional...inequalities' (Mellor, 1968). The concern in this thesis being the scope of a region's development through the use of its renewable resources, the various federal-state policy issues will not be anatomized. Nevertheless, the questions of distribution and of consistency between regional development and national objectives will be considered (c.f. chapter VI) in so far as they are related to resource planning.

2. It may well be that if Switzerland, Sweden and Denmark, or Japan were respectively to be regions, peripherally located and relatively niggardly endowed with resources, of a united Europe or South Asia, they might not have achieved such high economic progress?

more closely than when they are influenced by 'foreign' productivity. But Kashmir is not an independent state, and she has a unified monetary system with the rest of India. The above measures, therefore, cannot be implemented.

The alternative approach is that resource planning may assume Kashmir as an independent trading region of India and the world.[1] That is, resource allocation would be guided by the principle of comparative advantage. By so turning the above assumption into reality through regional specialization, not only will Kashmir benefit but also the rest of the regions to their mutual benefits. This may also reduce the burden of subsidies by the leading regions and the need for arbitrary transfers of resources on large scale practised presently (Hicks, 1968, Hindustan Times Weekly 1968). From the policy measures of regional development supported by the national government, it appears that allocation of resources favouring regional development would be welcome by all concerned.

There are economic reasons which would favour the use of resources in Kashmir on the basis of comparative advantage as proposed above. These arise from the complementarity of resource endowments and production processes between Kashmir and the neighbouring regions.[2] That is, through

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1. This seems to be the case in some Australian states which can negotiate terms of trade and investment directly with foreign countries without losing their federal identity (Webb,1970)

2. Complementarity can be evoked through locational distribution, which 'plays a dominant role in the exploitation of natural resources', and economic success can be had through trade with other regions 'with a different or better natural endowment' (Herfindahl, 1969a). Since some regions are better endowed with natural resources than others, e.g. Kashmir is better endowed with forests and pastures than the neighbouring Punjab and Haryana states, 'the exploitation of certain resources has greater urgency than others for phasing development' in each region (Lefeber, 1964) i.e. for avoiding inefficient regional allocation of investments, which results in 'wasting of scarce resources' if inter-regional complementarity is not catered to through specialization for mutual benefit. Assam state in India is similar to Kashmir in many respects and in advocating regional development through

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specialization on the basis of comparative advantage it is possible to avert the polarisation effects which take place when the activities in the poor region become depressed as a result of competition of the richer region. Instead, it is possible to generate what Hirschman (1966, pp.187-190) calls 'trickling-down' effects, which are favourable for the poor region and occur when the richer region starts buying from the poorer region with consequent capital accumulation (promoted through productive investment allocation, as attempted in this thesis).

The trickling-down effects could swamp the polarisation-effects, if the richer region has to rely upon products of the poor region for further development. This can be ensured if the poor region supplies these products, e.g. forest products which are unobtainable within Punjab, at prices which compete with those at which the richer region could procure them from abroad or another region. For this reason, investment appraisal will be here oriented to world market prices[1] (c.f. subsection 8.iv ff., chapt.V). To further ensure that comparative advantage is reflected in and transmitted to production activities - even for meeting domestic demand in Kashmir - transportation costs will also be taken into account.

..... efficient resource use Lefeber (ibid) comments: 'Assam provides particularly good opportunities in rational and bold planning. In addition to its...fertile soil it has vast unutilized natural resources...Large-scale paper pulp production and its transportation to other states for processing could be offset by opposite flows of commodities needed in Assam. Such plans would result in efficient production patterns according to comparative advantage and in optimum utilization of transportation facilities. Assam, as other states, must be encouraged to integrate gradually with the national economy rather than to strive toward regional self-sufficiency'. Such is an aim, our approach will be designed to subscribe to, for in the choice of sectors in the various regions 'it is not principally a question of a growth in demand at home, but of which industry or industries will yield the greatest returns from the scarce production factors available' (Tinbergen,1967,p.99)

1. In this way, it is possible to accord an 'open economy' treatment to Kashmir, which Seers (1967) considers essential for enabling development through competitive exports.

4. Kashmir's Physical and Economic Geography.

i. Location and extent. Jammu and Kashmir is the northernmost territory in the Indian sub-continent. It holds an extreme western position in the Himalayas which terminate towards its eastern boundary at Nanga Parbat.

Before 1947, Jammu and Kashmir was a princely state, extending over 86023 square miles. After that a cease-fire line has bifurcated it into a portion on the Pakistan side and another on the Indian side. The latter portion comprises a federal state, 53665 square miles in area. It includes the entire Kashmir valley, or Kashmir, which is the subject of this thesis.

Kashmir lies between 33.4 and 34.8 degrees north latitudes and between 74.0 and 75.6 degrees east longitudes.

Its geographical area is 5,838 square miles.

ii. Topography, soil and climate. Stamp (1957) provides an introduction to Kashmir and its physical geography:

> 'Between the great and lesser Himalayas is a valley different from most of the mountain valleys... it is much broader, with a valley floor sufficiently wide to include the extensive Wular lake (the largest fresh water lake in Asia). This valley is the world-famed vale of Kashmir. Through the vale wanders the Jhelum river, here broad and navigable and unlike most Himalayan rivers. If there is one thing the world traveller learns it is that few places on the earth's surface really live up to their reputation. Perhaps Kashmir is one of the exceptions...'

Kashmir is an oval valley stretching for about 80 miles from south-east to north-west. It is poised at an average elevation of 5300 feet above sea level, girdled all around by mountains which range from about 9000 feet at passes to nearly 17000 feet above sea level at Haramokh. Some of the peaks carry perennial snows and glaciers, e.g., Thajwas near Sonamarg.

The valley expanse is flat with very deep alluvial soils. The valley is interspersed by rolling country of lacustrine deposits or 'Karewa' hillocks. They have friable soils liable to erosion. The mountain slopes, especially higher up, are rugged, very steep to precipitous on southerly aspects, but not so on the northerly aspects. The latter slopes have comparatively deep podsolic soils. Those on southerly aspects are usually shallow, with more moraineoutcrops.

Nitrogen exists almost wholly in organic forms. Phosphorus exists partly in organic and partly in mineral form. Neither of the two nutrients become available in adequate quantities to crops during spring owing to low temperature. The weathering of potassium-bearing minerals is very slow. Fertilization and manuring is required on all soils, more so on cooler higher altitudes with shorter growing season. Three broad divisions on the basis of the soil fertility status correspond to altitudinal divisions, viz., 'Kandi' or mountain slopes; 'Karewas' or the rolling lands; and 'Lower belt' or the valley lands (Butt, 1966,p.12).

The mountains shut Kashmir from south-west monsoons. Therefore, precipitation is mostly winter snow or autumn and spring rains. The average annual rainfall in the valley is 26 inches. Appendix 5 reveals the climatic pattern and its contrast with that of the rest of Himalayas.

In brief, the climate is temperate-cum-mediterranean. There are four fairly well defined seasons. The winters can be severe; temperature may persist well below 28°F for January, and most part of February and December. The temperature occasionally falls below 20°F. But it seldom goes down to 10°F. The maximum temperature rarely touches 95°F. It usually remains below 85°F for most of the summer.

iii. Present renewable resource use pattern. A survey of the present use pattern was made and detailed, one inch to one mile, maps prepared. The geotopographical contour survey sheets were used as the base. Besides showing the bare rocky lands, the various uses of arable land, e.g. irrigated and dry type farming, of forest and pasture lands, were mapped separately for five catchments delineated for the valley. The catchments were further delineated into watershed units, 69 in all. A list together with the corresponding areas appears in appendix 25. The existing erosion, most severe on dry type farmlands on Karewa slopes and southerly mountain slopes, has also been located on maps; and the extent affected assessed for different intensities. A summary of the present use pattern, crop and land class-wise, is presented in appendix 15.[1]

Agriculture practice is very labour intensive. Paddy cultivation is given utmost care. The soil is thoroughly worked, water kept running almost up to harvest and timely weedings done. Manuring is done, at least biennially. Fertilizer use is, however limited.[2] It is restricted mainly

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1. It will be noticed that while appendix 25 shows a total area of 3,502,800 acres, only 3,207,084 acres are accounted for in appendix 15. This is because we have excluded from the purview of this thesis the wildlife reserves and sanctuaries (c.f. section 7.iii,chap.V), the rocky and other unculturable areas, including those proximal to the cease-fire line where civilian control is difficult. Hence, an area of 493 square miles, comprising about 8 per cent of the total geographical area, was not surveyed.

2. The total quantity of fertilizers used during the third Five Year Plan period ending 1965-66 is estimated at 13,000 tonnes. This in itself was a big jump from about 5000 and 1000 tons respectively used in the second and first Five Year Plan periods. The fertilizers used are mainly nitrogenous. The quantity of superphosphates used is small, much less than potassic fertilizers.

to the 'intensive agriculture district programme' area of Anantnag, where high-yielding varieties have recently been distributed. Ploughing is done, at least twice as intensively for the rice fields as for other crops. There are about 0.22 million ploughs in the valley. They are indigenously made of wood, and the ploughshare is tipped with iron. Other farm-implements are simple too, mostly wooden.

Over 720,000 acres are under agricultural crops: rice (paddy), maize, wheat and oilseeds in descending order of importance. Of this, 486,000 acres are assured of perennial irrigation, mostly through village-run, or zamindari, irrigation system, which covers over 410,000 acres. The snows at higher elevations feed the mountain streams. At convenient points, temporary weirs or spurs are raised. Downstream, small cheek-dams are erected. All these devices are made with wooden stakes, brushwood and boulders. Villagers do this voluntarily and jointly. 'Water-quarrels', so prevalent in the plains of India, rarely arise, for nature bountifully meets the local demand all over the valley.

Other than farm crops, villagers are much interested in raising trees; willows and poplars in particular. They do so on any available piece of land, along field boundaries, watercourses, paths, embankments and roads. Perhaps nowhere in India, apart from the Imphal valley in Assam which is dotted with silky oak, is landscape so much tree-clad. Such farm-forestry provides the folk with cheap constructional and general purpose timber. Willows are pollarded and yield valuable fodder for the sheep to tide over winter. The trees, especially the much higher priced walnuts, are a money box on which the villagers draw on in times of need.

The state-owned forests are extensive. The wooded forest area is about twice that of the agriculture land area. Of these, presently accessible forests, classified as commercial, are more than the area under agriculture. The forests are mainly coniferous: Himalayan fir, blue-pine or kail, and cedar or deodar. They are all covered by management plans since over 80 years. The plans are usually revised at 10 to 15 years' intervals. The management is on the old British Indian pattern, with very long rotations, viz. 120 to 150 years. The forests are undercut, with mature stocks accumulating in fir areas, and the working is extensive.

No range-management is practised, though some experiments on rotational closures in grazing areas and propagation of fodder grasses have been concluded. The grazing areas are of three types: communal, or 'Kahcharai', grazing grounds adjacent to villages in the valley, and the less communal 'Kaaps' in the mountain villages; forest blanks, or 'behaks'; and alpine pastures above the timber limit. The last type is the most extensive and least intensively utilized. The first two, more so the Kahcharai areas, bear heavy grazing incidence, often much beyond their carrying capacity.

The livestock population of the valley is about 1.60 million.[1] Of this, cows and bulls comprise about 48 per cent, sheep about 40 per cent, and goats about 7 per cent. The rest are buffaloes, mules and horses. The number of working cattle are estimated at 25 per cent of the animal population, viz. about 0.40 million.

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1. This excludes poultry, whose census places them at over 1.25 million in 1961.

Orchards, especially of apple, are dotted all over the valley. They compete with agriculture for land, are capital intensive and long-maturing for the poor peasants. Nevertheless, fruit plantations are popular among landlords for escaping from tenants' hold and for investment in a commercially profitable venture with real-estate benefits. Like the bulk of the timber, fruits are largely exported from Kashmir; the latter, however, are now facing severe competition from Kulu (Himachal Pradesh State) producers who are better organised, particularly for marketing.

Saffron cultivation is restricted to Karewa plateaux at Pampur, about 8 miles from Srinagar. The cultivation is done without irrigation, though that would increase the yield. There are some government run pyrethrum farms, initiated in 1940. The pyrethrin content is lower than that obtained in Japan and Kenya. Mulberry plantations exist on dry lands here and there. They are now gradually replinished, with improved stocks raised in nurseries, for sustained silk-worm rearing.

iv. Socio-economic and cultural aspects. Kashmir's present population may be estimated at over 2.0 million. This compares with less than 1.40 million in 1921. The rate of growth between 1951 and 1961, the last census, is placed at 11 per cent.

Kashmir's population is 54 per cent, though its area is only 11 per cent of the entire Jammu and Kashmir State. This is explicable by the fact that the valley holds the most fertile and culturable area in the State. The remaining parts, but for a small subtropical plains tract in the Jammu region, are highly mountainous and, in Ladakh region, very arid and cold as well. The latter region, which occupies

over 70 per cent of the State's area, holds only 2.5 per cent of the population. As such, the population density for Kashmir is 340 persons to a square mile as compared with an average of 74 for the state.

80 per cent of Kashmir's population, i.e. 1.60 million, is rural. The number of villages are 3100. Srinagar is the only city, the capital, where about 0.30 million people dwell. The remaining non-rural population lives in townships, of which Anantnag has the largest number, viz., about 25,000. Baramulla and Sopore towns each have a population of about 20,000.

Illiteracy is very high in rural areas, ranging from upwards of 95 per cent. The overall literacy level is about 12 per cent. The number of literates per thousand males are about 160, but only 40 to a thousand females.[1]

The total workforce is estimated at 0.82 million. 0.63 million work in the primary sector. 0.61 million, or 75 per cent of the total labour-force is estimated to be concerned with renewable resource production activities. Of these, 72 per cent are cultivators, or peasant proprietors. The remaining 2 to 3 per cent constitute the landless labour. There are no scheduled castes in Kashmir and occupational mobility is quite free.

The per capita income is estimated at Rs.298, equivalent to $40 at current exchange rate. This is about half of the per capita income for India as a whole. Over half of the

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1. Education is free at all stages and now over 75 per cent of boys of elementary school-going age are in schools However, the drop-out per cent is very high and hardly 30 per cent continue on to middle-school level.

income originates directly from crop production, animal husbandry and forestry. If, however, the value-added through processing and handling of resource commodities in sectors classified as non-agricultural were to be included, the contribution of the renewable resource sector is considerably higher (c.f. appendix 13).

A glimpse of the renewable resource activities has been furnished in the preceding subsection. The vegetation of Kashmir is discussed in appendix 5 and also in a forthcoming monograph by Meusel, Schubert and Muthoo (1971). The farming practices have been described by Randhawa and Nath (1959). An analysis of the recent economic changes is contained in appendix 4. Lawrence's (1895) work remains a classic.[1] It brings together the social life, culture and occupations, flora, fauna and land-use practices, all of which in the greater part of rural Kashmir have undergone little change.

A feature in Kashmir is the dispersal of economic activity according to the distribution of renewable natural resources. This corresponds strikingly with the valley's altitudinal zonation, with which the region's socio-economy and culture are intertwined, so that 'the life of the ordinary folk in Kashmir takes place in six steps, one above the other. And each one has its own traditions' (Zikmund and Hauzelka, 1962). A quick review of these steps would yield a conspectus of Kashmir without the risk of duplicating the works cited above.

The highest step belongs to Bakerwals, the pastoral nomads. After the spring thaw, they drive large flocks of sheep and goats from their winter haunts in the subtropical

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1. This rare book, which was out of print, has now been reprinted.

foothills of nearby Jammu province to Kashmir's alpine pastures up to the dizzy heights of 13000 to 14000 feet above sea level. At these heights, fire is a luxury; every piece of wood has to be carried up from hundreds of feet below, where slopes shine with white trunks of stunted birch trees mauled by avalanches. The bakerwals survive the rigours of alpine life, which they are accustomed to and apparently prefer over a sedentary life, for they have refused governmental overtures for settlement.[1] With every late spring and every early autumn, they tread back and forth the same paths that they have trekked year after year, carrying alongwith their tents, families and few aluminium utensils.

The next step is the sub-alpine meadows skirting the timber limit. This strip varies in elevation from 9500 to 11000 feet above sea level and includes the high level forest blanks or behaks. This step is the summer abode of gujjars. They too are migratory, with the difference that down below they do some cultivation of the high level varieties of wheat and maize in addition to rearing livestock - mostly cows and buffaloes, very few sheep and goat. They have their log cabins, or Kotthas, in the behaks, which are kept warm with a continually burning fire. While the bakerwals are disinterested in cultivation, are completely pastoral and undertake cross-country movements beyond and through Kashmir, the gujjars only move up and down a watershed or two.

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1. 'When customs have once been established and prejudices are rooted, it is a..vain enterprise to want to reform them' (Rousseau, 1962); however, they can be eroded by socio-economic changes and by organised external influences, if there is a will to do so on the part of the government and the people concerned.

The only contacts of the gujjars and the bakerwals are the forest guards and the grazing tax collectors at mountain check-posts, (rarely the land use and other surveyors!). Occasionally, the agents of merchants from towns or the city see them for their produce; the gujjars concentrate on dairy products especially purified butter or ghee and the bakerwals on live mutton, wool and coarse blankets. Usually transactions take place with the bakerwals during their movements through a town and with the gujjars in the villages down below. Barter exchange is becoming less universal; it is not uncommon to hear a transister radio from a bakerwal tent or a gujjar Kottha disturbing the solitude of a high-level pasture.

The third step of Kashmir's life between 7,000 and 9,000 feet above sea level is quiet and hushed. It is saturated with the dampness from snows capping its view and carries a luxuriant growth of forests. Man migrates from workplace to workplace, the axe over his shoulder, his paths crossing those of the gujjars for he moves along the contours.

The third step harbours some of the famous tourist resorts like Gulmarg, Pahalgam, and Yusmarg. But these are isolated spots; a deeper visit to this step is an excursion far backwards in time. In the sparsely populated high mountain villages, the people live by what the forest and the strip of primitively cultivated field cleared around their hamlets yield. The only signs of the twentieth century are the echo of trucks moving up and down a zig-zag extraction path from a far-removed timber coupe under work, or the sprinkling of primary schools to which the teacher walks on foot, for there are no roads. The pupils, barefoot, write on wooden tablets with pegs dipped in white clay.

But schools they are, representing an incipient frontal assault on the prevalent illiteracy. A mobile dispensary sometimes visits, but family planning remains unknown.

We may now descend a step to look around the valley as seen by tourists through the windows of their coaches. There are hamlets and townships, rows of houses with carved balconies and thatched[1] roofs, avenues of poplar and giant oriental plane, or chinar. In between the villages are very well designed terraces of rice paddies, and fairly well laid out orchards, usually fenced. Along the strip of asphalt, the twentieth century chases along the valley as long colonnades of lorries, buses and coaches. But fifty feet off the strip, the realm of the minute and second of time comes to an end.

In the villages, people have plenty to sit quietly over, or talk about nothing. They have made no granaries or silos. Dehusking of rice is done by women by hand-pounding; only in towns does a mill or two exist for this. Each village or two has a specialist: the barber, the moneylender and grocer, and the shepherd. The last named owns no land; he carries most of the village cattle to ranches, carefully keeping away from the meadows where gujjars and bakerwals would resent his presence. Therefore, he does not go very far up, though staying away from the village for a good part of the summer. The cattle roam about freely after harvest, nipping the stubble of rice and maize plants.

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1. Thatching is fast being replaced by corrugated iron sheets, wooden shingle being difficult to maintain and not cheap; yet corrugated roof is a sign of prosperity. Hewn boards are used when wood is obtained from the forest on a concession basis, i.e., when situate within three miles of the forest, this being a recognized privilege.

The shepherd boys, during summer look after the cattle left behind in the villages. These are the milch cows, the young ones and, of course, the working cattle. While the latter receive extra feed and cake meal, the former depend mainly on the open grazing that the 'Kahcharai' or village grazing lands and the bare hill slopes adjacent to villages can provide. During winter, rice straw, and less so the maize straw, are the main fodder.

The fifth s tep of Kashmir life are the city of Srinagar and, equidistantly-placed Baramulla-Sopore-Handwara 'conurbation' in the north-west and Anantnag-Kulgam 'conurbation' in the south-east. While the three places are each the headquarters of the three administrative districts of the valley, the city is its hub, spatially, economically and politically. With an automatic telephone exchange linked with Delhi and Jammu, it provides an easy access for business and governmental activity beyond the precincts of the valley. Through the radio station, and now through the television station, in the city, news and information is beamed from here for all the valley. It has a university with constituent colleges in the towns too.

The city provides a direct physical link to this mountain-girt valley with the rest of the world through the airport located only six miles from it. The airport annually handles about 9 million passenger miles mostly to Delhi, Pathankote in Punjab and the outlying Jammu city. At the airport are loaded annually about 60 and 50 thousand tonne-miles of outward cargo and mail respectively.

Srinagar city is connected with the valley's townships by tarred roads, which extend to touristic resorts. Passenger buses are frequent and regular. The motor transport system is both private and public, the two sectors competing

with each other. There are no bullock carts in Kashmir. Horse carriages are common, both as passenger and load carriers. They are useful on the dirt tracks that ramify the villages, thereby connecting feeder with main roads.

Besides an arterial road, the Jhelum river provides a traditional link by means of Khochu or barges. These carry to the city from both the directions building materials and firewood, and less so timber and grain. The river is connected to the lakes, Dal, Nagin and Wular, where shikaras or small gondola boats ply, carrying tourists in comfort. The unfurnished, unroofed model is for carrying vegetables and flowers raised on fields built up on the lakes and around it. House-boats, also completely made of wood, are well furnished for lodging the tourists in and around the city. They, too, are moved lazily and moored anywhere as the water transport is not motorised. The local people hire doongas, which are very much less sophisticated houseboats for carrying passengers to gardens on the lake front or elsewhere.

The barges, the houseboats and doongas are the home of the people who ply them. Together with the lake and river system on which they float, this comprises the sixth step of Kashmir life. This is a cascade of life humming with activity during summer, but with nothing much to do during winter except for a little fishing by the few who may, or ~~casuals~~ for serving as casuals in the plains of India.

With the onslaught of the winter, the landscape looks desolate and the outdoor activity comes to a grinding halt. The step that comprises the city and towns is an exception, though there too life gets subdued. There is a general outmigration of the smart and young among the labour-force

who return little before the sowing season is in. Yet there are a few who continue working unabated and whose work pioneered trade with Kashmir. These are the craftsmen, who sit indoors, summer and winter, embroidering, wood carving, and silk, high grade pashmina wool, carpet and basket weaving. In winter, they may be joined by the less artisan class of cultivators and even boatmen in their homes who spin and weave coarse blankets and rugs. A school of designs has been started a few years ago to diversify motifs used by the artisans.

The handicraft and cottage industries are the main industries of Kashmir. Though attempts at establishing raw-material based industries are being made, little headway has been made. Kashmir remains about the least industrialised area of India. Among other reasons for this are the lack of adequate means of communication and transport, inadequacy of power and fuel, absence of up-to-date data about raw-material resources and non-availability of know how.

Another difficulty is that 'private enterprise was shy and hesitant to come forward (Raina, 1967); such an attitude, however, can be overcome only by policy and measures that remove entrepreneurs' difficulties and bottlenecks, in which Kashmir abounds. Their endeavours have to be taken against the formidable challenge of terrain and climate, insufficient infrastructure, remote and outflanked location of Kashmir, ignorance and disincentives. Only tourism, by which the customer comes to producer's doorstep, seems to remove some of these bottlenecks and this as a growing industry would deserve encouragment. It is perhaps because of tourism that only such private industries seem to flourish which cater to middle class consumer demand.

Among the organised industries[1] 61 per cent produce silk, wool, carpets, food and wood products. These account for about 70 per cent of the total factory employment. The spinning and weaving group account for 24 per cent of factories. Wood-based factories are the next important group comprising 20 per cent of the total.

Kashmir's sericulture industry is the biggest employment providing unit in the entire state. It employs 2250 labourers in the factories, besides thousands of farmers who obtain part-time work from cocoon-rearing, which is spread throughout the valley. A government-managed joinery mill is second only to a private plyboard industry based on wood. Of the 50 sawmilling units only one is run by the government. They are located mostly in the city and various towns, generally by the riverside for storage, and in some cases for rafting, of logs.

A match factory and a pharmaceutical works, established about 30 years ago by private enterprise have recently been taken over by the government. The public sector has also undertaken a handloom silk factory, one woollen and one spinning mill, a small tannery, a brick and tile factory, and a medium-sized cement, prestressed concrete and spun pipe factory complex.

There are about 500 small-scale units, which include metalware, food processing, sports goods and furniture making. In addition, there are Khadi and village industries, aimed at the diversification of the rural base. They include hand weaving, village oil, leather and pottery, bee-keeping, willow-works and hand-made paper.

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1. Those which are registered by Act and employ over 20 men or 10 men and power.

The total power generated in the valley is about 16000 MWs. This is far less than the demand for industries and domestic use. Power cuts are, therefore, exercised and use of domestic electric appliances discouraged. Rural electrification is limited to areas close to main transmission lines. Only about 150 villages are electrified, i.e., 4.7 per cent of the total number. Two major hydroelectric schemes are underway, which, when completed, will have an installed capacity of about 100 MWs. The demand, on the other hand, is estimated at about 600 gwh[1] in 1975.

The vast hydro resources estimated at 18,900 gwh are underdeveloped and only 0.6 per cent of energy used in agriculture and forestry is derived from commercial sources. Instead, human energy and draft power respectively contribute 74 and 25 per cent. Due to the paucity of electric power, the trend of demand for non-commercial energy is upwards. The firewood demand for industrial and domestic purposes is likely to be about 0.12 million c.ft. with its share in non-commercial energy demand going up from 40 to 51 per cent from 1960 to 1975. The relative share of dung, as a domestic energy source, is however projected to decline from 39 per cent in 1960 to 28 per cent in 1975.

The present inter-industry table (c.f. Table 1, appendix 13) gives an idea of the commodity trade flows in Kashmir. She imports in descending order of importance foodgrains, cotton and manufactures, iron and steel, mineral substances, oils and oilseeds, petrol, sugar and tea and tobacco, drugs and dyes, metal and its manufacture, spices, soap and other

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1. One gwh equals 10^9 watt hours of energy. The demand figure and data in the next paragraph are based on a survey by the National Council of Applied Economic Research (NCAER,1965).

consumer goods. The main goods exported in descending order of importance are timber, fruits, wool and its manufacture, leather, silk and saffron. The number of vehicles, i.e., lorries and trucks going to and from the valley, carrying the above bulky items of trade and other goods exceed 0.18 million a year.

v. Kashmir as a planning region. That hard facts like the above, about the number of vehicles passing to and from Kashmir, are readily available is one among a number of considerations making the choice of Kashmir as a planning region reasonable. Kashmir has only one line of overland communication with India and the world, passing through a tunnel at over 6000 feet above sea level. Not only is the under two miles long tunnel a link, but it is also a physical point of departure from Kashmir's world and the rest, in whichever direction one steps. A check-post maintained ever since this road - the Banihal Cart road - was opened to traffic, ensures that anything passing either way is recorded. Kashmir's position is perhaps more unique than many countries. Her trade statistics could be no less accurate than for a country.

Kashmir valley is an administrative region, being one of the three provinces of Jammu and Kashmir State. The current data, planning and administration within the region is unified and discernible from other provinces.

Kashmir is culturally completely different from any of its neighbours. Kashmiris are, perhaps among the very few people, for instance, who have not tasted alcohol or spirits and where murder is unknown. Their puritanism, their dress, their language and their food is different from those in the neighbourhood. Their motivations, attitudes as well as cunning intellect too are different.

Kashmir is a complete watershed unit. It is drained by one main river - the Jhelum. This river makes its debut at the south-eastern extremity of the valley and ends in its independence shortly after accelerating through the region's north-western extremity, i.e. at its confluence with the river Kishenganga. All sub-watersheds and side valleys flowing into Jhelum are wholly included in the Kashmir valley region.

Because of Kashmir's long isolation, but for the visits of Moghuls and other emperors and now the tourists, she has oriented her economic activity closely to her natural endowments - as evidenced by the steps of life that can be so clearly recognized there (c.f. section supra). Her natural endowments, including climate, are different from her neighbours'. Therefore, her economy too is different from without[1] but intertwined within.

Kashmir's economic pivot is the centrally located Srinagar. Her physico-economic-axis cuts through the capital traversing along the river Jhelum and the arterial Jhelum valley road, which runs parallel to the Himalayan masiff of the Pir Panjal extension.

It would be personification to say that Kashmir has a personality of her own. For purposes of this thesis, it is relevant, however, to say that she is a unit, geographically, culturally and economically. Because her natural endowments - mountains, forests, water and valley land - are so different and her location so extreme and unique, Kashmir is an

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1. For instance, Mehra and Bhargava's (1967) study on landless population in India shows Kashmir strikingly different from the rest of the country, i.e., there is comparatively negligible landless rural population in Kashmir.

independent bio-economic entity from the resource-planner's viewpoint.

CHAPTER IV

BIO-TECHNICAL POTENTIAL

1. Introduction

A region's renewable resources are capable of providing a range of godds and services. This potential of a resource endowment for the satisfaction of human wants depends on the physical as well as the economic and institutional features. In this chapter, we will consider the former.

2. Classification

i. Concept. A terrain classification is useful because a 'description of present use of land resources, in itself, reveals little of their potential use capabilities for various purposes' (Schickele, 1965). 'Landscape' and the 'parametric' are the main approaches for a classification. The former defines part of the landscape with common appearance. This may be useful for a general scheme of development for a region, not for detailed planning of many specific uses (Renwick, 1968). The parametric method identifies individuals 'objectively from one or more parameters which vary together' (Mabbutt, 1968). This method has recently been used for investigating the grazing potential (Condon, 1968).

We have used a parametric method, defining classes which are readily identifiable and yet sufficiently uniform in properties vis-a-vis each of the different uses with a particular choice of technique. This approach assumes no pre-determined use for land since many physical features can be changed, e.g., through terracing. Therefore, in order to determine the potential, the key physical characteristics relevant to a specific use need to be identified and appraised for their amenability to the various uses.

ii. Land capability. The various methods of land classification have been reviewed by Jacks (1946). The review has been 'reproduced' at length, with some comments, by King (1963). Another repetition is unwarranted. Suffice it is to record that there cannot be an 'all purpose grouping or classification. A grouping made primarily to indicate erosion hazard and for planning erosion control will not serve adequately as a grouping for tax assessment, for example' (USDA, 1951).

Among the physical classifications, two have been widely considered. One is the American 'capability classification' (NRPB, 1941), attempted in England too (Wilkinson, 1968). Eight classes are distinguished (Klingebiel and Montgomery, 1961), solely from the physical characteristics of the land and susceptibility to erosion (Hockensmith and Steele, 1943). Bibby and Mackney (1969) advocate this method for Great Britain - with seven classes as adopted in Canada (Arda, 1965). This classification may be useful only for conservation farming or soil conservation planning, for it has the definite and limited objective of erosion control (Norton, 1939). It is 'subject to some degree of arbitrary decision' and is not a 'suitability classification for specific crops or use' (Bibby and Mackney, 1969, p.2). As such, this classification is of limited scope and may be 'defined more correctly as of soil rather than land' (Jacks, 1946, p.44).

The other classification was initiated for the Land Utilization Survey of Great Britain (Stamp, 1948). It is aimed at the productivity of land for agricultural crops. Ten classes are grouped into the three categories of good -, medium - and poor - quality land (ibid, pp. 362-381). This classification has been adopted with addenda for World

Land Use Survey (Unesco, 1952; Stamp, 1960, pp. 153-157) and applied, among other places, to Hong Kong (Tregear, 1958) and Tobago (Niddrie, 1961). The classification is essentially a land use inventory, with the classes distinguished by agriculturally significant criteria for the pre-assigned purpose of the reservation of the currently 'most productive' lands for agriculture.

Such classifications 'based primarily on present land use are perhaps the most likely to mislead ...; intensive use does not necessarily indicate highly responsive soils, adapted crops, nor optimum farming systems' (USDA, 1951). Conversely, many responsive soils in the world remain underutilized, because of the lack of transport, industry or population pressure. A present-day land-use need not reflect productivity; it emerges, among other things, from historical events and prejudices, which take time to erode under the influence of changing technology and socio-economy. For instance, Walker (1958, p.97) records that the method for allocating hill-land to forestry in Great Britain,'if there has been a specific "method" can only be described as "intuitive"', and which 'might be termed the principles of "least sacrifice" and "maximum benefit" to the existing system of agriculture.'

Stamp (1948, p.355) argues that in Great Britain 'much of the land has been settled, and farmed for upwards of a thousand years, some of it for two thousand. The present utilization does therefore reflect ... the combined influence of the various factors concerned'. Such an assumption would be too strong for developing countries; e.g., the nomadic grazing and shifting cultivation practices in the Himalayas are in consonance neither with the land potential nor economic desirability. So is the peasant subsistence agriculture, which with development is

likely to be reorientated away from land use practices conducive to stagnation.

iii. Use-possibility. The various land classifications, such as the above two, are negative in that they specify what uses are 'out-of-bounds' for a particular class. The same is true for the Canada Land Inventory program, which for forestry, for instance, includes seven classes of land based exclusively on the 'limitations to the growth of commercial forests'. (Arda, 1967, pp.2-3). But we need a positive approach for finding out what uses are possible on the various land types in Kashmir. This is because the classification is for assessing land capability with the aim of choosing an optimal combination of options (c.f. chapter VII). For this, there should be some correspondence between the 'natural' and 'use' classifications; i.e., the criteria used to distinguish natural classes should be related to distinguishing various use classes. The need is to reflect land 'capabilities for man's use' (Kellogg,1940) now and in the future, so that the natural aspects are synthesized with use-possibilities. The emphasis in our approach will be on the latter and not on any intrinsic attribute of the land, by which to classify it.

Almost invariably a particular possible use of renewable resources is dependent, not on a single parameter of a natural resource attribute, but on the interaction of a number of parameters of various attributes. The many causal and complementary relationships among these factors, with which the biotechnical potential is intertwined, need to be systematized. This involves the identification of the factors influencing the various resource uses. Then the extent suitable for each use under the constraints of the influencing factors can be assessed.

3. Site Factors

i. Reconnaissance. The natural potential basically depends on an area's climate and soil, including topography, with which other physical and biological factors are related. The information about climate in backward areas is limited. It pertains to few stations and does not reflect local variations. Often, it is unreliable having been collected over a short period. Likewise, soil surveys have been conducted only in few pockets and rarely practically orientated for use'in development planning and in the execution of development plans' (International Institute for Land Reclamation, 1963, p.7). Where the soil maps exist, they need to be interpreted, calling for field information (Wilkinson, 1967). Stamp (1955 p.248) records that for Great Britain, where much more information is readily available, the land potential on the basis of detailed soil surveys cannot be attempted yet. In any case, soil maps are generally so low in quality that they are far off from the 'general standards' for being of value to making planning predictions (Webster and Beckett, 1968).

A procedure is required which by-passes the limitations of data, and, yet is useful. This involves:
(i) a decision about the information which is important for determining the use-possibilities,
(ii) the compilation of the information from available record, and (iii) the collection of the missing information from field, including mapping.

The first step is to understand the problems of a region. For this, reconnoitring to assess the strategic variations in field conditions is useful. It enables one to gauge the practicality of a procedure, the scope of using existing data and of the methods for obtaining field information.

Such a preliminary survey also indicates the extent and magnitude of specific problems, e.g., floods, water scarcity, land-slips, special forms of erosion, and inaccessibility. This information gives clues to uses that may be excluded and highlights problem-spots requiring detailed investigations. The survey can have a joint purpose to furnish information on the need to subdivide a region into sub-watersheds or localities for planning, and on behavioural, institutional and economic features.

ii. Climatic, edaphic and vegetational indices. The critical division between suitable and unsuitable climates in the various climatic indices 'is arbitrarily placed at the point where the annual precipitation and evaporation are in equilibrium' (Klages, 1942).[1] Such average formulae, as Thornthwaite's(1933) precipitation effectiveness index, do not consider the compensating role of the interacting factors nor a rare but recurrent climatic propensity, e.g., drought, frost, which may be a limiting factor. King (1963, p.50), for instance, uses Koppen's'critical rainfall factor' formula. If this is applied to the Nubra valley in Ladakh (with a mean annual temperature of 42.44°F and a mean annual rainfall of 3.31 inches, which falls mainly in the summer and is less than the critical rainfall of 17.35 inches), its suitability for tree growth or cultivation is ruled out. But rice, wheat, barley, fruit and other trees, including poplars, are cultivated in the valley.

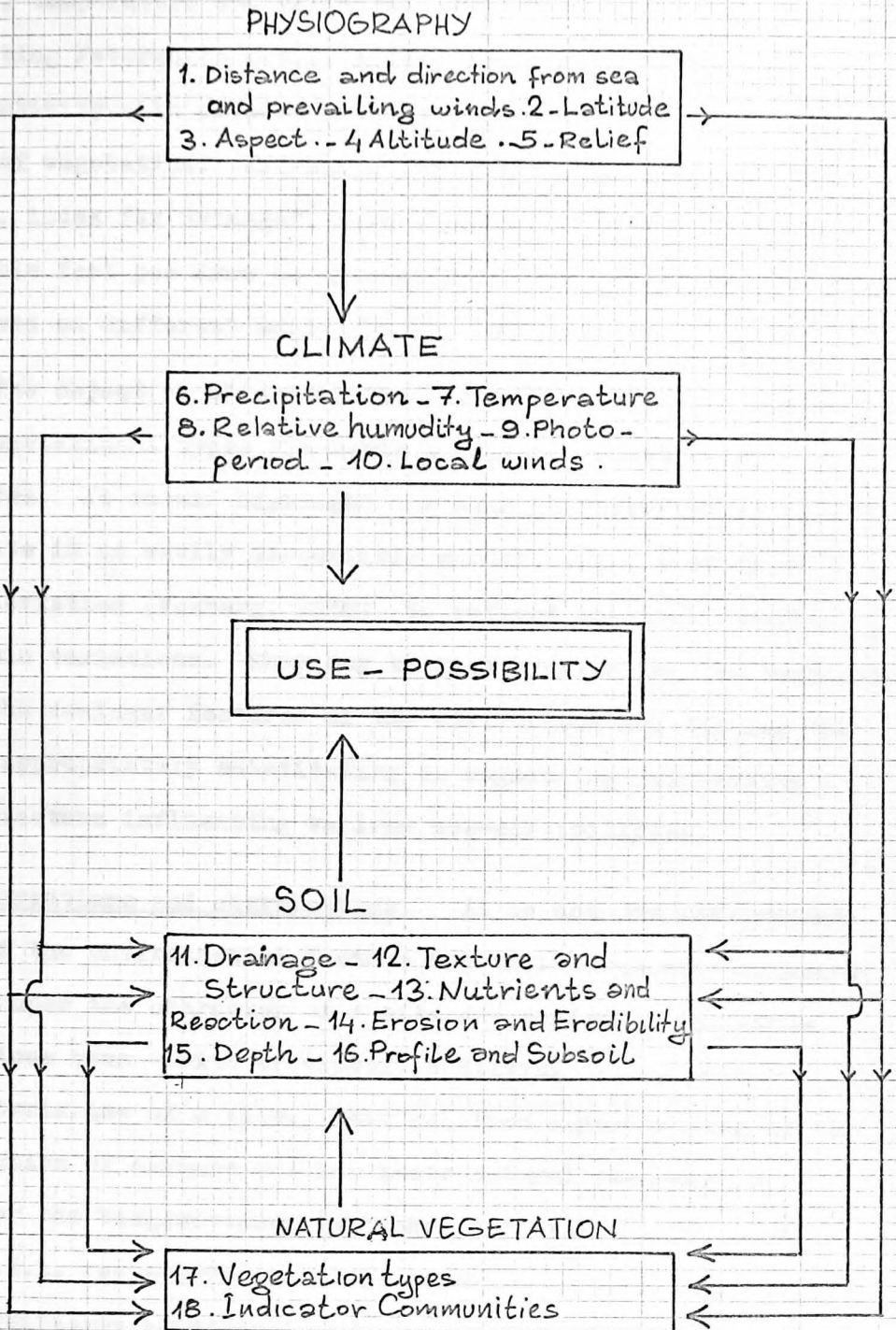
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1. It is, however, not arbitrary in so far as the various factors are considered and climatic limits do exist for various crops.

Apropos of assessing use-possibility in a region, generalisations can be misleading. Though the broad category in which a region falls is a starting point, it is the variations in the climatic environment that influence the use-possibility in different zones and localities. This applies to the edaphic factor too. The physical or chemical indices of soil are not an adequate basis because soil characteristics develop as well as change under the combined influence of climate and living matter. As such, the soil sample data, though an adjunct to soil study, cannot be the guide to technically rational utilization of land (Clarke, 1957, pp. 9-11). For this, a knowledge of the 'living soil' as a three dimensional piece of landscape, including the other factors, such as slope is required (USDA, 1951). It is difficult to evaluate the entire continuum of such landscapes for that involves a comprehensive soil survey. Only the preliminary soil survey results are available for Kashmir (Butt, 1966). The alternative is to identify correlations regarding the adaptability of uses under the different dominant features of soil and/or interdependent factors such as physiography, i.e., the effective variations and their influence as limiting factors for one or the otherwise.

Plant communities are 'indicators of the prime features of the environment and thus of its broad potentialities for various kinds of crop and livestock and forest management and production' (Phillips, 1961). The concept of plant indicators (Sampson, 1939) underlies site classifications in Europe and North America (Cajander, 1926; Coile 1938) and in South America (Hunter,1959). Nevertheless, the classification has to be purpose-oriented. For instance, Beard's (1955) approach of working up from the smallest recognizable units poses the difficulties of finding a basic definable unit in each situation and of the non-identity

FIG. 4.1 BIOGEOCOENOSE



of use-possibilities. Likewise, Paterson's (1956) 'climato-isophytes' method assumes that productivity is a function of light, temperature and moisture. But, there is a risk in accepting Paterson's C.V.P. index, because it correlates productivity with climate without taking notice of soil and type of vegetation. Kashmir's forests, on the basis of the C.V.P. index for Srinagar, have a potential productivity of 42 cubic feet per acre as against more than twice this quantity produced on different soils (Singh, 1970).

The object of classification is to identify and locate the vegetational types vis-a-vis a region's outstanding features. It should highlight the main characteristics of the site in an easily discernible manner, e.g., a study of the floristics (Fosberg, 1958), to reflect the local edapho-climatic variations. This may be done by relating the vegetation with the dominant features of the environment and filling the gaps, appropriately substituting or augmenting information about factors influencing various use-possibilities.

iii. Variations and correlations. It is not the independent role of the environmental factors but their combined influence that shapes the character of a site and renders it amenable to various uses - with or without modifying the natural characteristics of a site. This requires understanding of the interaction of animate and inanimate natural phenomena of a site, or the biogeocoenose (Sukachev and Dylis, 1967, p.26). Figure 4.1. represents the biogeocoenotic complex involved in use-possibility assessment. Each combination of the climatic and edaphic features and the interdependent physical and biological factors finds expression in the flora and fauna flourishing in each set of conditions, i.e., the natural flora provides a guide to the environment. Newham (1968) has analysed the correlation between climate and vegetation in

British Columbia with the principal climatic components accounting 'for 87 per cent of the total variation among the 70 stations' studied. He concludes that there is a 'well defined relationship' between the distribution of tree species and the various components of climate other than latitude.

A classification can be useful if it considers the local variations as a reflection of the influencing factors for evaluating the correlation between the two and the contingent use-possibility. Champion and Seth (1964), mainly because of the 'extensive development of coniferous forests' place Kashmir in the 'Himalayan Moist Temperate' group. This is inapt; the character of the vegetation and the phytogeography particularly the absence of oaks (c.f. appendix 5) in Kashmir is different. This uniqueness is corroborated by the lack of monsoons in Kashmir. The vegetational and climatic variations between Kashmir and the rest of the Himalayas make distinct their use-possibilities. This shows that the study of the vegetation has to be oriented toward establishing correlations between variations that influence the use-possibility in different regions.

The correlations are not a firm guide in all circumstances. In an apparently homogeneous area, the compensating effect of interacting factors or the adaptability of natural vegetation over a wider range may conceal the limitations in adopting alternative uses. Instances, e.g. Tanzanian ground nut scheme and Indian Dandakarnya Resettlement Project, exist where, inter alia, reliance on the mere luxuriance of vegetation proves hazardous. This problem is not so crucial in areas like Kashmir, where different uses have been extended to the various bio-climatic and edaphic localities. Caution, nevertheless, must be exercised. The components of the biogeocoenose besides the vegetation, e.g., the elements of

the climatic and edaphic factors, need to be assessed vis-a-vis limitations on the amenability of a site to various uses.

Besides climate and soil, use-possibility is related to physiographic and biological factors in a locality. With 18 main factors enumerated in Figure 4.1. and numerous possible combinations thereof, it is useful to eliminate factors which do not cause variations within a region; the obvious ones in Kashmir are the first and second of the physiographic factors. Subsequently, correlations may be established, from reconnaissance survey data, between individual or groups of factors for assessment from only one set of the inter-related factors; e.g. the climate and phytogeography in Kashmir are both correlated with aspect and altitude, so that use possibility can be linked with all the four features by considering only the latter.

iv. Erosion and erodibility. Two features that stand out independently are the existing erosion and the liability to erosion. The former is related with the bio-cultural environment in historical perspective and the latter with the future resource-use shifts. Neither appear in the biogeocoenotic model (c.f. Fig. 4.1).

The feature of erosion is difficult to eliminate by correlation because the causal factors include aspects of human ecology. The extent of area affected has to be assessed for the different degrees of erosion which influence the possibility of various uses. This information can be recorded on maps and areas affected in different localities planimetered. An easily discernible classification is operationally useful. The following four erosion classes will generally serve the purpose.

Table: Erosion Classes.

Class	Degree of Erosion	Remarks
I	Moderate	Less than 25% topsoil removed.
II	Severe	25-75% topsoil removed.
III	Very Severe	> 75% topsoil removed but less than 25% of subsoil removed.
IV	Critically Eroded	> 25% subsoil removed and/or gullied.

This classification is useful because the ranges of the classes correspond to markedly different anti-erosion treatments and, hence, the use-possibilities.

Usually 'erodibility is determined on the basis of soil characteristics alone and does not take into account any other site factors' (Dyrness 1967). But since soil is an inseparable element of the site complex it is not possible to measure the absolute erodibility. When soil erodes under one use and not another, it does not indicate its so-called inherent erodibility but its liability to erosion under a particular use-pattern. The various experiments measure 'the effect on erosion of the variable factor - crop or angle of slope - rather than soil erodibility' (Jacks and Whyte, 1949). Formulae exist for relating erodibility and erosion inducing factors. But hardly 'any quantitative information exists on the magnitude of (these) factors'. (Kohnke and Bertrand, 1959). This is true for Kashmir.

An alternative is to indicate erodibility by reference to correlated site factors. In an area where climate and hence the nature of detaching agents can be assumed to be uniform, the problem narrows down to the appraisal of variations in the other factors that resist or augment soil detachment and transportation. These include the soil structure, depth, organic matter and vegetal cover. Such characteristics are

reflected in the soil groups and vegetational types, which are delineated while keeping the erosion and hydrological aspects also in view. Another dominant factor, including the splash-effect, is slope, because it influences both the potential energy and the intensity of run-off.

v. Steepness of slope. The steepness and length of slope is measurable in the field. For this, a slope group classification is required to demarcate areas for different use-possibilities.

Ceteris paribus, limits can be defined for the ranges within which (i) little danger of erosion exists, (ii) the erosion can be prevented by adopting specific practices, and (iii) erosion cannot be prevented unless resource use allows the maintenance of a permanent cover, or the slope is too steep for working the land. Two or more slope groups may be identified in the second group. This depends on the variations in the nature of soil management practices and/or if some uses would be limited to one or the other subdivision. The range of each group should be broad enough to cover the erosion conditions under the different uses and practices which are related to climatic and edaphic factors. Thus, while for temperate climate and well drained fluvo-glacial soils in Kashmir (Butt, 1966), the ranges are grouped into (i) $< 5\%$, (ii) 5-25% and (iii) $> 25\%$, with the second group further divisible into (iia) 5-12% and (iib) 12-25% slope classes, in the two subtropical watersheds of Lunkhar and Sirkhad in Sutley basin, with siwalik formation, imperfectly drained sedimentary soil and given to monsoon outbursts, scope exists only for three classes, viz., ((i) $< 3\%$, (ii) 3-10% and (iii) $> 10\%$ slopes (Muthoo, 1966, Mohan & Gupta 1965).

The reference of a site to a slope class serves the twin purpose of use-possibility assessment and of indicating the manner of a particular resource-use . The classification is oriented towards not only the choice of possible uses but also the variations in practices that go with a resource use from one class to another. With the manageable number of classes, the extent of land in different groups can be estimated readily with simple aids such as the pacemeter and altimeter. For Kashmir , the areas in each class are estimated from the geo-topographic sheets.

4. Use-possibility Assessment

i. Resource uses and factor combinations. The sum total of climate, soil and physiography of a site is reflected in its organic complex of vegetation and other living things, which itself influences the environment (c.f. Figure 4.1). The appraisal of the role of a crop is, therefore, necessary for assessing the suitability of alternative uses, for they involve the removal or the replacement of the existing growth or the establishment of a cover where none exists now. The removal of a permanent cover on a sloping site may induce erosion with a different use as happened after the Usambara mountains of Tanzania were planted to tea (Russell, 1967). Conversely, using a site for a xeromorphic or a leguminous crop may respectively mitigate its water or nitrogen deficiency, because of which the earlier use was not a success. The appraisal is required for all the alternatives to assess the deficiencies or the various inhibitive features of a site for different uses.

Such an evaluation is possible by considering each use-possibility separately in relation to different sites. Apart from the difficulty of gauging plant responses for each factor variation, this involves the recognition of every micro-site.

This is unhelpful in so far as many sites will be suitable for a resource use and vice versa. The difficulty is avoidable by testing each possibility for the different combinations of factors, restricting the number of factors to those assuming critical levels in any of the alternative uses. This is effected by running through the chain of influencing factors in a juxtaposed manner so that every single variation of an over-riding factor overlaps all the variations in the succeeding factors. This enables one to isolate the limitation/s on a possibility from among the entire string of factors, recorded in one direction - say horizontally - and their variations in another - say vertically; the area possible for a use is that left after considering the variations in the last limiting factor in the chain. This is analogous to a sieving mechanism.

For the 8 variations in climatic (aspect/altitude cum vegetation) zones, 4 physiographical and 4 erosion classes, 5 soil groups, 3 drainage and 2 flood submergence classes, that demarcate the critical degrees of the influencing factors in Kashmir, the sieving process is represented in Figure 4.2. The area possible for a resource use is given by the areas in blocks under Column 7. These blocks represent the (two) variations in the last factor, each of which are repeatedly tested within the constraint of variations in the preceding factors till all the earlier variations are reflected. However, this process involves 76,800 computations for a possibility assessment of 20 alternatives, i.e. less than in Kashmir, and, which if has to be linked with 20 present uses, the number swells to 1,536,000.

ii. Dovetailing and critical factors. To make the process manageable, all the alternatives are tested simultaneously against a particular variation in the influencing factors

FIG. 4.2 AREA POSSIBLE FOR A RESOURCE - USE

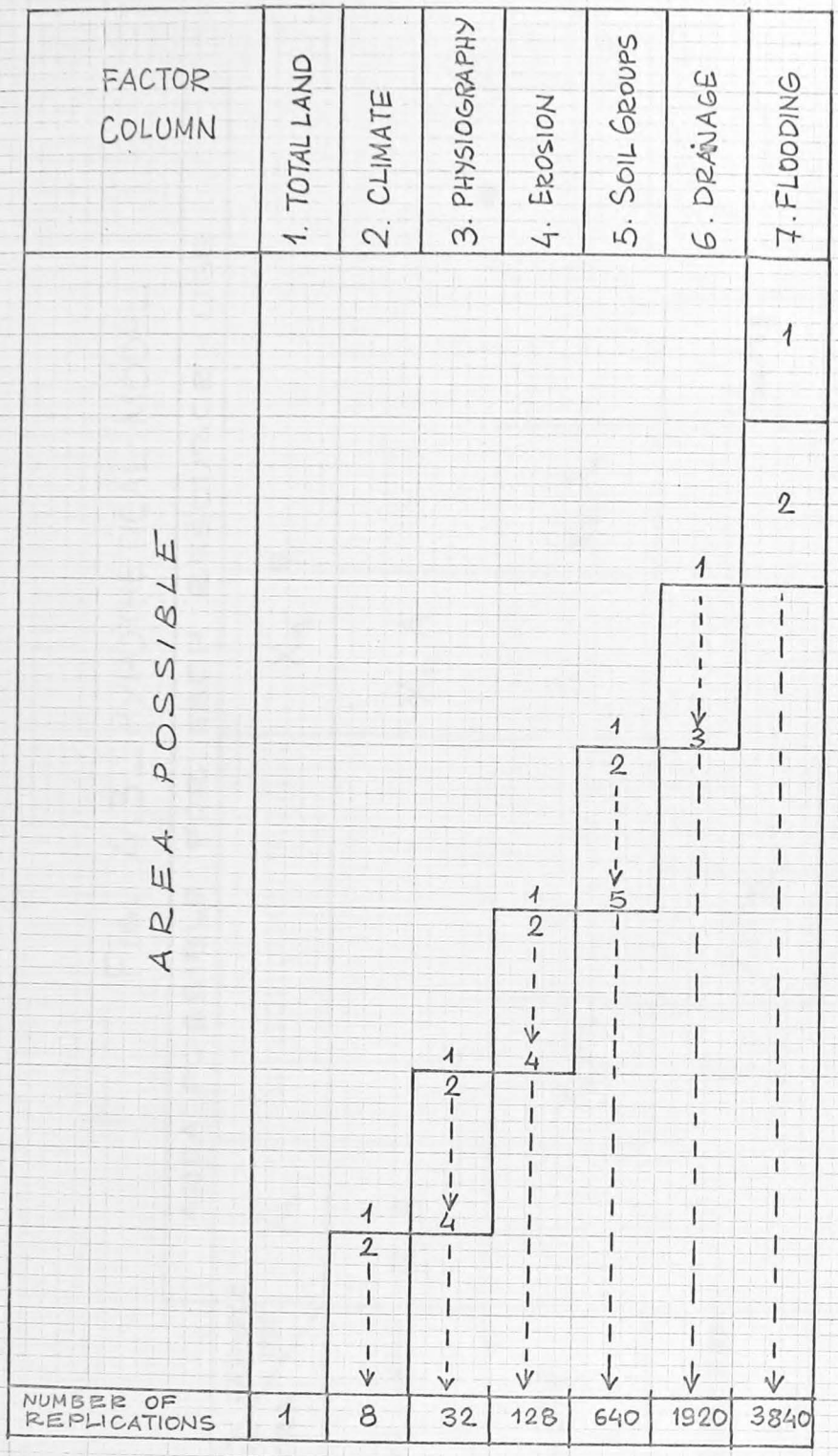


FIG. 4.3 – HYPOTHETICAL MODEL

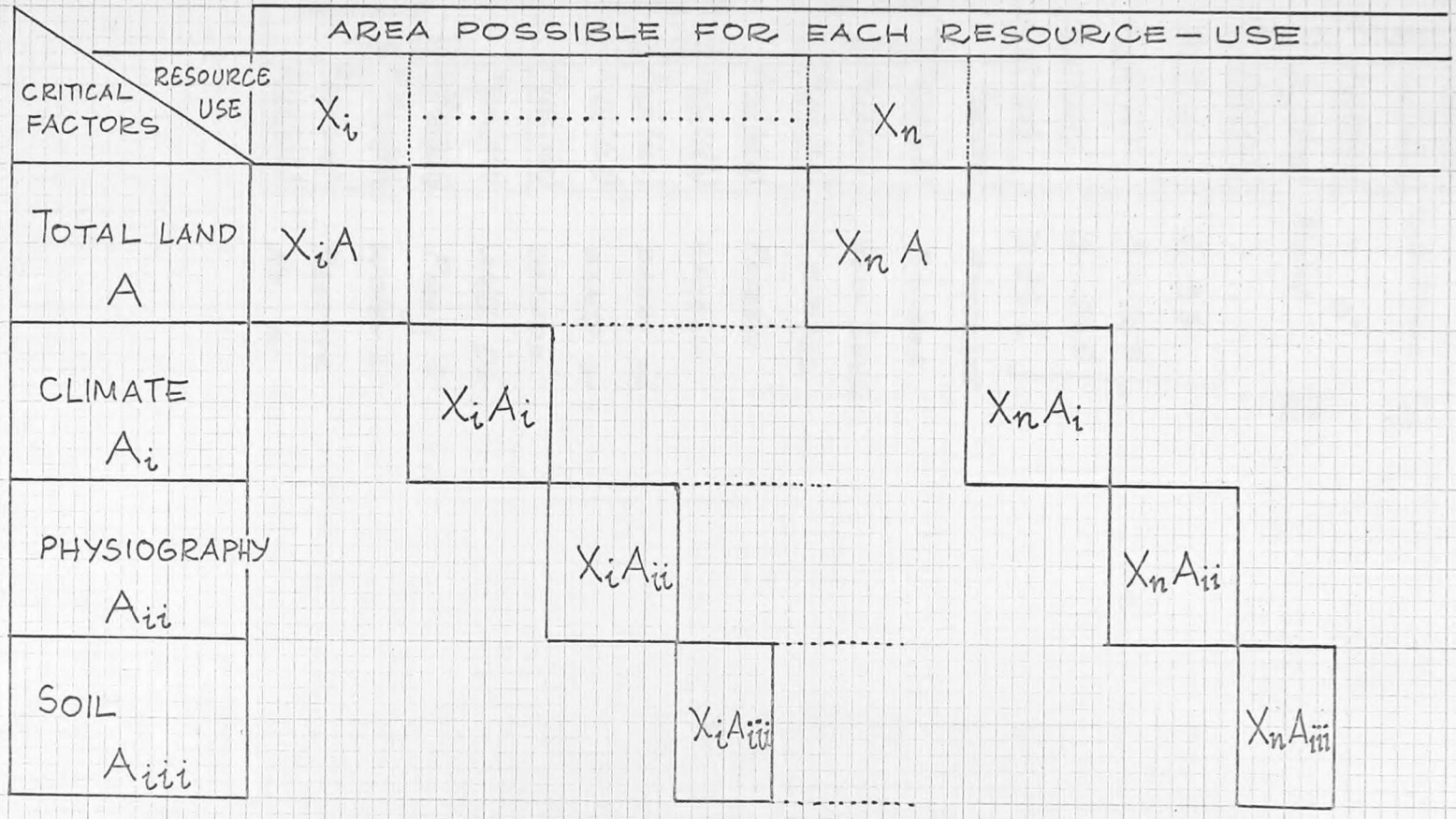
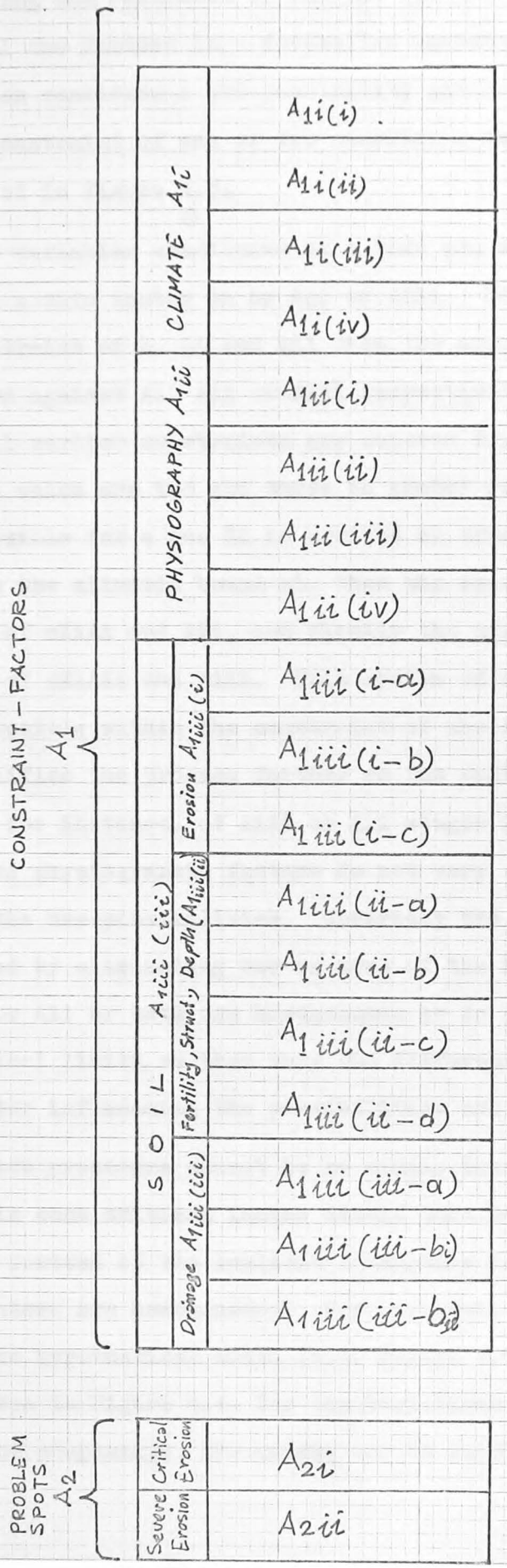


FIG. 4.4. Factor Variations in Kashmir

			CLIMATE	DOMINANT PLANT COMMUNITY	ASPECT	ALTITUTE	
CLIMATE A_{1i}	$A_{1i(i)}$	$A_{1i(ia)}$	Warm-Temp.	Cedrus-Pinus	N	< 7250′	< 7500′
		$A_{1i(ib)}$	" "	" "	S	< 7750′	
	$A_{1i(ii)}$	$A_{1i(iia)}$	Cold-Temp.	Abies-Pinus	N	7250′ – 8750′	7500′ – 9000′
		$A_{1i(iib)}$	" "	" "	S	7750′ – 9250′	
	$A_{1i(iii)}$	$A_{1i(iiia)}$	Sub Alpine	Betula-Abies Picea.	N	8750′ – 10250′	9000′ – 10500′
		$A_{1i(iiib)}$	" "	" "	S	9250′ – 10750′	
	$A_{1i(iv)}$	$A_{1i(iva)}$	Alpine	Rhododendron-Forage species	N	> 10250′	> 10500′
		$A_{1i(ivb)}$	"	"	S	> 10750′	

PHYSIOGRAPY A_{1ii}	$A_{1ii(i)}$	< 5%	SLOPE CLASSES
	$A_{1ii(ii)}$	5 – 12%	
	$A_{1ii(iii)}$	12 – 25%	
	$A_{1ii(iv)}$	> 25%	
SOIL A_{1iii} — EROSION $A_{1iii(i)}$	$A_{1iii(ia)}$	MODERATE	EROSION CLASSES
	$A_{1iii(ib)}$	SEVERE	
	$A_{1iii(ic)}$	VERY SEVERE	
	$A_{1iii(id)}$	CRITICAL	
SOIL A_{1iii} — FERTILITY $A_{1iii(ii)}$	$A_{1iii(iia)}$	PAYEEN	SOIL GROUPS
	$A_{1iii(iib)}$	KAREWA	
	$A_{1iii(iic)}$	KANDI DEEP	
	$A_{1iii(iid)}$	KANDI SHALLOW	
	$A_{1iii(iie)}$	UPLAND	
SOIL A_{1iii} — DRAINAGE $A_{1iii(iii)}$	$A_{1iii(iiia)}$	Well Drained	
	POOR $A_{1iii(iiib)}$	Poorly Drained	BADLY DRAINED
	POOR $A_{1iii(iiic)}$	Water Logged	
	$A_{1iii(iva)}$	Recurrent and Prolonged inundation	FLOOD HAZARD
	$A_{1iii(ivb)}$	No or rare inundation	

FIG. 4.5 CRITICAL FACTORS IN KASHMIR



that imposes critical limits in the region. This is possible by synthesizing the reference of all the use-possibilities vis-a-vis all the factors in a dovetailed manner, so that each iteration considers a use-possibility against a factor within the constraint of one or two overriding factors. This is illustrated in Figure 4.3.

The two variables considered at a time are a use-possibility Xi,...Xn and a site factor Ai or Aii or Aiii. There is one working constraint of A, Ai and Aii when the use-possibility is considered against Ai, Aii or Aiii respectively, though in effect all earlier constraints are catered for against Aii and Aiii which are two and three in number respectively. The area possible for a use Xi is arrived at from the area cXiAi within the climatic bound Ai, then the area cXiAii within that of cXiAi and Aii, and finally the area cXiAiii within that of cXiAii and Aiii. This system of dovetailing the areas possible within the constraint of the overriding factor simplifies the process further as the analysis may stop short, for instance, of Aiii or Aii stages if soil or both soil and physiographic factors do not vary to influence critically the use-possibilities. Obversely the process may be simplified by eliminating one or more of the higher stages, e.g. if Ai or Aii or both are homogeneous or do not vary beyond critical limits, so that only the different features of soil factor influencing the possibilities are considered.

The above procedure cannot be so simple because of the variations in each critical factor itself that have to be considered, instead of the implicit assumption in the foregoing that the factors are homogeneous. For instance, the first column of the hypothetical model (i.e. Figure 4.3) actually looks as shown in Figure 4.4. for the variations in Kashmir. To reduce the complexity, the column may be reformulated

as shown in Figure 4.5. This is possible because the variations that necessitate subdivision of A1i(i), A1i(ii) and A1i(iii) and A1i(iv) each into two are in the factors of aspect and altitude. But in each subdivision the vegetation is similar. Its extent is known, the region being covered by forest management plans with well documented stock maps. This also obviates the need for data on the individual variations in the climatic factors; these can be assessed from vegetation and cross-checked by reference to the correlated aspect-altitudinal limits. The factors A1iii(id), A1iii(iva) and A1iii(ivb) need not appear directly in the constraint-factor column because areas critically eroded, or gullied, or prone to recurrent flooding represent problem spots within one climatic division viz. A1i(iv). The area so affected is deducted from the latter in the reformulation and considered separately.

In the reformulated column the number of factors against a use-possibility on the basis of the dovetailing is reduced by over 25%. Notwithstanding that, some factors are overlapping, so that the dovetailing principle is not directly applicable. The difficulty is accentuated by the multiplicity of factors owing to variations in each site factor. As such, the working constraints exceed the limit of two more so as we descend the column. For example, the constraints for the drainage factor are not only the four climatic and four slope variations but also the five site factors above it. In order to correlate a factor in the column with a use-possibility, the various (vertical) factors are to be realigned so that each soil factor is considered separately within the bounds of each physiographic and climatic factor, i.e. two constraints at a time and yet none of the site features are left out. Such realignment involves the ranking of the individual

FIG. 4-6. VARIABLE-CONSTRAINT MATRIX FOR KASHMIR

S. No.	CRITICAL FACTORS ↓ / USE POSSIBILITY →				GROSS TOTAL
	A1	X_i	.....	X_n	
1	A1 i(i)		Alpine		
2	A1 i(ii)		Sub-alpine		
3	A1 i(iii)		Upper-temperate		
4	A1ii(i)		< 5%		
5	A1iii (iii-b)		Poorly Drained		
6	A1 iii (iii-a)		Well Drained		
7	A1ii(ii) & (iv)		> 5%		
8	A1 i(iv)		Warm temperate		
9	A1ii(iv)		> 25 %		
10	A1 ii(iii)		12 – 25 %		
11	A1iii(ia)		Karewa Light Erosion		
12	A1iii(i-b)		Karewa Moderate Erosion		
13	A1iii(i-c)		Karewa Severe to Very Severely eroding		
14	A1iii(i-d)		Kandi-Shallow &/or S. to V. Sev. Eroding		
15	A1 ii(ii)		5 – 12 %		
16	A1iii(i-a)		Karewa Light Erosion		
17	A1iii(i-b)		Karewa Mod. Eroding		
18	A1iii(i-c)		Karewa Severely Erod.		
19	A1iii(i-d)		Karewa Very Sev. Erod.		
20	A1iii(ii-d)		Kandi Severe to Ver. Sev. Eroding and/or shallow		
21	A1 iii(ii-c)		Kandi deep, colluvial & alluvial		
22	A1 ii(i)		< 5%		
23	A1 iii(iii-b)		Ill drained		
24	A1 iii(iii-bi)		Poorly drained		
25	A1 iii(iii-bii)		Badly drained		
26	A1 iii (iii-a)		Well drained		
27	A1iii(ii-a)		Payeen Light erosion		
28	A1iii(i-a)		Karewa Lightly Eroding		
29	A1iii(i-b)		Karewa Mod. Eroding		
30	A1iii(i-c)		Karewa Severely Erod.		
31	A1iii(i-d)		Karewa Very Sev. Erod.		
32	A1iii(ii-c)		Kandi shallow		
33	A1iii(ii-c)		Kandi deep		
34	TOTAL A1	+++++ +++++		+++++ +++++	xxxxx xxxxx
35	TOTAL A2	+++++ +++++		+++++ +++++	xxxxx xxxxx
36	Problem spots: A2 ii		Critically eroding		
37	Problem spots: A2 i		Flood affected Payeen		
38	A2	X_i	.....	X_n	G. Total

variations one above the other from their over-riding nature and the grouping together of factors which exert a similar influence when considered jointly at a particular stage. The combinations of the variations that do not occur in the region are eliminated and some of the variations as are not critical within the constraint of a particular factor are merged together. In this way any unnecessary replication is avoided.

iii. Variable-Constraint Matrix. The model that emerges is a lattice diagram. The variables representing alternative use-possibilities are in the horizontal rows of the matrix and the features of site in the vertical column as shown in Figure 4.6. Each block shows the area possible for a resource-use by relating a use possibility with the site against which it stands within the constraint of immediately preceding two site factors. The exception is the row against the first (vertical) factor or individual variations thereof, in which there is only one constraint of the total land area.

In this model, dovetailing is not a continuous stream down a column but is repeated for each factor from top down in a succession so as to accommodate the multiplicity of variations of site factors. Therefore, the net total area possible for a resource-use is not that in the last block in a column as in Figure 4.3, but the sum of the areas in the blocks against the last factor or variations thereof in each replication (shaded in Figure 4.6 with diagonal lines). Thus the model functions as a multiple of the hypothetical model in order to incorporate the various combinations of factors in a region. To this (vertical) sum is added the extent possible from problem spot areas to give the total area possible for a use (shaded with plus signs). This total is either less than or equal to the total area of the region

(dotted) if no variation in/or any site factor acts as a constraint. The (horizontal) total (shaded with vertical lines) of any row is either greater than or equal to the area against that factor (horizontal broken lines) if the area is unsuitable for more than one use. This is rare. Thus, usually, the total of the areas in the blocks of the horizontal rows summing up the area possible for different uses (shaded with crosses) exceeds the total available land in the region (dotted blocks). The use-possibility assessment, as such, raises the problem of allocating land among the different uses. This problem is dealt with in Chapter VII.

iv. The possible uses. The appendix 15 shows the data for the variable-constraint matrix for Kashmir's present land-use pattern, i.e., the area distribution of the 23 uses vis-a-vis the various climatic and other site features. The appendix 16, ~~table 1,~~ shows the area possible for paddy cultivation, i.e., 954,770 acres, distributed on various sites, many of which are devoted to other uses at present. This area is nearly three times the present area under paddy, because it represents the possibility of this use on new sites with different technologies. By computing similar tables for all the other uses, composite variable-constraint matrix is constructed as shown in appendix 17. ~~table 2.~~ This represents the total area possible for each resource use on different sites on a bio-technical basis, many of which are mutually exclusive.

CHAPTER V

ECONOMIC APPRAISAL

1. Introduction

Physical relationships are of little importance to mankind if they have no economic application, and 'a major portion of economic interpretation consists of the appraisal of physical relationships' (Collier, 1942). This is the task before us in this chapter.

2. Scope of Appraisal

1. Options and Systems. An appraisal is more useful the more it encompasses the feasible options, or projects, for using a resource base. The less limited the range of options, the greater is the scope for a choice that enables the maximisation of objectives. The technical possibilities of resource uses need exploration to avoid overlooking a relevant option. For this, the use-possibility assessment is a pre-requisite (c.f. Chapter IV). However, options which are obviously impossible, say for socio-cultural reasons, e.g., beef production by Hindus, need not be appraised. The process involves the identification of the present uses and of the practicable changes that could be implemented with different technologies by the use of factors in different ways and proportions.

Alternative systems designs emerge from different combinations of the various possible uses or options. One can have as many alternative designs as the permutations and combinations of the options/permit. Systems analysis will be objective if the choice of combinations is not set in advance. For this, we need a conjoint procedure for discovering alternative

systems designs. This will be attempted in Chapter VII.

ii. Ex-ante appraisal. The purpose of an economic appraisal is not to justify or decide on a systems design. It is to compare or rank options. Options appraisal is a stepping stone in the decision-making process and should not precondition decision-making, i.e., it should be objective. To counteract the defects of the past practice of post-facto evaluations (c.f. sub-section V, ii, appendix 6), decisions should be free from commitments on systems designs and anticipatory choice; designing should follow and not precede an appraisal. For this, an appraisal has to be ex-ante.

Lest the purpose of the ex-ante appraisals is defeated, we have to ensure that no feasible options are eliminated, so that the systems analysis too is in an ex-ante manner. One option should not pre-empt another prior to evaluation, even if they be mutually exclusive. The feasible technologies and options scale should not be restricted in advance. We will independently appraise all the options within the systems purview without prejudice either to its magnitude or to the scale and combinations of the component options.

iii. Object and scope. The object is to appraise options for their socio-economic effects. Thus the ambit of appraisal is wider than private profitability and closer to 'social desirability.' The latter implies that the attempt will be to reckon social, and not merely private, costs and benefits (Pearce and Sturmey, 1966). Later, the term 'social desirability' will gain content from the development policy (c.f. Chapter VI.)

There are two implicit assumptions for socio-economic appraisals in a mixed economy: one is that social control is possible over resource use. This is notwithstanding that only 60 per cent of Kashmir's renewable resource area is publicly owned. This assumption is not an oversimplification.

Social control over renewable resource use exists in most economies, the difference being in degree. The ownership of land in Great Britain legally vests in the crown. None has absolute rights. Various regulations interfere with 'private' owners' free choice. Often, these are to prevent what are regarded as socially undesirable uses and, not infrequently, to promote others, such as private forestry through negative taxation (Lorrain-Smith, 1969). In the United States, zoning ordinances are used to enforce land use of plans (Clawson and Stewart, 1965, p.64), involving the 'exercise of police power' (Soil Conservation Society of America, 1970). Even where the ordinances do not apply directly to rural planning as in Massachusetts, they do residually (Black and Westcott et al, 1959). Conservation societies in Ontario (Parliamentary Select Committee, 1967) and Irrigation Associations in Taiwan (Hsieh, 1965) play a similar role on a voluntary basis.

The above assumption is useful for meeting social objectives, because publicly oriented appraisal will minimise the divergences between private and social goals. If the private resource use pattern is already in accord with the objectives, no realignment is warranted. If adjustments are required, the appraisal will help to illuminate these. The assumption forces consideration of the social costs of private enterprise, which are widely manifest in the renewable resource sector (Kapp, 1950, 1969).

reduces

The above assumption/group interests in favour of what society wants, i.e., development, because society supports a development plan. It gears appraisals towards public policy. This implies the second premise that systems designing has little influence over policy planning. In

countries like India, their development plans may be assumed to include expressions of social desirability. The objectives stated therein may be considered as overriding aims for systems designing. This premise avoids violation of, or non-conformity with, public policy aims, which could cause divergence from socially desired allocation of resources. We do not construe that exchange of information in two-way streams is not desirable, simply that a national planning process is assumed to have considered society's views. Nevertheless, the appraisal may be supplemented by analyses with different policy assumptions to highlight the costs of pursuing given aims. While social objectives are the guide lines for the systems designer, he should be able to argue for changes, if necessary, so that the appraisal contributes towards refining the objectives and loosening the constraints.

It is not practicable to use resources so as to maximise the net value of output, among other reasons, for maintaining a desired balance between demand and supply of different products. Likewise, it is technically inconceivable to accept all options simultaneously to the point of maximum 'profitability'. Since the appraisal is for the choice of use combinations, options need to be compared for their contribution to society's objectives rather than mere absolute assessments of whether an action generates more social gains than losses. The emphasis, therefore, will be on evaluating options ordinally to gauge their relative merits.[1] If the constraints and assumptions are applied consistently across the system and the relative positions of options brought out appropriately, their cardinal values do not acquire crucial

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[1] The relevance of relative versus absolute merits of options will be further discussed in section 4.

importance in systems designing. Information about the magnitude of total gains to society from alternatives is useful, but not sufficient. In the main, the scope of appraisal covers the evaluation of the relative, and not just the absolute, socio-economic merits of options.

3. Social Investment Analysis.

1. Social benefit-cost analysis. A social benefit-cost analysis is the relevant technique for socio-economic investment analysis (c.f. appendix 6). It is a socially oriented adaptation of the traditional cost-benefit analyses, so far applied to systems other than the one under investigation and mostly in developed economies. For applying the technique to the evaluation of renewable resource-uses, particularly in developing economies, considerable conceptual reformulation is required. This will be sketched in the remaining sections of this chapter.

Sargent (1969) comments on the traditional cost-benefit analysis that 'it is a misuse of this method to prove that a certain dam should be built when alternative methods have not been considered'. Such a limitation, among others of the traditional analysis (c.f. sub-section V iii, appendix 6), can be overcome by bringing the full range of choice within the fold of appraisal. Hence, the need for exploring the options and their ex-ante appraisal, stressed in section 2 earlier. The next section analyses the place of various evaluation criteria in societies aiming at development with limited resources. Externalities and other causes of erroneous counting of project consequences are discussed in sections 5 and 6. The extra-market consequences will be dealt with in section 7. Sections 8 and 9 are devoted to the evaluation of consequences from society's view-point.

ii. Data and quantification. Despite the attempt to meet the weaknesses of traditional cost-benefit analysis, we cannot claim that the measurement of costs and benefits in our analysis leaves no room for improvement. A conceptually suitable refinement cannot eliminate inaccuracies of basic data in the published statistics and other sources of technical information, such as the topographical maps used in identifying options. But, this is a limitation of any appraisal. The difference is that many inaccuracies do not remain masked in our method because of the need to balance all the costs and benefits. Besides indicating the future lines of research for data improvement, important errors and omissions, which would otherwise be overlooked, are rectified during the analytical process. The necessity of quantifying makes the analysis worthwhile 'because of its stimulating effects in expanding scientific understanding of the physical as well as social problems' (Wantrup, 1965).

The improvement of the basic data and the quantification of consequences could be carried out to near perfection. This depends on purpose, time and resources. The aim of our analysis is to present a mode of moving from the present use of renewable resources for helping economic development, instead of pursuing an idealised future. Its postponement for want of time and resources, would defer the advantages of the analysis in that the lack of guidance for conscious decision-making would continue. By refining the available basic information for use in the analysis, we have attempted to resolve the dilemma that 'poor measurements and analysis unfailingly contribute to erroneous conclusions, but high-quality measurement and analysis are extraordinarily difficult to come by' (Barnett, 1966).

iii. Role of the analysis. Since public decision-making is essentially political (section V. v, appendix 6), resource allocation could be left to the political process. But politics are a sum-total of the social, cultural, institutional as well as the economic features of society. If system-designing considers all these features decision-making can be rationalised to avert misallocation likely from random behaviour. The issue is not that benefit-cost analysis is unnecessary but that it needs to be supplemented by analyses of dimensions other than costs and benefits (c.f. sub-section V. iv, appendix 6). The limitation of the analysis is that it is inadequate for handling multiple criteria and multi-product problems as considered here (Leslie, 1967).

Political process may trade-off some economic rationale for other reasons. Lest it does not frustrate developmental aims, it should have access to objective information of social costs and benefits, so that limits and scope of the trade-off are made explicit. Such information helps to gauge the arguments of pressure groups and agencies for favoured options. It avoids dominance by faulty but vociferous reasoning, as is not uncommon in developing countries. The analysis is useful because 'political choices can be aided by quantifying costs and benefits' (Herfindahl,1969).

We recognize that benefit-cost analysis cannot directly lead to choice, only that it is an essential component of the social decision-framework. This thesis makes a departure from the manner in which benefit-cost analyses have been applied; we do not rely solely on it to reach the socially most desirable design for Kashmir's renewable resources. The need to go beyond investment analysis arises from the

interdependence of decisions (c.f. section II, appendix 11). This has to be considered before choosing one or the other option.

4. Ranking Criteria

i. The criteria. Present social worth is a criterion for benefit-cost ranking of options. It measures the difference between the present social values of benefits and costs.[1] Another criterion is the internal rate of return. At this rate, the present worth equals zero. Benefit-cost ratio is another criterion; a project is considered admissible if the present value of benefits divided by that of the costs exceeds unity. An algebraically equivalent version is if the ratio of the present worth to the present value of costs exceeds zero. A fourth is the constant annuity criterion. It accepts projects if a constant annuity with the same present value as benefits exceeds a constant annuity with the present value as costs (Jensen, 1969).

ii. Constant annuity. This criterion is ineffective in considering the timing of consequences. Reducing heterogenous time profiles of benefit-cost flows to a constant annuity defeats the purpose of discounting (c.f. sections III. iv and III. vii of appendix 6). The options with discontinuous investment schedules and unlike gestation lags cannot be ranked commensurably by this criterion.

iii. Present Social worth. Hirschleifer (1958), Flemming and Feldstein (1964), and Dryden (1964) advocate the present worth (PSW) criterion for its infallibility in choosing an option with the maximum net present value. The object of

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[1] Henceforth, the prefix 'social' may not appear in the text, but it continues to be implied unless otherwise stated.

analysis is to rank the relative merits since absolute maximisation is unhelpful in systems designing (c.f. last paragraph of subsection 2.iii). Nor is the analysis capable of choosing options (c.f. section 3.iii). Restricted resource availability and other constraints to attain the maximum can cause divergence from marginal efficiency and lead to misallocation (c.f. section 4, Chapt VI). PSW does not reflect the marginal cost associated with the excess of benefits over costs; options with equal surpluses appear equally desirable though the costs of one might be higher. This could be unimportant only if the relative costs are no object.

The main emphasis among the impediments to development in India is placed on the scarcity of capital - in contrast to most other developing countries (Streeten, 1968)[1]. With resource scarcity, costs should be incurred to maximise overall net benefits and not just in a single or few large projects to the exclusion of others. The right measure, then, is of efficiency, with which scales of options do not distort ranking. If mutual exclusiveness is not involved, efficiency leads also to the maximisation of net benefits for given investible resources. These aspects are elucidated in subsection v infra.

iv. Internal rate of return. The internal rate of return (IRR) is an efficiency measure; Solomon (1956) reasons that the 'rate of return'[2] is a more useful criterion than PSW and that it 'will lead to a maximization of...present worth'.

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1. Beazley (1965) also singles out India among the few developing countries where the 'developmental needs are mainly capital and technical expertise'.

2. 'Rate of return' is synonymous to IRR in the U.S. capital budgeting literature.

Merrett and Sykes (1966) 'strongly' favour it over PSW 'on operational grounds'. It has been recommended for the U.S. national forestry planning (Marty et al., 1966) and applied by Gunter and Rudolph (1968). Termed as 'financial yield' of plantations, Hiley (1956) advocates it as the 'clearest expression' of 'the relative profitableness'. Bhalla and Svanqvist (1968) commend IRR as 'the best measure' for evaluation and ranking of options.

The IRR conceives a growth of capital which only takes place if at the beginning of each period the capital and the interest from previous period are reinvested (Hirschleifer, 1958). It cannot provide the so-called internal measure of time productivity of investment, unless the reinvestment rate equals the rate of return. If IRR 'is maximized, then it is the internal rate which should be used in compounding outlays or discounting productivities' (Boulding, 1955). This implies either an indefinite expansion of the original project or that nothing exists to prevent reinvestment at the given rate. For this reason, it is a 'stalinist maximand' (Turvey, 1963); time preference is irrelevant and there is no choice of consumption at different points of time.

A difficulty, mostly in the natural resource sector, arises when no unique IRR exists. An alternative to gradual conversion of forest land is intensive mechanised extraction. It involves initial outlay on logging facilities, subsequent net incremental returns from more timber extraction, and final net incremental costs because of the earlier exhaustion of timber. This is illustrated by net benefit streams of -1, +5 and -6 at one year intervals or of -1600, +10,000 and -10,000. Either equals zero twice - at 100 and 200 per cent and at 25 and 400 per cent respectively. A project with income flows at ten year intervals of -25, +112.25,

-165.96 and +80.78 would yield ambiguous results, for the present value equals zero at 2, 4, and 6 per cent. A forest could have three rates on the analogy of net present values from beginning to end of -1 (maintenance cost), +6 (felling revenue), -11 (regeneration, establishment and maintenance costs), +6 (felling revenue).

Lorie and Savage (1955) suggest 'that the relevant rate of return is the one at which the investment is a decreasing function of the rate of interest.' This by-passes the above anomalies but involves arbitrariness about the latter. The ranking can no longer reflect the so-called 'internal ' measure or the marginal efficiency for the appropriate cost of capital. They, therefore, hasten to conclude that under certain conditions, 'the rate-of-return does not result in maximizing' (ibid). Arrow and Levahari (1969) show that a unique IRR exists for the truncated period of a project. This is if truncation is chosen so that with a constant discount rate the present value of the project is maximised. Such a condition does not make helpful reliance on the IRR criterion by itself.

Another difficulty is that no IRR may exist at all. This arises from consistently positive or negative net benefits, so that the PSW curve does not intercept the abscissa at any discount rate. Examples are the subsistence farming and sustained yield forestry.

Johnston et al (1967) point out that IRR conditions the timing of forest fellings through the effect of past costs (which are irrelevant), ignoring that thinnings enable larger value increments. The deficiency is that revenue and cost increments are not balanced. Another reason against IRR is its inability to reckon with a discount rate changing over time; the internal productivity is uniquely defined over time and independent of an exogenous rate.

v. Social benefit : cost ratio. The benefit:cost ratio (B/C) suffers from none of the above deficiencies . It'may be calculated in any situation, no matter what the objects of analysis '(Linnard and Gane, 1968). Among the few recent examples of its use are by Gillhepsy (1968), Gisser (1968) and Rao (1968).

Sinden (1966) rejects this criterion suggested by the Australian Commonwealth Treasury (1966). He claims that IRR is superior, because 'it shows what the forest actually earns and so what interest it can afford to pay'. Gane (1969, p.29) similarly writes that IRR 'is apparently preferable to a ratio because it avoids making an arbitrary choice of discount rate'. But the fact that IRR calculation does not require discount rate, does not circumvent the need to know the appropriate rate. A cut-off rate is required to ensure that a project selected on the IRR basis of 'what interest rate it can afford to pay' falls also within the limits of admissibility.

McKean's (1965, p.76) 'counsel of perfection: maximising present wealth' opposes the B/C criterion. Steiner (1959) says that 'efficiency seems the sensible criterion', but maximizing the ratio can lead to 'foolish solutions'. Prest and Turvey (1966) state that an 'error' may arise from the use of B/C. These remarks apply to the direct choice of mutually exclusive options. A project with higher ratio may not use all the allocated resources as against an incompatible option, of which the ratio is lower but extra benefits exceed extra costs, i.e., B/C may preclude an option with larger net benefits. But this is begging the question; systems designing is to find an optimal combination of options instead of premising about their scales in advance.

We will compute ratios such that conceptually all the options are compatible. Unlike the usual practice, such evaluation will not be used for direct acceptance or rejection comparisons, so that the question of mutual exclusivity need not arise. Instead, system's ranking is guided by changes in efficiency, interalia from varying the scales as well as combinations of options. The ratio is applied not for independent comparisons but for selecting a pattern of most productive resource use. This procedure is, in effect, of maximisation but reversed to do so without sacrificing efficiency within the limits set by various constraints, including incompatibility. This subject is further discussed in sub-section V. e, appendix 11.

The problem of mutual exclusivity does not disappear by using an absolute measure. In the absence of predetermined scale of options, efficiency measure is valid for comparing the relative effectiveness of resource uses. Even if the procedure for dealing with incompatability were not adopted and net benefits not maximised, the ratio remains more useful for analyses in resource-poor countries. (c.f. appendix 1, Feasibility of Study, Paragraph 6). That this criterion may pre-empt a site in favour of a smaller but more efficient project is not undesirable when resources in the overall context are scarce. If it does not lead to the use of all land, because to do so is less efficient, that is economically better use of the land. In both, investment resources become available for reallocation to more efficient opportunities either in the system, or elsewhere in the economy. By choosing options that may have lower net present value, the ratio aims to maximise the PSW of total investment resources. This argument fails if resources are so abundant that the problem is not of maximising benefits

to society with limited resources but that resources cannot be used except either for large or for small projects. Such a situation, warranting employment of resources on a particular project for maximum absolute benefit, does not exist in Kashmir. Nor are there mutually exclusive options of extreme sizes in the renewable resource sector.

The following two separate statements of the Subcommittee on Evaluation Standards (1958) clear the position.

> 'The most effective use of economic resources required for a project is made if they are utilized in such a way that the amount by which benefits exceed costs is at a maximum rather than in such a way as to produce a maximum benefit-cost ratio' (p.5).

> 'The ratio of benefits to costs...is the recommended basis for comparison of projects...(It) constitutes a useful measure of the effectiveness of use of the Nation's resources insofar as the use of such resources for project purposes is concerned' (p.16).

Contrary to what Gane (1969, p.25) thinks, the first statement is not against the relevance of ratio as a ranking criterion. It rests on the assumption that 'resources required for a project' are somehow anticipated. Apart from the danger that the scale or the strategy of investment may not have been determined optimally, this statement is not addressed to the problem of choice among inter- and intra- sectoral options. The second statement only assumes that resources for development over and above those accounted for in project consequences would be used equally effectively with or without the project, so that comparative evaluations via the ratio are placed on equal footing. We have no substance to deny this.

We conclude that benefit:cost ratio is apposite to the comparison of options involved in, and for, systems designing; a direct measure of the absolute net benefits is valid for individual project planning, once an optimal

systems design and concomitant resource requirements are determined.

5. Social Benefits and Costs

i. Project consequences. The consequences of an action are its costs and benefits. The subcommittee on Evaluation Standards (1958, p.8) identifies 'project' and 'associated' costs, and 'primary' and 'secondary' benefits. Eckstein (1961, p.51) calls the latter as 'indirect' benefits. The United Nations (1958) recognize 'primary' and 'secondary' costs and benefits, and distinguish between 'direct' and 'associated' primary costs. Some separate 'indirect' benefits into 'stemming' and 'induced' and extend evaluation to so-called 'tertiary' benefits. Regan and Weitzell (1947) include all the effects of soil and water conservation among the 'direct attributes'. Khattak (1968) counts only those as 'direct benefits' which can be 'measured in physical terms', viz., increases in crop production and employment opportunities. He excludes protection benefits and improvement of soil and other resources. Such definitions cause subjective inclusion or exclusion of consequences.

ii. With and Without Principle. The consequences of an action can be objectively identified by 'with and without' principle, i.e., resources drawn from the economy, and the goods and services that flow to the economy are the relevant costs and benefits. This principle allows a contrast to be made between development of the economy which would occur with a project and that without it. It avoids the possibility of counting consequences which arise not from a project but from other causes such as the passage of time. All the five cost-benefit analyses done in India suffer from the latter deficiency, which needs to be avoided (c.f. subsection V. ii, appendix 6).

iii. Multiple counting of benefits. Multiple counting occurs by including benefits subsidiary to those attributable to an option. Consider the production of wheat. The increased incomes of bakers and intermediaries involve additional capital, processing and other costs. Counting all the income additions is tantamount to a value-added approach, which does not indicate the net gain to society (c.f. subsection III. vi, appendix 6). The additional incomes of bakers and others may be at the cost of their counterparts', so that they over-represent benefits to the economy. By including the income additions of the producers as well as the processors and labour, many costs get treated as benefits, viz., the costs of flour to bakery, wheat to flour mill and farm inputs to producer. The subsidiary activities may be possible without the project, by importing wheat or by producing it alternatively or by substituting it with another material; society loses only the project's output stream. Therefore, the inclusion of all the incomes is erroneous.

Over-counting occurs by including both the increased output and the enhanced value of a renewable resource. Total land supply being 'inelastic', the land value is derived from the product. Only the value of the increased output is relevant, because the increased land value is due to capitalization of the output stream. Both the increases are not simultaneously realizable. We will count among benefits the 'products' of an action which accrue to the economy, and not the isolated changes in values or gains.

iv. Multiple counting of costs. Costs may be exaggerated in the above two ways and one more. NCAER (1968) include among the indirect damages of floods 'the value added of crops lost' including the revenue to transporters equivalent to freight charges for the quantity of crops lost. This

is erroneous because the value of crops lost, of damage to capital inventories and infrastructure, and of interruptions in transport services are counted among direct costs. Comparing the present dry farming practice with soil conservation options, Muthoo (1966) attributes costs to the former in terms of the degradation of land and the increasingly lower output. Such double counting of decreases in values inflates the relative merits of the alternatives.

Costs are obverse of benefits. They should represent the value of economic resources actually employed regardless of lower or higher benefits, which are separately accounted for. Likewise, no historical costs need be counted. The cost of terracing, if already done, is irrelevant because it is a sunk cost and only the maintenance and replacement costs are effective in the future.

v. Consistent evaluation. Literature seems to have ignored the need for consistency in computing project consequences, without which grave errors can arise (c.f. appendix 18). This is because different methods yield different evaluations of options and this leaves open the possibility of distorting the results. Consider the usual practice of computing annual benefits net of operating, maintenance and replacement costs (Marglin, 1962); i.e., the practice of relating the present value of all net benefits to capital costs (Henderson, 1968). It does not represent the actual costs and benefits through the course of action. Such practice implies that no costs occur after initial outlay. The idea may be that the latter is the only constraint in implementing a project and, once started, the recurring costs are met from recurring benefits. But actions once taken are neither necessarily 'self-financing' nor independent of other actions.

An option may have more costs than benefits at any time during operation. To measure the consequences in the economy, an action has to be considered not in isolation but as part of a system, contributing to or deriving from society's resources through its course. The comparison of costs and benefits in their unaltered magnitudes is, therefore, recommended.

Some output of a process may be its input, e.g. the seed from an earlier crop, part of a timber harvest for fencing for regeneration, and farm-yard manure for subsequent fodder output. Such products may be treated either as no costs and deducted from previous benefits or as costs without the deduction. We favour the latter for all the options to ensure uniformity in evaluation and to avoid erroneous ranking. This procedure rejects the common practice of assigning no costs and no benefits to the produce that subsistence farmers use themselves. The additions of the value of the produce on cost and benefit sides, though identical, may properly alter mutual ranking. It also enables commensurate comparisons with options, all or part of the produce of which is marketed or is of different kind and value. Such procedure allows for contingencies like the producers selling their produce and later buying. It is desirable from social accounting viewpoint too.

Leslie (1967) considers material production as direct benefits and all other consequences as indirect benefits. He discounts these differently at 5.5 per cent and 3 per cent respectively. But non-market benefits are fully equivalent to market benefits (c.f. subsection 7). The inconsistency will be avoided by uniformly discounting all consequences of an action (c.f. section 9).

Woudt's (1968) enumeration among the 'direct benefits' of land consolidation both the 'increases' in production and the 'reductions' in water and labour requirements amounts to counting inputs on benefit side. Blaug's (1968) plea to include earnings foregone by students is a converse example; reduced benefits of the income content are transferred to cost side but these are reflected in the smaller magnitude of benefits, so that adding the incomes foregone exaggerate the costs. Such inconsistency, arising from interchangeable treatment of costs and benefits, can be avoided by counting costs and benefits, whether reduced or increased, on cost and benefit sides respectively without any manipulation.

6. Joint Costs, Welfare and Spillovers.

1. Joint costs. The foregoing discussion may be questioned on three counts. One is the joint costs and benefits of different projects. An alternative to minor irrigation is a two-purpose dam. A consistent comparison is theoretically possible by allocating the latter's joint-costs to the irrigation and the power benefits 'by means of some formula' (McKean, 1965, p.45). The costs are divisible to the extent these would not be incurred without power generation or, conversely, without irrigation benefits. The apportionment of the remaining costs, such as for most of the upstream works and reservoirs, can only be arbitrary and approximate. Even if it is 'somehow' done for a particular option, how can consistency be ensured in assigning component costs when faced with numerous and diverse options, as in multiple land use? Gregory's (1955) 'multiple product analysis' of joint recreation and timber production benefits is unhelpful for ex-ante evaluation. It can be applied only when the levels of different products are known. Even so, inconsistency arises from the value judgments about the trade-offs between

the products and about the extent of different uses considered desirable in the mix. This is because the recreation value can be derived from the marginal rate of substitution between timber and recreation only for a particular combination.

Such inconsistency is avoidable by applying the 'with and without' principle (subsection 5.ii). In the first example, ranking will be done for three (or more) conceptual options, viz., minor irrigation, major irrigation, and major irrigation-cum-power. All the consequences will be counted for each option without aribtrary apportioning. In the second example, the options are of timber production, recreational use or timber-cum-recreation. The last named may include different mixes. Ranking will be done between and among the former two and any number of the latter options. Each kind and level of joint-production is objectively appraised as separate options.

ii. Distribution of costs and benefits. The second question is about who the cost bearers and beneficiaries are and how they are affected. An option may reduce the immediate income, even if the long term income is larger, or may alter the costs to those affected. These effects are not evaluated, being income transfers within the system. The income changes, whether from changes in technology or prices that affect a particular group, are redistributional. Nevertheless, the size of immediate income/output and the redistributional effects are important for decision-making. These aspects are discussed in subsections V.iv and V.v of appendix 6 and in Chapter VI.

iii. Externalities and spillovers. The third question is about the 'uncompensated influences' (Meade, 1952) or 'side-effects' (Turvey, 1966) of an action exerted outside the market mechanism. Such external effects are not taken account of, being relationships other than between buyers and sellers or involving common property resources, such as air and water in cycle. An example is the reduced water availability and the consequent effect on incomes felt by farmers in South Africa and ascribed to the establishment of plantations by companies (Interdepartmental Committee, 1968). Such spillovers need counting among consequences attributable to an action.

The identification of relevant spillovers may be guided by the distinction that 'technological spillovers affect the physical output that can be obtained from other producers' physical inputs while pecuniary spillovers do not' (McKean, 1965 pp. 134-150). The latter are occasioned by price shifts. Such 'extended effects' are either 'offset by others' or 'are not valid' (Regan and Weitzell, 1947), and 'price changes of goods and factors should be ignored' (Prest and Turvey, 1966). Prime changes causing income transfer effects may be disregarded when the concern is to count those effects which make a difference to the output in the economy. Nonetheless, 'pecuniary spillovers' too will be considered later for the same reasons as for income changes over time and among people (c.f. subsection ii supra), which may affect effective demand and welfare.

Besides analysing related policy issues, such as controls and compensations, various approaches to take account of external effects (Davis and Whinston, 1962; Turvey, 1962) are confined to 'partial equilibrium analysis' (Mishan, 1965). But externalities are not isolated relationships

between a producer and an affected party. They are effects that permeate the economy. Boulding (1966) observes that some, though ignored because of 'small personal incidence', can be large in magnitude with lasting and ever-accumulating content. The broader interrelationships and adjustments in the economy that ensue from spillovers need to be analysed. Ayres and Kneese (1969) attempt to consider the diseconomies of residual disposal in relation to the general equilibrium model. However, this implies knowledge of all preference and production functions, external costs, and factor and process substitutions. This attempt fails to recognize that the marginal disutility to those affected by an external diseconomy, such as pollution, may not be constant; usually it will be increasing, so that in optimizing externalities the individual preferences of the polluters and cost-bearers have to be considered for both the rates of increase or decrease and the quantity of an externality.

Externalities that appear at certain threshold values, such as air and water pollution, are 'exceptional cases for less developed economies' (ibid). The problem is further simplified in this thesis by treating the renewable resource system co-extensively within the entire region. This is ensured also by designing the system through the simultaneous consideration of the resource bundle, instead of isolated, ceteris paribus, analysis of individual units.[1] The diseconomies or economies of one area or unit of activity,

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1. This is a reason against decomposing the total problem for the advantage of reducing its immensity instead of considering it as a whole, as we have in Chapter VII.

both in spatial and socio-economic terms, enter as costs or benefits elsewhere in the system, so that in the overall context all the relevant effects are captured. Conceptually, the externalities have been internalized and/may be likened to transfers within the system during resource use adjustment.[1]

Such an integrated decision framework obviates the possibility of under- or over -counting of external consequences, which may get ignored or distorted in partial or decentralised analyses. Scitovsky (1963) reaches a parallel conclusion with 'especial force to underdeveloped countries', advocating 'centralized investment planning' to ensure proper coordination. This is similar to Rosenstein-Rodan's (1963) solution of planning 'like one huge firm or trust' to offset 'Pigovian divergence between "private and social marginal net product"'.

7. Unit of Measure and Non-marketables

i. The money measure. One reason for the ad-hoc selection of priorities in Kashmir stems from the use of unrelated measurement units for appraising investment programmes (c.f. section 3, chapter 7). Uniformity in quantifying costs and benefits is axiomatic for comparison of options. The yardstick of money may be adopted for this purpose. However, it does not entirely remove the above defect; certain 'intangible' or non-marketable consequences cannot be adequately brought into relation with money measure.

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1. This does not dispense with the need to evaluate effects, like in situ soil erosion, which are generally ignored by a producer. This will be considered in subsection 7. iv.

The provision of non-market benefits, though elusive to our yardstick, is equivalent to market-oriented products. The partial 'test of accessibility to a money measure' (Pigou, 1932) camouflages consequences which may add to or override market merits. There may seem little reason in adopting money as the principal denominator. Scherer (1967) proposes a 'time-cost' measure for research and development benefits, because it is impossible to translate into dollar terms 'the prestige value of being the first to land a man on the moon'. However, his proposal is subjective in trading-off time and cost, for the objective itself cannot be evaluated (c.f. subsection IV. vi, appendix 6). The class of intangibles persists because some consequences continue to defy a chosen convention of quantification. A substitute for the money measure would be less applicable as a common denominator to inter-programme systems, such as renewable resources beset with the complexity of multiple use (Muthoo, 1968).

It appears that 'although a given sum of money may have different intrinsic values to different individuals, money still is the best common denominator between individuals' (Clawson, 1968). However, either through reference to money or directly, need exists for the appropriate conversion from one non-monetary unit to another to avoid subjective valuations like $1 per acre for damage to wildlife as well as soil and water values (Lindermuth et al, 1961). Burton and Wibberley (1965) employ 'user expenditure method' to calculate the value of recreation service. They equate the non-market benefit to the costs of travel in search of recreation experience less maintenance expenditure of the area. Clawson and Knetsch (1966) define 'user benefit' as the total area under the demand curve relating quantity

of recreational use and willingness to pay. This concept, using travel costs to reflect the willingness with refinements for 'net consumer surplus', has been applied by Wennergen (1967).

The above methods have 'rough spots' (Knetsch and Davis, 1966), mainly because of the considerable inseparability of the concepts of 'opportunity' and 'experience'. Such methods are inapplicable to non-marketables which do not involve 'experience'. Nor do they apply to non-monetized economies with unavailable figures for user expenditure or consumer surplus; indirect evaluation is unhelpful because no market demand may exist for a related activity

ii. Environment and outdoor recreation. One non-market consequence of an action is the effect on environment. Mishan (1967) highlights its relation with social amenity and questions the value to a wealthy society of economic growth and industrialism at the cost of quality of life. There seems an apparent conflict between economics and 'conservation', requiring that amenity be considered in economic evaluations 'to avert the onslaught on quality' (c.f. appendix 3). However, in backward areas like Kashmir, the pressure on environmental quality is far from intolerable. There 'the most urgent resource problems today remain those of scarcity' (Jarrett, 1966).

Renewable resource environmental effects are manifest in outdoor recreational facilities, wildlife and wilderness areas, landscape, air and water; of these pollution is the most seriously considered effect in industrialized countries. The nonemarket products of recreation and amenity, and the cleanliness of air and water in Kashmir have not assumed a role as economic resources owing to relative abundance.

That is, they do not have a scarcity value, though they do indirectly contribute to the economy, e.g., through tourism.[1]

There is no imminent danger of industrial and urban spillovers in Kashmir. Yet a monetary measure is not satisfactory in principle if the above assumption about the degree of pressure on environmental quality may not hold in the future. But, in practice, such an unforeseen change in Kashmir's economy would not thwart the appraisals because no option considered in this thesis is such that it may infringe on quality, if not enhance it. Also, some resorts, e.g., Pahalgam and Gulmarg, managed specifically for amenity and tourism (Muthoo, 1968) will not be considered for a change in resource use pattern. The same is true for the sanctuaries and wildlife reserves, e.g., Shankaracharya park and Dachigam near the capital city, which are touristic spots popular for their location and scenery. Nonetheless, money measure is inadequate for quantifying wildlife, erosion and stream-flow, rural depopulation and employment effects of renewable resource uses.

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1. A 'free good' is one which all persons wishing to use it can as much as they wish - i.e. use it in such quantities that its marginal utility or the net value of its marginal product to them is zero - without exhausting the supply. In this, a process of competitive bidding for the good by all potential users, expressing their demand for it, would result in its having a zero price, since the total supply would equal or exceed all demands at a zero price. Besides air, water at source too qualifies as a free good. Since delivered water even in the water abounding Kashmir (c.f. the first footnote to subsection iv infra) costs for capturing, transporting and distributing, the effective demand is reduced but still does not raise the price above zero. A 'corollary of the existence of a zero price for water at source would be that it had no opportunity cost' (Bain et al, 1966) (c.f. subsections i and ii, section 8). This being true for Kashmir, water like land does not call for opportunity-cost pricing (c.f. subsection viii, section 8). In appraisal, only the costs of development of water (or land) for say irrigation have to be considered for pricing this input. This will be considered in subsection vi, section 8.

iii. Wildlife. There are 241 square miles under sanctuaries and game reserves in Kashmir (Muthoo and Khushoo, 1966, p.48). These are excluded from the system analysis. The problem of measuring the effects of increasing or decreasing this area, do not arise thus. This is because the extent of the area is a constraint. The area, by current international standards, suffices for the demand projected for 2000 AD, being over 4 and 7 per cent respectively of Kashmir's geographical and forest areas as compared with a forest area percentage of 2 in India and 4 in the United States (Gee, 1964; Wani, 1964).

Kashmir harbours no lions, tigers, rhinos or other sought-after species found elsewhere in India. There is little likelihood of a spurt in demand from the affluent foreign tourists for Kashmir's temperate fauna which offer little uniqueness to them. While there is no apparent reason to extend the existing wildlife reserves, legislation in force since 1942 (J & K Govt., 1958), publicly reinforced in 1955 and reiterated ever since, prohibits their diversion to other uses.[1] Thus the area is better dealt with separately; the achievement of aims for which it has been reserved can be appraised by a cost-effectiveness analysis (c.f. appendix 6, subsection IV.vi) being more applicable than a benefit-cost analysis to 'public expenditures in which the efficiency content is insignificant and the efficiency impacts are largely nonmeasurable' (Haveman, 1967).

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1. Though past decisions should not restrict the future possibilities (Margolis, 1959), the consistent decision of the government to keep the reserves is tantamount to an implicit evaluation by society. An example of such 'precedential evaluation' (Hughes, 1965) is the conclusion that since the Netherlands' government is continually backed by people for land reclamation even though its costs are twice the net income from commercial farming, society values the programme such that the appropriate discount rate is one half the market rate (International Institute for Land Reclamation, 1960).

iv. Watershed protection and erosion. Each renewable resource use has an effect on erosion and streamflow. These effects are complex, occurring conjointly with other consequences affecting the productivity of a renewable resource.[1] In appendix 14, we have proposed a method for reflecting these non-market effects in the efficiency ranking of options. These effects will be evaluated for the various degrees of protection corresponding to erosion classes for Kashmir (c.f. chapter 4), so that the benefit:cost ratios for options will represent both the components of market and non-market benefits and costs.

v. Rural depopulation and employment. Depopulation is not a problem in populous backward countries. The current trend and conceivable resource use adjustments in Kashmir in the near future will not cause depopulation in the countryside. Urban populations in most developing countries are increasing fast, reducing the quality of life in cities. But rural populations are also expanding, causing increased un - and under - employment in areas where most people live. These consequences deserve attention.

A value could be attached to a job opportunity. But, this will inflate the benefits of employment because its contribution is included among the value of output computed on the benefit side. Double counting becomes serious if a

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1. Water regulatory effect is incidental to erosion control and the two may be treated together. We will do so under soil erosion, because it can be studied within the sphere of our system whereas water regulation can be effected at other points too, such as in the main river system. Our treatment does not explicitly consider the effect of different resource uses and concomitant erosion practices on total discharge. This is unimportant, because water availability throughout the year, both locally and regionally, has not and is not likely to be a limiting factor in Kashmir (Khan, 1961, Engineering Subcommittee,1964) in the foreseeable future. There, effective droughts are unrecorded and renewable resource production suffers from overabundance of water, if at all (Stein, 1961, pp.410-426 Irrigation Department, 1959), so that only the evening out of the flow is important. This too, like 'most problems of water shortage, poor water or floods traces back directly to land' (Sauer, 1960).

man-day cost is scaled-down to reflect under - or un - employment, as we will do (c.f. subsection 8. vii). The use of social prices of labour credits a project in proportion to its employment potential and further valuation is unwarranted.

Nevertheless, the provision of employment per se is considered important in underemployed economies. Employment for its own sake is a social problem and need not distort the efficiency ranking of options (c.f. subsection IV.v, appendix 6). The economic merits of options reflect regional variations if evaluations are based on social prices relevant to each region. The aspect of the social merits of job creation will be considered in chapter VI.

8. Social Pricing and Linkages

i. Private opportunity cost. Pricing by the value of a resource in the best alternative foregone ensures profit maximisation, for it assigns a value equal to what is sacrificed to have the use of a factor, i.e., the opportunity cost. The sacrifice in the private sector is usually measurable by the market price of the services of a factor; the opportunity cost equals the price payable by the entrepreneur. The sacrifice is involved whether one owns the factor and does not pay for its use, for factors have alternative use. Only when alternatives do not exist, the opportunity cost is nil, e.g., for land usable only in a given manner and which cannot be sold or hired out. The opportunity cost of using resources is what is currently foregone by using them.[1]

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1. The emphasis on currently is in accord with the point about historical costs made in subsection 5.iv.

ii. Social opportunity cost. The above logic applies to society, although it does not borrow and lend, or buy and sell, from and to itself.[1] The social opportunity cost of using resources alternatively may not be reflected by market prices for reasons given in Section 2, appendix 8. Private and social opportunity costs differ. The former measure the values in alternatives available solely to an enterprise, instead of to society. The private and social 'opportunity benefits' also diverge. The former represents the benefits that a firm could obtain by selling, lending or hiring its resources, even if they be only income transfer benefits; the latter includes benefits obtainable through investment and consumption in the economy.

As discussed in the footnote to subsection 7.2, resources have economic value only when they are scarce. The economic cost of using a scarce resource in a particular way is the sacrifice involved in diverting it from other uses. This cost is measured by what the resource can earn in its next best use. If a resource has no alternative opportunities for employment, it has no social opportunity cost; society sacrifices nothing from its employment in the single possible use. But as long as alternatives exist, a social cost is involved in using a resource; the cost is represented by its value in the next best use. If renewable resource capital is not earning at least as much it could earn in its next best alternative and whether the investor is private or public, society as a whole suffers from a misallocation of economic resources. The aim of using social prices representing the social opportunity cost of resources in Kashmir is to avoid the misallocation as well

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1. Theoretically, the possibility to invest in a foreign country's securities may be comparable to a firm's option to lend.

as to evaluate the opportunity cost of using land less than most productively.

iii. Linkage effects. Divergences between private and social opportunity costs may arise from linkage-effects, which the former ignores.[1] Hirschman (1966, pp. 76-119) argues for considering the interrelatedness of different actions. The criteria suggested by him are 'those that will permit us to judge new ventures, products and processes in terms of their probable contribution to [inducement and] "self inducement"' (ibid, p.140).[2] Such approach forces one to consider the economic system as a whole. It involves identification and evaluation of intersectoral projects and strategies of development. Its application as a criterion at intra-sectoral level is difficult, because systems designers do not have an overview of the economy. But the idea is important that a project may influence economic development by inducing other actions. Renewable resource

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1. Linkages are the economic relationships between different economic activities. The market mechanism does not allow for all the relationships between the institutions, organisations and individuals comprising the economic system. The prevailing prices of factors and products therefore, do not reflect the consequences in the economy of the linkages associated with different actions. This occurs also for the external consequences of an action which are considered irrelevant to an enterprise. In so far as they represent technological externalities, the problem of pricing does not arise because we have considered the entire system over which they would be manifest. This aspect and of the pecuniary economies and diseconomies causing income transfer effects have been dealt with in subsections ii and iii of section 6, and subsection 5. iii.

2. The main argument underlying linkages helpful to development is the 'inducement mechanisms' associated with different sectors and industries. The merit of a project would be judged in terms of the likelihood that it will induce a series of ventures in the economy. The inducement mechanism involves consideration also of 'self inducement', which concerns the growth of the project and the capacity to sustain it by itself.

production generates forward linkages (Chenery and Clark, 1959). Their evaluation is required, because it cannot be assumed that the nature and magnitude of the linkages among options is identical even if they be in the same direction.

We will incorporate linkage effects in appraisal through the adjustment of prices for such effects. This may be done by relating the production of a commodity with the opportunity it creates in the establishment or expansion of other activities, e.g., manufacturing. Extension of forest working in Kashmir may yield wood enabling the establishment of a pulping industry. Then the evaluation of the extended forest working will be based on raw material prices derived from pulp and not lumber. The efficiency of pulpwood versus conventional wood production options would be compared for their different costs of production and different prices for the same unit of wood.[1] The production of a particular commodity will represent a number of options each with product prices according to end uses, other things remaining equal.[2]

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1. The feasibility studies and a project report for a pulping facility in Kashmir have failed to evoke a decisive response of the government, which nonetheless has been reiterating its desire for the industry since 1959. The main difficulty arises from raw material prices. The government is unable to reconcile that production from Kashmir's fir forests, eminently suited for pulping could be allowed at (money) royality rates lower than what lessees offer for lumber from forests currently in production. The feasibility studies, including the one by the central government consultancy agency (i.e. National Industrial Development Corporation), are based on market prices of pulp. They ignore the linkage effect and consequent social benefit of the integrated system of forestry, logging and manufacturing. None has looked at the option of the entire system vis-a-vis the import of the manufactured good, through which the demand is met. This would be apart from the multiplier and employment effects of the larger system in contrast with the present practice of forestry only. Nor have the consequences of extending systematic working to hitherto unused resources, that the demand by the mill would enable, been considered. The untapped fir forests are putting on little increment owing to lack of silvicultural treatment and it could be argued that in the absence of alternative uses, the resource has no opportunity cost for pulping.

2. Other things need not remain equal in investment analysis. Allowances in costs will be made for the different costs of managing a resource for different products e.g., shorter pulpwood vs. longer railway sleeper rotations.

Alternatives will be explored not only for different commodities and technological processes of production but also for the different effects on the economy of producing a particular commodity, e.g., as a final or an intermediate good. The appraisal will include different costs and benefits for the production of a single commodity. It will involve ranking as separate options for the different links with other industries, production and consumption patterns in the economy possible with different forms of production and uses.

Linkages call for the adjustment of social prices; i.e., the social prices vary according to how and for what a product is produced and used in the economy. This will be possible by following the course of a renewable resource through the economy from its production to end-use stage and by using social opportunity cost prices.

iv. <u>World pricing</u>. In chapter 3, arguments were adduced for orienting resource allocation to the comparative advantage of a region. Evaluation with world prices, i.e. international border prices, as discussed in section 4, appendix 8, can help to achieve this. Apart from other deficiencies of market - and shadow - prices (c.f. sections 2 and 3, appendix 8), the closed-economy assumption of shadow pricing is overcome by producing commodities for their values in the context of regional and extra-regional supply and demand. Thereby technological choice too will be related to international relationships of the proportions and relative costs of factors and prices of products, instead of being constrained to processes feasible from available quantities of resources.

The world prices[1] indicate the relative values of the costs and prices of commodities to society, i.e., the relative social opportunity costs. If a commodity is imported, society foregoes the opportunity of importing other goods and services equivalent in value to the foreign exchange spent on the import, or of using commodities of equivalent foreign exchange value exported in exchange. Obversely, the export of a commodity creates opportunity for using foreign goods and services equivalent in value to the foreign exchange earned from the export.

An adjustment for the cost of transporting a commodity from or to the port is needed to incorporate the relative locational merits of different regions, e.g., the sacrifice by society for importing a commodity is not only the c.i.f. foreign exchange cost but also the transport cost up to the importing region. The appropriate social price for an import

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1. During the later stages of this thesis, Little and Mirrlees' (1969) advocacy of world prices was made known during seminars on project selection at Nuffield College, Oxford. Many participants seemed in agreement on this score. These included Joshi (1969), who had earlier raised some criticism, viz., (i) the use of world prices implies that a country must follow optimum trade policy, which it may not 'due to irrationality, ignorance'; (ii) the criterion is totally insensitive to the rate of foreign exchange; and that (iii) we should guess correctly the list of importables, exportables and non-traded goods, and that the last named can be decomposed into traded goods. The second point is an advantage of this method and need not be held against it; it obviates the need to infer an appropriate shadow exchange rate. The last point may raise practical difficulty in so far as one needs to be conversant with trade statistics and the demand and supply of the country and region in question. This difficulty can usually be met by considering each good on its merit in a particular economy. The first point is, of course, an assumption implying in practice that the selection of projects based on world prices would lead a country away from 'irrationality' in trade and towards optimisation, if it is not so already. That is for good, being in keeping with the argument for comparative advantage.

Elsewhere too it has been recorded that 'the domestic price of an imported commodity should be the world price plus transport costs; similarly the domestic price of an export good should be the export price minus transport cost' (Kaser, 1968). The Czechoslovak reforms of investment rules (c.f. subsection IV. viii, appendix 6) aim to consider a relationship with world prices. The International Institute for Land Reclamation (1960) has also used world prices in an investment evaluation.

is the c.i.f. price plus social cost of domestic transport, and for an export the f.o.b. price less social cost of domestic transport. Difficulties may arise warranting suitable reformulation. But these are not serious and are discussed with special reference to Kashmir in appendix 8 section 4.

v. Traded commodities. The above approach is suitable for tradable commodities, whether or not they are actually traded. Suppose Kashmir is self sufficient in wheat world prices/ are again relevant. The fulfillment of demand does not prevent society from importing other goods and services; that would happen if demand were unmet and wheat imported. The value of wheat is reflected by the foreign exchange saved by producing it domestically; this exemplifies import substitution. Contrarily, if production is surplus, it can be exchanged for goods and services equivalent to the foreign exchange value free on board less transport cost.[1]

Our logic is simple; the production of a commodity, whether for domestic use or for export, is linked with others in the economy. Ultimately, it either hinders or enables importation equivalent in value to the net foreign exchange used, released or earned, respectively, by producing it in insufficient, sufficient or surplus quantities.

vi. Non-traded commodities. The social opportunity cost pricing enables the imputation of value to non-traded commodities. For instance, cattle dung does not enter the

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1. If the surplus production is unsaleable, society must avert waste of resources by curbing production. Planning on the basis of our social prices would ensure this, because the value of such surplus production would be negative - zero world price for the wheat less a positive transport cost.

market and is not priced. Its social price may be deducted from the opportunity that society foregoes by burning it as fuel; i.e., the foreign exchange equivalent of the cost of fertilizer which would not be imported if dung were used as manure. As shown in section 6, appendix 8, from this the 'opportunity benefit' or the social worth of fuelwood production is also evaluated. Conversely, the opportunity cost of dung can be determined from the social price of alternate fuels.

Similarly, the social cost of bullock power is the foreign exchange equivalent of the inputs used for rearing and working the bullocks. The barter exchange or cash purchase prices of bullocks are not relevant, for they represent income transfers within the renewable resource sector and not the costs to society. Likewise, the foreign exchange value of fodder yield per acre of grazing ranges of different qualities is estimated for various grazing intensities and incidence. The value is derived from the saving or earning in foreign exchange made possible through the production of meat, milk, wool and products. The other non-traded commodities, including irrigation inputs, are similarly valued (c.f., appendix 19).

vii. Labour. In places with 'surplus' labour, its 'shadow price' is 'set at almost nil' (Tinbergen,1967, p.157), so that the free market wages represent institutional rates or 'payroll subsidies' (Lefeber, 1968). This is because shadow or 'accounting prices' measure marginal productivity, which is zero for factors that cannot be fully utilized. This is said to make 'economic sense. If a facility is not fully exploited in the most economical scheme, then it is not worth paying anything for its increase' (Vadja, 1961) .

But a zero shadow wage does not reflect the social opportunity cost even if involuntary unemployment exists. Besides medical care and other services, inputs are required to train, house and transport the labour to project site. The overhead and extra consumption costs, for making labour accessible to economy, suggest that labour cost in social terms has a positive magnitude in labour surplus economies too.

The different kinds of labour involve different social costs. The cost to society of using a non-wage subsistence worker is estimated at Rupees (Rs.) 0.26 in foreign exchange. The assumption is that the peasant's produce on which he subsists will not be forcibly taken away from him lest he starves, i.e., there is no alternative possibility to use his consumption, which is already very low (c.f. appendix 7). Hence the opportunity cost of the peasant's existing consumption to society may be regarded as nil; only the extra consumption for converting him into a reference-man-day unit at subsistence level is the effective social cost.[1]

The cost to society of using a wage labour day would be equivalent to the value of goods and services that the labourer spends his wages on. This is estimated at Foreign Exchange (F.E.) Rs. 0.80 for the prevalent wage of Domestic

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1. This corroborates with the finding in Pakistan that 'real wages' have stabilised around subsistence level (Khan, 1967).

(D) Rs. 3.0.[1]

The semi-skilled labour is valued at 26 per cent of the money wages on the same assumption as for the unskilled wage labour. The skilled labour is valued directly from the actual establishment costs in the renewable resource sector. This labour is a small component of the costs in the sector, and the salaries of the different skilled personnel may compensate the likely distortions in the prevailing prices.

The methodology for labour pricing is elucidated in section 5, appendix 8. The prices cannot be claimed to be precise. They are estimates indicating the relative costs to society of using the different kinds of labour. This is to meet the aim of a valuation which is consistent among the various labour categories and with that of other inputs and products, being based on opportunity costs in terms of foreign exchange.

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1. Non-wage labour could be priced at F.E.Rs. 0.26. But in Kashmir's rural sector, 'the overall proportion of hired workers to total number of workers is...3 per cent' (Kamili, 1965). We will allow for the 3 per cent wage labour component and assume a weighted average of F.E.Rs. 0.28 as the social cost per reference-man-day in the peasant proprietorship and livestock farming. The cost of unskilled labour on government run farms and land development projects, including state irrigation schemes, is assumed as F.E.Rs. 0.80 as against F.E.Rs. 0.28 for 'zamindari' khuls or village run minor irrigation channels. This is because the government engages labour for wages and the villagers employ themselves voluntarily on community projects. Forestry workers receive wages except for such works as grass cutting allowed free of charge in closed areas, for which non-wage labour cost will be imputed. Orderlies, watchers, forest guards, cleaners, help-mates and other regular and casual workers of the concerned departments, whose monthly wages usually equal about D.Rs. 80.0 to 100.00, will be priced as unskilled wage workers. So will be the labour employed by orchardists, being wage-paid.

viii. Land. The valuation of land as a factor is unnecessary. All options, including non-use such as of unexploited timber resource or fallow land, are ranked by evaluating the goods and services used and produced over an acre in each case. The option which maximizes the relationship between the benefits and costs represents the opportunity cost of diverting land to another use. This holds even if the attributes of one acre are different from another because, through use - possibility assessment, all the feasible options of using 'every acre' are considered. The choice of options on an acre of each resource class includes the one which maximises the objective function or the returns to an acre. This ensures that the diversion of land from one use to another will occur only if the opportunity cost is lower or the marginal value product is higher. Thus our system of appraisal yields opportunity costs, in the sense of 'programmed marginal productivities' (Clark, 1969), by comparing the various degrees of present and anticipated uses (c.f. section IV, appendix 11).

ix. Foreign exchange. Foreign exchange shortage is considered as a bottleneck in India's development. The merits of renewable resource uses which use or earn it may be less or more than that reflected by valuing resources in domestic currency. Conversion at the official exchange rate may not yield the social values because of overvalued currencies in developing countries, though undervaluation immediately after devaluation is not unlikely. Shadow pricing of foreign exchange based on the 'black' or 'free' rates has been advocated (Tinbergen, 1967, p.157). This presupposes a definite proportion of the amount involving conversion at black rate. That is difficult to guess properly. The programming approach is beset with the same difficulties as

pointed out for labour and other resources (c.f. section 3 appendix 8).

We have resolved the problem by valuing all resources in foreign exchange (c.f. footnote to subsection 8. iv.). It is for convenience that these prices may be expressed in foreign exchange rupees by revaluation at (any or) the official exchange rate. The latter's divergence from the social value of a dollar unit is immaterial, because the revaluation is done across the board and not just for actual imports or exports. As such, the relative dollar prices reflecting the relative social opportunity costs are not affected. Likewise, devaluation during the course of an action is unlikely to influence the relative social merits of options.

ix. Logic of social pricing. The underlying theme of social pricing is the maximisation of the efficiency in the use of the entire bundle of resources at society's command. It assumes indifference among the kinds of products of different options. It incorporates the foreign exchange costs and benefits, but does not rely on obvious substitution of imports or contribution to exports. The argument to favour a project, because it directly saves or earns foreign exchange is untenable if it involves diversion of Kashmir's limited resources from projects ranked more efficient on the basis of social prices.

Suppose wheat is more efficient than walnut production advocated for its foreign exchange potential (Bose, 1966). The former is superior despite that walnut export is reduced in favour of increased wheat output consumed locally to meet Kashmir's demand. The latter was previously met from domestic surplus of a neighbouring state (Punjab), now available to another deficit state (Rajasthan). Wheat option

makes a better use of region's resources as well as bigger contribution to the economy's foreign exchange. This is implicit in the logic of world pricing. The relationship of benefits to costs of wheat versus walnut production will include evaluations at the relevant wheat import prices and the relevant walnut export prices. By using resources for producing wheat instead of walnuts, foreign exchange is available to import more goods and services. This is because of the greater saving of the exchange than the earning possible from walnut export. The relative efficiency of producing either commodity takes account of the relative foreign exchange implications.

Similarly, all other products and inputs, including labour, directly or indirectly in the chain of the economic system, contribute to and use some foreign exchange. An efficiency criterion, in conjunction with social prices which measure foreign exchange opportunity costs, ranks options for their social desirability from both the viewpoints of the effectiveness of resource use in the economy and the foreign exchange effects.

9. Social Discount Rate

i. Discounting. Waiting costs; the present satisfaction foregone, or the postponement of consumption, because of delayed receipts involves a cost. The value of enhanced future satisfaction, possible through re-investment, given up by consuming now is a comparable premium placed on present enjoyment. The time element needs consideration to make additive the consequences occurring at different times and for the comparison of options with unlike time profiles. This is possible by discounting future

consequences.[1]

ii. Social time preference. Society as a whole cannot distribute the time stream of social benefits by borrowing and lending. As such, a measure of the desirability of an investment is inadequate if it does not take into account the social time preference function, i.e., the relative weights society places on benefits at different times in the future. Two net benefit time streams 'which differ in profile, although they have the same unambiguous internal rate of return are not necessarily equally desirable from society's point of view' (Feldstein, 1964). This implies the need for converting the consequences of options occurring at different points of time into comparable magnitudes by a discount factor which incorporates society's marginal rate of substitution between benefits in consecutive years (c.f. appendix 9).

iii. Economic growth and savings. The main conflict in the choice of the rate of saving is one between present and future consumption. It cannot be solved without some intertemporal decision or 'value judgment.' Social time preference assumes importance both in evaluating investment

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1. The need for and the mechanism of discounting is explained in appendix 6, subsection III.vii , The discount factor formula shown there is the reciprocal of the compound interest formula. Timing effects can be harmonised also by compounding forward the costs and benefits. Discounting is preferable because the reference point is the starting date. It weights the consequences over time to yield the present worths of alternative benefit-cost time streams in commensurate terms. These can be compared directly and readily related to their present costs, with which decision-makers are pre-eminently concerned. Unlike the compounded values of options with different production cycle lengths, present values do not involve the incompatibility of future dates.

options and determining the optimum rate of national savings and growth. This is because investment from the public view-point is an exchange of one time stream of consumption and investment for another, with concomitant effect on growth; an investment creates productive capacity for a number of years, and the present sacrifice of consumption leads to a flow of additional future consumption.

The level of consumption in a democracy cannot be suddenly pushed below a certain limit determined by history. There is a sociologically determined lower limit of consumption, and a corresponding upper limit of the saving rate. The latter limit may arise also because beyond a certain point an expansion of investment may yield negative marginal return (Horvat, 1968). The lower limits to savings may be given by the investment necessary for the maintenance of the existing production capacity and by the growth of population. The latter indicates the minimum growth rate of consumption required to avert a decline in the living standard and hence the lower limit to the rate of capital accumulation.

India is poor with a high population growth rate. For planning economic growth, it is interested in the choice of the rate of savings. The above upper and lower limits narrow the range of the choice. Nevertheless, a decision has to be and is made through political evaluations. The values of the present-day society are used to allocate consumption between two different periods in the future. Society's time preference plays the role of balancing present consumption and investment through the policy maker's choice of the economic growth and savings rate. This is implied also in

the paragraph on pages 10-11, appendix 10.

iv. Social discount rate. In a democracy, government policy regarding the intertemporal allocation of resources may be used to infer society's time preference (Marglin, 1963). The policy decisions are a reasonable proxy to society's indifference between less consumption now and more consumption later; the legislature would not continually back development plans which involve disproportionately more sacrifice of present consumption for an investment programme, from which benefits accrue in the future.

The preceding two subsections indicate that social time preference is reflected by the growth rate target that it chooses. A method which takes account of this in determining a social discount rate for an economy is presented in appendix 10. From the model developed there, the appropriate social discount rate for India is 10 per cent on the assumption of a 5 per cent growth rate per annum (c.f. footnote 4 from end, appendix 9) and a given pattern of income distribution (Ranadive, 1968). With the revised target of 5.5 per cent growth rate for the fourth five year plan (Government of India, 1969), the discount rate would be 11 per cent if the other parameters of the earlier draft plan are used. But since increased savings are envisaged in the revised plan document (ibid), the appropriate social discount rate remains closer to 10 per cent.

v. Changing time preference. In the last two paragraphs of appendix 9, we have argued that social time preference is not a constant magnitude. As such, investment analyses should consider the effect of a discount rate appropriately changing over time. We have used five discount rates ranging

from 5 to 15 per cent, in order to cover the possible range of deviation from the 10 per cent arrived at above. Of these, two rates vary over time, viz., from 15 and 10 per cent in the earlier to 10 and 5 per cent, respectively, in the later periods during the course of an option. Thus, this thesis provides the first instance of applying a changing discount rate for economic appraisal.

CHAPTER VI

RESOURCE ALLOCATION DECISIONS

1. Introduction

Having studied the culture, institutions, and the economy of an area, its present renewable resource use pattern, the biotechnical possibilities and the relative economic merits of options, how should decisions be reached circumspectly?

The theme, so far, has been efficiency in resource use (c.f. section 3, chap.I), viz., the enhancement of productivity of the renewable resource sector for making a greater contribution to the national product (chap.II); the use of resources according to a region's comparative advantage (chap.III) and potential (chap.IV); with an efficiency criterion (chap.V). In practice, however, such aims of efficiency have to be related with various other aspects of decision-making. These are discussed in this chapter. This discussion provides a bridge between analyses in the preceding chapters and the planning process in the remaining part of the thesis.

2. Decision-making

i. Analysis for decisions. People-goals-resources-organisation-programmes: In coordinating these things for renewable resource management, decisions are the pivotal events. Therefore, it is important who makes the decisions, how decisions are made, and how ought they to be made. Among the answers to these questions are: many people make or influence renewable resource use decisions; decisions depend on higher level goals of the state; and these depend on the aims and attitudes of society.

Quantifiable outputs are the basic building blocks for decision-making. They define objectives in measurable terms. They are data for evaluating alternatives for achieving objectives. The purpose of evaluating alternatives is to achieve an analysis in which i) objectives and alternatives are clearly defined; ii) assumptions, calculations, and judgments are presented systematically and clearly; and iii) interested parties can see what information was used in the analysis, how the results were derived and influenced by assumptions, and how they were used to formulate plans.

Such analysis provides the means for double-checking data, assumptions and calculations. It gives participants in the decision process the means for identifying, clarifying, and resolving areas of disagreement. It points out uncertaintities and makes them explicit. Such analysis pinpoints the areas where judgments are required and shows the effect of judgment on the final decision. Thus the analysts provide valuable service to the decision-maker.

ii. The decision-process. Decisions may be classed into two categories: those which are deliberated and those which are derived from custom or faith. Consider a year's fixed sum, say, for planting. The renewable resource manager may put much thought into the selection of planting sites from among the many elegible tracts. He may calculate the efficiency with which each site can use the limited budget. His final choices will be deliberated from such considerations as site productivity and the prospective costs of establishment and operation. Yet the decision for the planting programme itself may not have been similarly deliberated: the planting effort at large may have been based on faith in the long future and may follow an accepted custom. Such

choices now customary may at one time have been carefully and repeatedly deliberated. But now deliberation is bypassed: the choice is, in effect, predetermined.[1] And, in the course of actual planting, hundreds of smaller-scope decisions will be taken directly from custom or from habit, e.g., the size of planting crew, its organisation, and the tools used.

A deliberated decision is like a tailor-made suit, painstakingly measured and fitted. A customary decision is like a ready-made suit; one scans the clothier's rack for it, picks it out, and puts it on. But just as few suits are either entirely tailor-made or completely ready to wear as they hang on the rack, so many decisions are compounded of deliberated and customary elements.[2]

Resource allocation decisions are made by or on behalf of individuals or groups. The functioning of society is the manifestation of all its decision-making units. Any part of society would be characterised by its decisions and the relevant decisions of outside units. The decision-making units have certain characteristics. Foremost, they

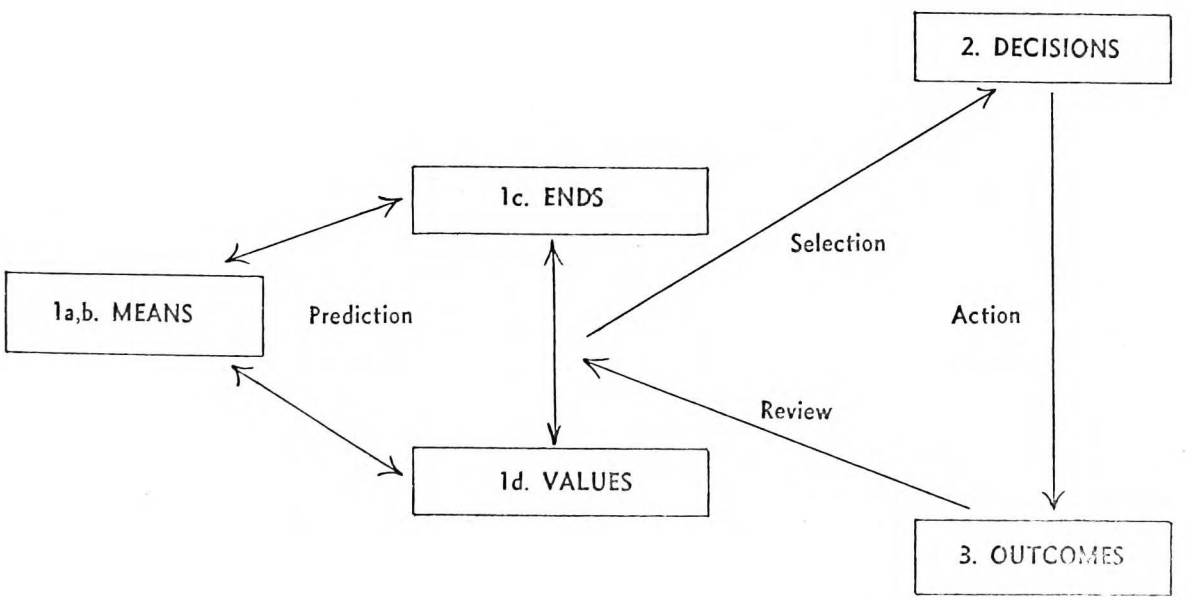
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1. Just as the route followed by the crew of a railroad train is predetermined when the railroad is built.

2. The attempt in this thesis is primarily on deliberating the decisions regarding Kashmir's renewable resource use. In this too, customary elements are involved, e.g. in the various aspects of physical production functions to avoid getting bogged down in trivialities. The latter, however, are not so trivial for those concerned with lower-level decisions, such as planning of seasonal operations on an individual farm. There, work study and other deliberations regarding the detailing of labour in mornings and afternoons, rainy and dry days, would be important - unlike this thesis concerned with resource allocation in the overall context.

have purposes or goals: broad and general, and many specific ones that flow from these. They have organisation, a system for controlling the flow of internal decisions, which can both contribute to and hinder the achievement of purposes. They have control over resources: land, capital, people, knowledge, and faith. They have opportunity, within the constraints imposed on them by other decision-making units including society at large, to use their resources in order to approach their purposes. The decision-making concerns the use of these resources.

Fig.6.1. The flow of deliberated decision.



From the above, it may be clear that resource allocation decisions are, or should, not be instantaneously made; for they involve many aspects within and outside a decision-making unit before a decision is reached. Decision-making is, therefore, a process of evaluation and coordination of various resource uses, as well as a review of the outcomes for future planning. The process of deliberating a decision may be idealized as comprising three steps, the first of which has four parts. These steps and their parts are arranged as a flow chart in figure 6.1. The parts of step 1 are interdependent conclusions reached simultaneously, or by successive approximations. This is illustrated below:

> 1a. The decision-making unit considers the questions of its choices and identifies them; only if there are choices is there a decision.
>
> 1b. The consequences of each choice are predicted. The production of paddy would involve terracing the land. For apples, a nursery may have to be established and to await the planting stock to be ready.
>
> 1c. The purposes, or ends, are reviewed. What is wanted is a use of land which maximises returns per unit inputs.
>
> 1d. The decision-making unit weighs its choices in the light of its purpose: it places values on them. Apple production may have a greater value.
>
> 2. The choice is taken.
>
> 3. The decision-making unit follows up after the event. It reviews the land-use decision and the array of subsequent decisions. Did the course of action turn well? What guides come from this experience for future use?

3. Policy, Objectives and Decisions

i. Policy goals. Choices lie always in the future. Decisions, therefore, relate to the future: they constitute plans, and all the data required for decisions are predictions. This raises two problems: one is of coping with uncertainty, which will be discussed in the next section. Second, what rationale to use for favouring one choice over the other, i.e., what is the datum for considering one set of likely outcomes superior than the other? Stating that the 'existing economic and political institutions fail to bring all costs and all benefits to bear on each decision in land management, whether in the private or the public sector', Zivnuska (1968) argues 'that intelligent human action is the better choice'. But, what is intelligent and what is unintelligent?

To answer the above question, we turn to society, i.e., find what its aims are. Actions which further these aims, are correct decisions.[1] To know society's aims is not so easy however. This difficulty is reduced by assuming that governmental policy in a democratic society reflects its aims; for otherwise it will be voted out at the next election. This is reasonable also because 'the dominant feature of the Indian economic system today is the assumption by the state of overall responsibility for economic development' (Lokanathan, 1962).

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1. Whether they are good or bad decisions is difficult to say, because it is equally difficult to say whether societal aims are intrinsically good or bad. The above statement, therefore, is logical in the sense that actions commensurate with objectives are rational (c.f. subsection 2 iii, chap.V).

ii. Multiplicity of objectives. The Indian national development objectives may be classified into two main aims: economic growth and distribution. The other so-called objectives are means to these ends. Balance of payments and self-sufficiency in certain commodities like food contribute to the former aim; for otherwise they may act as bottlenecks to growth. Such objectives are 'not a goal but a constraint' (Streeten, 1966). The 'objectives' of reducing income-group disparities, and of rehabilitation of 'backward-classes', are tantamount to the distributional aim. The employment 'objective' is also 'chiefly a means of redistributing consumption' (Marglin, 1967, p.23). The place of these subsidiary objectives is discussed in appendix 6, section IV.

The development policy does not state the heirarchy of objectives. The relative weights on the two main aims is not possible to discover from the policy. Ranking options by their comparative efficiency contributes to the aim of growth.[1] But, if those receiving the benefits and those bearing the costs vary among options, the ranking should include comparisons for the distributional aim. This aspect is ignored in an analysis for allocative efficiency only.

The likelihood of the above conflict is minimised by social pricing (c.f. section 8, chap.V). This favours more labour employment, especially of the unskilled peasant category, than less, thereby furthering the redistributional objective. This also averts to a large extent the chances

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1. This is ensured by measuring benefits and costs from effects on the economy as a whole, and by using benefit to cost ratio as the ranking criterion (c.f. chapter V).

for welfare losses, i.e. among the poorer sections, through the market mechanism.[1] The relative price, and consequent income, changes hardly arise from renewable resource use adjustments. The overall demand and supply of commodities will be negligibly affected by adjustments conceived in this study (c.f. subsection 4 v infra). Also, those commodities with a high income elasticity of demand of lower income levels can be ensured to be in such supply that changes towards the optimal design are unlikely to entail a decrease in general welfare (c.f. subsection vi infra). Even if there is any change in income distribution which the policy-makers consider inimical to general welfare, this can be remedied if overall net incomes are enhanced. This is ensured by efficient resource allocation, so that fiscal and monetary measures can be instituted for favouring any income group more easily than when resource allocation is less efficient.

The above is a defence for retaining objectivity during benefit-cost analysis and for our approach during the analysis to distributional considerations for community's living members. The future members, however, have no votes and cannot make their preferences felt. We have argued in chapter II that renewable resources are a form of capital and questioned the conservationists' puritanic ethics and Pigovian espousal of protecting future interests, when the primary concern is development. To bring our analysis in line with this argument, it should incorporate society's

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1. 'Provided the welfare effects involved are small, the deviation from some exactly defined output is likely to be small. In a science of human behavior, where a ten per cent error of prediction over a several-year period is more an occasion for rejoicing than dismay, such difficulties cannot be taken seriously. If by excise taxes and/or subsidies the government can bring economy as a whole closer to overall optimality - while correcting, if necessary, unwanted distributional effects through direct transfers - it need not feel inhibited by the practically insurmountable difficulties of exact calculations' (Mishan, 1968).

intertemporal preferences, which would be related to its state of development. This is attempted by weighting future consequences for social time preference (c.f. subsection 9.ii ff., chap.V). In this way our analysis is realistic in the sense that 'the analyst must be sensitive to "higher-level" aims' (Krutilla, 1961).

Our analysis attempts to reconcile economic efficiency with both the interpersonal and the intertemporal comparisons of gains and losses, according to society's revealed general preferences as represented by its developmental objectives. Nevertheless, the principle remains that we have to count costs and benefits of all feasible options, so that decision-making follows and not precedes the analysis. Boulding (1969) names this as the 'economic ethic' of 'total-cost-benefit analysis'. This is an ethic of being rational and depends on the development of measurement and numbers, even if these be ordinal. The analysis may not take account of what is called the 'heroic' ethic of military, religious and sporting values (ibid). But such aspects are not compelling in the renewable resource sector save for the religious values, such as inhibitions against production and consumption of beef and pork in certain countries, and the aesthetic considerations. We allow for both these during the use-possibility assessment through identification of options and during systems designing (c.f. section 5 v infra) - through demand constraints which embody the tastes of people. To the extent the 'military' values[1] should affect the results,

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1. Such values are likely to be met better by relying on social-benefit-cost analysis, which aims to use society's resources effectively. For example, an objective analysis favours options which could help make country's defence stronger, if society wanted to, by providing scope to release more resources for it than before, without necessarily reducing 'non-military' welfare component.

of society's decision making institutions have the upper hand. Nevertheless, this and other heroic aspects too can be incorporated in our analysis for less subjective decision-making by presenting a set of analyses with different assumptions about them (c.f. section 4 vi).

A somewhat thorough investigation of the ways in which economic efficiency and redistributional equity may diverge and the ways in which the two can be synthesised is made in section V iv, appendix 6. The welfare effects of the method proposed here are also considered. It is concluded that value judgments are required for trading off efficiency for equity, and that welfare-increasing measures are practicable through the pursuit of efficiency at analytical stages. The role of such a social benefit-cost analysis is defended, though it is argued that for decision-making the policy values are required (ibid, subsection V iv). This will be considered in the following sections.

iii. Facts and value judgment. Policy decisions for resource allocation are similar to all other problem-solving situations in the broad sense that choices are made among alternative courses of action. But complexity of values and objectives, and the extensive scope of persons affected, distinguish policy decisions from lower-level managerial problems. The resolution of resource policy problems requires evaluation in terms of two or more primary aims (c.f. preceding subsection). Also, many resource policy aspects are concerned with institutional issues, e.g., modifications of laws, agency responsibilities, and private use of renewable resources. The impact of these changes, or decisions, on society is both direct and indirect; so

value judgments are an essential part of choice.

Lest value judgments impair the objectivity[1] of analyses, separation of facts and values, and a clarity of the roles of the analyst and the decision-maker are required. In attempting at this in the next subsection, there is a fundamental premise: if policy formation and decision process is considered socially optimal, then the policy resulting from this process is socially superior to a policy resulting from a less optimal process. On this basis an attempt is made below to present an understanding of the various concepts involved in the next subsection.

Public policy is an action in the public interest regarding an expenditure or investment activity, a change in institutions, or both that affects the environment within which individuals or groups operate. This definition is more comprehensive than the usual concept.

Systems analysts, or analysts, are people responsible for predicting consequences of policy alternatives in terms of all values pertinent to choice. They present these 'facts' in some understandable manner to the policy maker and other policy participants.

Policy makers are people actually responsible for making choice among alternatives. Generally these people also direct programme implementation and receive criticism from those displeased with policy choices and consequences. They are normally charged with representing the public interest in the policy process.

Public interest refers particularly to the common, general interests of the usually unorganised and often unaware members of society affected by the policy choice. More formalized interests

1. Objectivity means independence from anyone's influence except society as a whole, which reflects its preferences in societal policy goals.

including pressure-groups, are also a component of this general view.

Facts include the consequences, or the expected outcomes, of an action. The outcomes include both the market and the extra-market values. The former are the monetary values of goods and services that are considered socially acceptable as guides for policy decisions. Acceptable market prices refer to opportunity-cost prices. For extra-market values, no acceptable market price exists, e.g., the value of an extra unit of employment. Such values can be expressed numerically or verbally, but not monetarily. No distinction, however, is made between tangible and intangible values; any value worth considering can be expressed by some measure, although imperfectly. Even if a particular outcome can be logically classified only as better or worse compared to present circumstances, the value is more tangible than not.

Value judgment refers to the subjective assignment of absolute or relative value weights to policy consequences in the process of reaching a final choice. This includes weighting market and extra-market values, and decisions by which extra-market values be considered . Value judgments may be distinguished from professional opinions rendered during the analytical predictions of consequences. Data limitations, methodological and other difficulties often require expert judgment in lieu of more objective and repeatable procedures. For instance, an estimate of the future food consumption in Kashmir is based partly on statistical analysis and partly on experience and judgment. The statement by experts that the natural availability of water in Kashmir is adequate for meeting the demand in the

foreseeable future is a similar example. Both these are professional opinions. They contrast with an opinion that 'the value of a man-day of recreation is a rupee for me and two for you'. This is a value judgment.

iv. Decisions and analyses. As defined, almost any action by decision-makers, including no-action, or maintaining the status-quo, is a public policy. Virtually, all interest groups concerned with a given situation consider only a limited set of consequences. Their viewpoint is, rationally, determined by their own values and problem context. Thus many policy effects relevant to other groups are disregarded. But, if the public interest is to be maintained in policy decisions - i.e., all relevant values and consequences affecting all groups are considered in deciding upon a specific choice to be adopted - it can be upheld only by the objectivity and broader outlook of the professional policy analyst and policy maker and the institutional format of the decision-process.

The roles of the analyst and the policy maker must be separated. The functions of the analyst are identification and prediction of the consequences of each alternative. The ideal analyst should not, therefore, make value judgments. The analysis should provide the factual base for value judgments by the policy maker when reaching a decision. If this factual base is intentionally or implicitly distorted by the inclusion of value judgments, the foundation of the policy decision may be misrepresented and the probability of inferior choices increased.[1] An intentional inclusion of

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1. This may not be possible to eliminate completely; for some unintentional distortion does enter an analysis through the choice of the analytical method, units and display format.

value judgments in the analysis can be a deliberate device for confusing issues and allowing the policy maker to hide behind pseudo-scientific 'factual' evidence.[1]

The recognition and application of value judgments separate from professional analysis are the critical criteria for measuring the relative superiority of a policy-formation process. It may be concluded that a superior process is one in which i) all value judgments are entrusted to the policy maker, ii) value judgments are explicitly faced and consciously made, and iii) infusion of value judgments into the analysis is minimized.

The selection of alternatives to analyze is itself a value judgment; the entire policy formation process can go astray at this stage. At the risk of repetition (c.f. subsection 2.ii, chap.V) in a different context here, it is clear that if the optimal alternative is not included at the beginning, no amount of objective analysis and decision-making can produce it in the choice. To avoid this, extraordinary efforts are required to maintain an open viewpoint and diligently search for all possible alternatives (c.f. section 4, chapter IV).

In renewable resource planning exercises, e.g. by Lembaga (1967) and others (c.f. subsection V.ii appendix 6), the importance of the above does not seem to be recognized. But choice of alternatives for analysis is the most demanding operational test of the role separation between the policy

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1. The device also helps him, not irrationally, to avoid facing complex and difficult value judgments. 'Suspicions of this practice are heightened when it is noted that proposed projects always seem to have positive intangible benefits and negative benefits somehow tend usually to go undiscovered and undeducted in official project evaluations' (Bain, 1960).

maker and the analyst. It is an equally crucial test of the social optimality of a policy process. This is because the optimality of the process requires that a reasonably close approximation of the optimal alternative must be included for explicit consideration. For the analyst to purge his work of value judgments, he must either find some acceptable objective scheme for considering a representation of all feasible alternatives or take as given the alternatives designated by the policy maker.[1] The latter approach seems less reliable here because agencies and policy makers are themselves interest groups by virtue of tradition, education and outlook. This places an impossible burden on the policy maker to be totally objective in his selection by personal judgment of policy alternatives for explicit consideration. This dilemma can be mitigated by developing systematic procedures for selecting alternatives.

As would be clear from the last two chapters, we have achieved such a systematic procedure - firstly by identifying all possible alternatives (chapter IV) and then by objectively ranking them by a social benefit-cost analysis (chapter V). The physical benefit and cost consequences of an alternative are quantified; then comparable weights are estimated for each cost or benefit item. In this way the investment options are evaluated.

In the above process, the net expected effect for each option is condensed into single numerical value indices, viz. present worth and benefit-cost ratio. The use of a single net value index could force a mixture of facts and even values. As such it is conceptually ill-suited for evaluating options in terms other than direct economic efficiency. This does not

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1. In this thesis, we have attempted to include all feasible alternatives, i.e., those possible and adoptable options which have a benefit to cost ratio equal to or greater than unity.

invalidate the benefit-cost criterion as an important guide for resource allocation from the public viewpoint. For instance, it serves to eliminate options which do not at least pay their way. The priorities among the remaining options for inclusion in systems-designs, however, need to be struck on the basis of other considerations too, e.g., political besides the analytical.

Since the evaluation of the benefit-cost consequences is predominantly a value judgment, analysis must be limited to the prediction of consequences. A classification of policy consequences by value categories clarifies the types of information that can be entered within each category without resorting to value judgments. An attempt for this is made in table 6.1.

Table 6.1.

Value classification and Objective Information.

Value class of policy consequence considered	Specific policy alternative P_1, P_2, ..., Pn
Benefits	Legitimate objective information describing each policy consequence
Market valued	(Rs.), (N)
Extra-market valued	(N), ($\gtrless$), (+, 0,-), (words)
Costs	
Market valued	(Rs.), (N)
Non-market valued	(N), ($\gtrless$), (+, 0, -), (words).

Symbols:
- (Rs.): acceptable 'market'-determined rupee values
- (N): item capable of numerical description and enumeration.
- ($\gtrless$): Consequence of alternative Pi as numerically or logically greater than (less than) the same item of alternative Pj.
- (+,0,-): a consequence can logically be said to have a positive, neutral or negative effect with respect to some standard.
- (words): effect of consequence can only be approximated or described in words.

The role of the analyst may be defined as development of the information indicated in the table. The role of the policy maker is to intervene as little as possible in the analysis, and when he does so, to make his value judgment explicit.

The argument for an absolute separation between value judgments and facts and between analysis and decision can be carried too far. It is desirable both operationally and philosophically to have some explicit interactions. The role of an analyst is to define problems in a manner susceptible to optimal solution. Policy makers have a 'pragmatic' political outlook and tend to define problems with the purpose of selecting, what they consider, a better or more workable solution than that now in effect. The analyst and policy maker, then, must work in order to clearly understand each other. The policy analyst focuses on searching for the best solution; the policy maker on searching for a workable solution. Both the aspects considered together are the essence of planning.

v. Plans and objectives. Now we may see that plans cannot be born independently of objectives; analyses have to be geared to policy aims. Analysis, policy and decisions comprise a plan; i.e., decisions are the ultimate step of the planning process before implementation of plans can be set in motion. In the following subsection we will indicate how to synthesise policy and value judgments with objective analyses for the preparation of plans as undertaken in the next chapter. For this, the central arguments of the preceding discussion are our guide. These are listed below as criteria for a socially optimal behaviour of professional analysts and policy makers in the policy formation process. The arguments

are advanced as standards but with full recognition of the pragmatic difficulties of separating roles and functions and the need for a policy process which is not so encumbered that it loses its ability to operate.

> 1. Responsibility for value judgments and choice is identified and entrusted explicitly to the policy maker at the outset of the policy-formation process (Kuhn, 1962, pp.4,27).
>
> 2. A representation of all feasible policy alternatives is explicitly considered by the analyst and the policy maker (Fox and Herfindahl, 1964; Bain, 1960, pp.318-319).
>
> 3. The analyst neither interjects his personal value judgments nor assumptions of the policy maker's value judgments in his analysis (Krutilla and Eckstein; 1961, pp.3-4; Eckstein, 1961, pp.35-36).
>
> 4. All policy consequences for which value judgments are essential to decision are explicitly enumerated or described by the analyst and clearly displayed to the policy maker and the public (Kuhn, 1962, p.26; Fox and Herfindahl,1964; Castle, 1965).
>
> 5. Value judgments are neither hidden nor distorted, but faced openly by the policy maker.
>
> 6. The analytical basis for decision is reduced in complexity to the point where the policy maker can comprehend the alternatives and make rational, deliberate decisions (Kelso, 1965; Lindbloom, 1961).

vi. Objective function and constraints. In subsection ii above, two primary developmental aims have been recognised: efficiency and distributional equity. The social benefit cost analysis of options is geared to the efficiency objective. The analysis devised in this thesis is such that it would favour options that further distributional gains, e.g., enhance employment through lower labour cost than in the market, spread expenditure areally over a region, and encourage regional development through a full exploitation of its comparative advantage. Notwithstanding the options ranking being commensurate with the distributional aim, the latter is not explicit; for that would require a value judgment regarding

weights on, say, the relative incomes of poor versus rich and Kashmir versus Punjab. The policy makers in India do not state these weights. We cannot make assumptions about the same nor interject values in the process of analysis (such as regional employment multipliers for Wales and Scottish highlands).

To avoid distortion of the analysis by policy-makers' implicit or our own explicit weights, the social benefit-cost analyses, and hence the ordinal ranking, of options is for efficiency. But decision about their choice is not reached from such ranking. This, among other reasons, has to await synthesis with the value judgments, i.e., the full policy considerations. This we shall do in the next chapter. The procedure for systems designing, i.e., the choice of the combinations of options, will be guided not only by efficiency.

In combining options in any feasible manner, if efficiency is the objective function, this will be constrained by other policy considerations, viz., employment per se, incomes of peasants and other groups, and supply of food and firewood (i.e. commodities for which self-sufficiency is an aim). These and other considerations, which may be relevant to policy-makers' choice, will be used as constraints in systems designing in a multiperiod manner. This is to offset the weakness of the efficiency index which does not reveal the outcomes of an action in relation to their distribution over time.

Furthermore, the systems-designing format will be such that it will be possible to switch one or the other constraint as an objective function and vice-versa. That is, if

employment or distribution is higher in the hierarchy of aims (which is ambiguous in the existing policy statement), the analyst can meet policy maker's judgment by using efficiency as a constraint instead of the objective function. Also, there will be scope to make policy-maker's choice easy by providing systems designs for different levels of attainment of objectives, whether included as the objective function or constraints.

vii. Regional and national development. By making analysis of investment options for efficiency, there is no conflict between regional and national development aims. This is because efficient resource use in a region will help the region's development as well as contribute to the national objective of income growth.

In this thesis, consistency between regional resource allocation and national development is ensured in two main ways. One is that we use a social discount rate which is derived from national policy aims. The consequences of options are, therefore, weighted by national policy parameters. Second, by using world prices of commodities for the country as a whole, the regional resource allocation decisions are linked with national opportunities. The place of Kashmir vis-a-vis rest of the regions of the country is made explicit by adjusting the prices for transport costs to and from Kashmir and by using such prices for local resources, i.e., labour, which reflect their opportunity cost to the nation through use in Kashmir.

4. Uncertainty and Risk

i. Decision theory and partial ignorance. Decisions are considered to be made under one of the three conditions: certainty, risk or uncertainty[1]. The practical consequences of a course of action would, therefore, depend upon a) the 'state of nature' which cannot be known at the time the choice is made b) decision alternatives, and c) the consequences. The states of nature are the future occurrences which influence the outcome of the decision but which are beyond the decision-maker's control. The decision alternatives are those actions which are considered possible to take. However, it includes the assumption that alternatives which are considered unworthy, i.e., those with a benefit to cost ratio of less than unity, are excluded. With assumption of the decision theory, actions which are dominated are also excluded, i.e., if a_1 and a_2 are two possible alternatives and for each state of nature a_1 is at least equivalent to a_2 and for at least one state a_1 is superior to a_2, then a_1 dominates a_2 and the latter is not a member of the set of decision alternatives. Such an exclusion of options is not necessarily correct for reasons discussed in subsection 2 ii, chap.V, chief among which is the interdependence of options (c.f. section II, appendix 11).

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1. In practice, it is difficult to envisage resource allocation decisions, the outcomes of which depend upon situations arising in the future, to be certain. Nevertheless, decisions may be considered to be made under certainty, if the result of each possible action is a single, known outcome. If there is more than one possible outcome but the objective probability of each outcome occurring is known, the decision is ~~to~~ made under risk; otherwise the decision is made under uncertainty.

Whether a decision is made under certainty, risk, or uncertainty depends upon the degree of knowledge about the occurrence of the states of nature. If there is only one state, i.e., the consequence of each alternative is known, the decision is made under certainty. If there is more than one state and the objective probability of each state occurring is known, the decision is made under risk. If the objective probability of each state occurring is not known, the decision is made under uncertainty.

Under certainty, one would choose the alternative with the most favourable consequence. The generally accepted decision criterion under risk is to choose the alternative with the most favourable expected value. Under uncertainty, there is no single, generally accepted decision-criterion.

There are two broad categories of uncertainty: complete ignorance and partial ignorance (Luce and Raiffa, 1957). Under the former, the decision-maker has no information or opinion regarding the occurrence of the states of nature. Under partial ignorance, while the decision-maker does not have an objective probability distribution on the states, he may have opinions about their occurrence. With partial ignorance, the decision maker can combine his opinions, judgments, or historical data with empirical evidence. No matter, what a resource manager's opinions be, it is doubtful that he will endorse an attitude of complete ignorance. Therefore, the assumption of partial ignorance may be made regarding renewable resource planning decisions.[1]

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1. Uncertainty with such an assumption could be systematically incorporated in the evaluation of options by formulating subjective estimates regarding the occurrence of the states of nature. The Bayesian decision theory could be employed for this (Savage, 1954). The distinguishing characteristic of this theory is about an a priori probability distribution on the occurrence of the states of nature. If empirical evidence about the occurrences is available, Bayes theorem may be used to convert the a priori probabilities into a a posteriori probabilities (ibid). This theory seems compatible with reality,

.....

In this sense (the situations of pure risk and (partial) uncertainty are alike, and an attempt to distinguish between them is unhelpful' (Henderson, 1968, p.140).

ii. Risk-discounting. It is a quite common presumption that the rate of return payable by a risky loan, or investment, must be greater than the rate payable by a safe loan. Thus in computing the present value index, one might apply a rate of discount of the form r + pd, where r is the rate of interest on a 'very' safe investment and pd the risk premium, which increases in proportion to d, the standard deviation of outcomes. Even if variability were likely to increase over time, it does not enable us to determine the appropriate size of the risk premium, 'so that any given figure is no more than a guess' (Henderson, 1968).

Baumol (1968) argues for a discount rate higher than that which accords with time preference. One of the two main reasons given for this is that the rate used should allow for the risk premium. These arguments are questioned in appendix 9, pp.10-13. It is concluded that a high 'social discount rate' because of a risk premium is not appropriate, for investments in the economy as a whole are subject to the law of large numbers. Indeed in the diverse mix of options in Kashmir's renewable resource system, risks are likely to be pooled. Furthermore, the arbitrary penalty on later outcomes than sooner ones through a 'risk-harmonized' discount rate is not commensurate.

.....i.e., decision-makers possess opinions, based upon judgment and experience, about the environment surrounding their problems. If no additional information is available, they will make decisions based upon their opinions. If additional information is available, they will use it to modify or reinforce their original opinions.

iii. Expected value. The maximin-returns principle advocates the evaluation of alternatives by their guaranteed minimal returns and the choice of the one with the highest guarantee. It is an extremely conservative principle; it pays no attention to the potentialities of a decision in any circumstances except the worst possible . . . The minimax-risk principle is the reverse of the above. It defines the risk of any combination of a decision and a state of nature by the excess of the maximum return attainable in that state of nature over that actually results from the given decision in that state of nature. An alternative may be chosen for which the maximum possible risk, defined in this way, is minimal. This principle can lead to illogical conclusions, for it concentrates on the largest risk figure among a set of payoffs, ignoring the rest of the data. Since the comparison of alternatives is with the one with the highest risk figure among the various states of nature, the inclusion or exclusion of an alternative could reverse the choice. The latter could well be reached with a maximax principle, selecting the alternative whose maximum return is as great as possible.

There seems no logical basis for preferring one over the other above principles. The logical defect with them is that decisions would be made without forming a judgment of the relative likelihoods of the various states of nature. Such judgments, however, are possible by assigning probabilities to the latter, making use of available information. Deciding is then simply the making of choice among the probability distributions of outcomes associated with different decisions.[1] The first moment of a probability distribution,

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1. That such decisions are often made in practice is exemplified by the decision to insure or not to insure against a risk, and if so, how fully. Insurance converts a situation in which there is a small probability of a great loss into one with a certainty of a small loss (the premium) plus a small probability of a middling loss (the uninsured or the uninsurable part of the risk).

or the expected value, measures the 'central tendency' of the distribution.

In a comparison between two decisions, the one that gives rise to the higher expected value is not invariably to be preferred. There may be situations when it is reasonable to give up some expected value in order to reduce uncertainty, i.e., in order to reduce the standard deviation of the distribution of outcomes.[1] However, there are three main reasons why expected values are adequate for ranking the individual units of the renewable resource system under consideration here.

Firstly, because public resource planning places the decision-maker in the position of an insurance company. This is the case of 'actuarial risk'. It arises because the decision to be made is one of a large number of similar, and independent, decisions and the major importance attaches to

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1. Besides the expected value, there are other measures of central tendency too, e.g., the mode (the outcome with a probability at least as great as that of any other) and the median (roughly, the outcome which has a 0.5 probability of being exceeded). The second moment measures the spread of the possible outcomes around their expected value. Although the other moments too are useful for a complete description of a probability distribution, a choice from only the first moment, i.e., from the highest possible expected value, is a simpler and most useful practicable proposal for choice among renewable resource options. Insurance, no doubt, provides an example where the highest expected value is not chosen (because premia are usually greater than the expected value of losses insured against), but in practice government property is not allowed to be insured in India and Kashmir. This is rational by considering that government as the 'trustee' of national interests is the insurer: the insured reduces the expected value of his net benefits when he takes out insurance, and may be behaving rationally when he does so; but the rational policy for the insurer, who has the advantage of pooling numerous risks, is to maximise his expected net benefits.

the average or overall result of all the decisions. It arises also because net benefits in the individual years are random variables for the different component options, and the concern is with net benefits over the planning period rather than with the benefits in any particular year. Both these arguments are an application of the law of averages, i.e., planning is concerned with maximising expected net benefits per unit of costs expended.

Secondly, the renewable resource systems design alternatives have approximately the same spread or standard deviation of outcomes. Thirdly, it is easy to choose among probability distributions by using expected values as an adequate measure of relative desirability. The rationale for this flows from the decision theory: if the various outcomes in the payoff matrix, or the benefits table, are measured properly, the expected value is an adequate measure of desirability and the problem of choosing among design alternatives can be solved (c.f. subsection i supra).

ii. Weather. Renewable natural resources activities are weather-related. The various production functions on the basis of which economic evaluations of options considered in this thesis are made are beset with uncertainty about weather. The theory of decision-making is a subject area to which the problem of weather-sensitive decisions leads. There are various reasons why expected values of yields of different resource commodities are reasonable estimates for the ranking of options in Kashmir.

Firstly, Kashmir's renewable resource production is not dependent on Monsoons, which do not penetrate the valley. There such uncertainty that is associated with weather patterns causing widespread droughts and severe floods, does not usually arise.

Secondly, renewable resource activities are about equally weather-sensitive as well as have about the same degree of decision-latitude vis-a-vis weather, e.g., for the various forestry and agriculture activities, the former's indices vary only from 2 to 2.3 and the latter's from 3 to 3.3 (Maunder, 1970).

Thirdly, on the one hand the expected yields are based on the averages of a large number of years, usually ten, so that the less severe fluctuations are reflected. On the other hand, and more importantly, the data are applied to production yields for the entire planning period (viz. 30 years). As such, the hazards associated with predicting the yield for a particular single year, in the event of weather turning out to be abnormal in that year, do not arise. Instead, by virtue of the law of large numbers the expected yields and probable outcomes are likely to be close to each other.

The planning of renewable resources use on past weather experience seems rational also from the actual behaviour of governments and enterprises. They make long-term decisions, notwithstanding the uncertainty of weather.[1] This contrasts with the flexibility of decision by individuals who may 'wait and see' what the weather or the weather forecast is.

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1. This is not to deny the influence of weather on day-to-day activities of renewable-resource operations. It however signifies that the choice of options will be conditioned by outcomes that are expected on the basis of past information available about the weather at the time of evaluating the decision-alternatives, and not from a hypothetical vagary. Maunder (1970) concludes that the social and economic implications of long-range weather forecasting are such that 'there are many advantages in <u>not</u> knowing what the weather is going to be next month or next year...Gambling on the weather and the weather forecast has its rewards!

v. Prices. In the foregoing, it has been discussed that the physical outcomes of renewable resource production decisions can be estimated with reasonable accuracy by using available records and experience. The same cannot be said for economic outcomes; for prices, by which the expected physical outcomes are translated into economic outcomes, can be predicted from past trends only if everything else remains the same. But other things rarely, if ever, remain the same. The effect of technological change (which would affect physical outcomes too[1]), changes in tastes, deviations from planned levels of investment, and changes in political and international conditions can be foreseen very dimly. An analysis of such uncertainties in terms of probability distributions, or expected values, applicable to risky situations, is not plausible.

The problem of price uncertainty in this thesis, however, is greatly reduced by the use of world prices for the valuation of outcomes (c.f. subsection 3 ii supra). World prices can fluctuate without conforming to past trends no doubt. But the various commodities considered here have been exhibiting small, or no, fluctuations in contrast to others like jute and tea.[2] Moreover, any increase or decrease

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1. This has been allowed for in this thesis to the extent that options with new technology, based on experimental evidence and recent innovations, have all been included. While we have not entered into technological forecasting, the mere application of the results of the recent experiments in Kashmir (e.g. the use of packages of hybrid seeds, irrigation, fertilizers, better soil working) as well as the probable outcomes of altering management techniques (e.g. shortening of forest rotations), could increase yields manifold.

2. It would seem safe to assume somewhat homogeneous relative price changes for the commodities considered here; nevertheless, the trends of price changes for the different commodities has been realistically incorporated in evaluations by basing the prices on the world prices for last ten years in each case (as recorded in FAO commodity reviews and Indian foreign trade statistics).

in the quantities of the various commodities produced will not affect world prices, i.e., the decision alternatives are similar in their insignificance in terms of world demand and supply.

vi. Sensitivity analysis. A practical way to consider, or make oneself aware of risk and uncertainty, is sensitivity analysis. It focuses attention on a few key factors or assumptions, to which the measure of costs or net benefits seems to be highly sensitive, and on the implications of varying these, e.g., the effect on the profitability of forestry use of hill land by using different discount rates, by exclusion or inclusion of housing costs, by assuming changes in wages and in relative prices of timber and farm product (Walker, 1960).

Besides the use of 'expected values' for consequences - i.e. what appear to be near-realistic estimates as also advocated by Little and Mirrlees (1969, pp. 195-197) - we have employed a number of discount rates to study the outcomes of options. A number of present worth and benefit to cost ratio calculations for the system are made on the basis of alternative assumptions, e.g., regarding demand and budget availability. Such an analysis will help in deciding whether more examination of the various possibilities is desirable, so as to reduce uncertainty before a decision is made. It will also indicate which assumptions are crucial in the relative desirability of alternatives, so that these assumptions are refined; and/or the decision-maker can choose the design which is based on the set of assumptions which appears most probable. This is because the sensitivity of the renewable resource systems designs to various exogenous factors will be made known.

5. Systems Analysis

i. Complexity of choice. An idea often appearing in this thesis, in one form or the other, is that the choice about renewable resource uses is complex; that it is more complex than decision-makers usually comprehend, or may appear to from their way of deciding; that it is more complex than many resource allocation problems, which involve neither biological phenomena nor spatial dimensions; and that the complexity in choice arises because it involves a host of biological, physical, and social (including economic) variables. To meet his responsibility, a planner[1] needs all the understanding he can get of what the variables are and how they interact. Systematic efforts to identify the variables and their interactions is required for such planning that rationalises the decision-making process. This implies 'systems alanysis'.

ii. Systems concept. A system is 'an organized or complex whole; an assemblage or combination of things or parts forming a complex or unitary whole' (Johnson et al, 1963). Any research aiming at synthesising the results of the analyses of interdependent units of a complex whole needs to be based on the systems concept. Darwin's 'system of nature' allowed the integration of all life in a manner so

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1. Planner is an abstract term. As seen in section 3 supra, there are analysts and there are policy-makers. Their roles are separate, but combined together they result into decisions, or plans. The so-called planning bodies, e.g. the Indian Planning Commission, are not decision-makers; they should analyse the pros and cons of alternative decisions and present their expected outcomes to the policy-makers, or the legislature, for choice. They may then either alter or adopt a chosen plan, depending upon the policy directive. Then alone a plan is born. In this thesis, the term planning is applied in the context of framing alternative proposals for Kashmir's renewable resource uses together with analyses of the alternatives for decision-making. And the term planner implies when the analysis includes, or refers to, elements of choice as well.

that it could be indicated how the myriad of living subsystems were interrelated. Likewise, a systems approach[1] is required to indicate the interrelationships among the various renewable resource subsystems, e.g., agriculture, horticulture, forestry, grazing, and watershed protection; among their component units, e.g. wheat, paddy, maize and oilseeds production in the agriculture subsystem ; among the various renewable resource production processes and other human aspects, e.g., labour, capital, demand, and institutions; and among societal goals and the outcomes of the various production processes. All these interdependent elements form one whole, i.e., the renewable resource system. A systems analysis so conceived will enable such decisions to be made that the objectives are achieved with full understanding of the environment. It is likely that objectives will be achieved closer to what is desired by formalising renewable resources as a system than by ignoring the complexity of the system.

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1. A first attempt suggesting a comprehensive systems approach has recently been made by McLoughlin (1969) for urban and regional planning. Though he has not provided a case study, and, therefore, the attempt may not be effective, he has adduced some general arguments in its favour: 'The main results of adopting a systems approach is a move towards greater integration of the several parts of planning process in the office...Because no office has yet been run wholly on a systems basis it is too early to be more than speculative... At the same time, a systems view..would foster a greater degree of integration between the planning operations and those of many other public welfare activities. By these means, physical planning which serves the community's welfare largely from the spatial point of view may become more closely meshed with the work of many others whose task is to serve individuals, families and groups in the non-spatial parts of their life' (Ibid, pp.301-302). Wilson (1968) has also argued for 'modelling and systems analysis', though only for urban planning.

The above is likely because the systems concept provides a framework for visualising internal and external environmental factors as an integrated whole, as they are in practice. The systems concept fosters a way of thinking which, on the one hand, helps to dissolve some of the complexity, and on the other, helps the recognition of the complex problems. Thereby planning can be done within the perceived environment. Planning for isolated parts of the system, or for subsystems, loses sight of the overall objectives of their area of activity and the latter's role in even larger systems. Planning is likely to be more realistic and possible of implementation if the planners analyze within their context as well as are aware of the 'big picture'. Indeed, an ultimate, though distant, goal should be a framework (or system of systems) which could tie all disciplines together in their relevant relationships. To do so for the renewable resource system of systems in Kashmir is a big step forward, because these resources dominate the region's socio-economy.

iii. Systems and subsystems. Abstraction in the study of renewable resources system promotes knowledge about its parts, or subsystems. But it may not necessarily clarify the manner in which the parts go together or the way the system contributes to the social system. And yet it is precisely such clarification that the planner must strive for. A dilemma arises. On the one hand is the desire for precision, which may enhance complexity; on the other is the need for simplicity, which militates against complexity and thus precision.

A complete systems analysis would picture everything as related to everything else: to take the view that there is only one system, the universe. If given free rein, this

inclination would lead the analyst to construct models in which a dependent variable, X_1, is a function of an infinite number of independent variables:

$$X_1 = F(X_2, X_3, \ldots, X\infty)$$

Furthermore, there would be an infinite number of such equations, which must be solved simultaneously if absolute precision is to be obtained. But some absolute precision must be foregone in the interests of simplicity (c.f. subsection 3 ii, chap.V). This means that some independent variables may be taken as given. Then the above equation becomes

$$X_1 = F(X_2, X_3, \ldots, Xj \;/\; Xj+1, \ldots, X\infty),$$

where the bar separates those variables treated explicitly from those taken as given.

The location of the bar in the equation may be determined so as to find that combination of precision and simplicity which serves the purpose in view. Given that universe is ultimately the only system, we have placed the bar between the various technically possible, socially adoptable and economically feasible renewable resource options in Kashmir, and the rest of the universe. But, since the variables prior to the bar include such consideration as comparative advantage, trade and world prices of consequences, the subsystems explicitly considered are treated as open; the influence on them is traceable from the rest of the 'universe' through production and demand conditions in the rest of India and the world. As regards systems other than renewable resources in Kashmir itself, they are presently much less important, are implicitly brought in relationship through overall considerations of the prevailing physiographic, social and economic conditions by planning for the entire

region, and are explicitly evaluated through an intersectoral analysis (c.f. chap.VIII).

iv. Systems models. A model is a statement of relationships designed to represent the significant aspects of reality. Models have two basic features. First, they are abstract from the real world: they include only those variables that are either significant or controllable by policy makers. Omitted variables become sources of error and uncertainty, which, however, can be expressed in a form useful for decision-making. Second, models may be built of various kinds of materials: a pilot plant, a miniature reservoir, and maps depicting relief with contour lines. In this thesis, we shall devise a synbolic model in mathematical terms. This is because the latter are particularly 'powerful', i.e. they express relationships and likely outcomes in explicit form and can be manipulated readily by using computers.

Kashmir's renewable resource system would be very difficult to reproduce as a pilot or scale model. Such models would be very expensive; yet it may be impossible to modify in order to predict alternative outcomes. A symbolic model, on the other hand, allows means for representing the system so that it can be subjected to almost any conceivable manipulation; e.g., forests, which would take decades to grow in pilot models, are grown to maturity and felled in less than a minute on computer and the consequences studied.

Since we are interested in how the variables of the system interact, we need not only a set of symbols but also rules by which the symbols can be related. This leads us to the choice of models which draw on mathematical rules and the computer for rapid mimicry of reality as well as of

possible outcomes with imaginary resource use adjustments. The latter is important. This is because in this thesis the essential condition is not whether the model mirrors what people do, but whether it provides a working hypothesis for improving renewable resource planning decisions.

v. Systems designing. Renewable resource systems may be created in almost infinite variety through different combinations of system units, levels of outputs and allocation of land to various uses. The aim of systems design is to select the combination of variables that ~~maximizes~~ is in accordance with the requirements of design criterion. This criterion itself is a function of the objectives which are chosen by society from among a number of alternatives.

Systems designing should enable the policy maker to make choice. Its methodology will, therefore, involve four related steps: identifying the objectives of design; translating the objectives into design criteria; using the criteria to devise 'plans' for the development of renewable resource systems that fulfil the criteria in the highest feasible degree; and evaluating the consequences of the plans that have been developed. These steps summarise the core of the investigation made in this thesis.

As discussed in section 3 supra, a choice of objectives is open to community from among a variety of combinations of economic efficiency and development, income redistribution by regions or economic groups, and other subsidiary 'aims'. The first step is to determine which of these alternatives reflects the consensus of the community concerned with renewable resource development. This we derive from the policy directives of the legislature as contained in national plans. However, with the lack of an explicit hierarchy and relative weights among the objectives, their translation

into design criteria demands greater precision in the statement of the objectives,[1] e.g., a high growth rate signifies efficient resource allocation, and a specified target rate of growth implies the rejection of all projects which do not pass muster with a particular discount factor.

Once the objectives - and constraints - have been determined, the methodology leads to the selection of that combination of options, levels of development for different renewable resource uses, and operating procedures that will best achieve the objective. Also, the methodology will demonstrate the cost to any one objective of substituting another; e.g. efficiency and distribution, or the cost in terms of efficiency of honouring an institutional constraint, such as a fixed budget. All this information can be used by the policy-maker to evaluate the consequences of objectives.

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1. In translating the objectives into design criteria and the criteria into system designs, conflicting policy aims may be confronted, e.g., efficiency in resource allocation and other Indian national developmental aims on the one hand and a forest policy which ignores national developmental objectives (c.f. appendix 1, p.189). In some instances the legislature purposely may have transferred to the executive responsibility for reconciling conflicting goals. This seems to be so regarding the aims of economic growth and distributional equity, which is sought to be reconciled in systems design along the lines indicated in subsection 3 vi supra. In other cases, the conflict may be revealed only in the process of moving towards greater specificity. This seems to be so for the conflict between national economic and forest policies, which has come to surface for the first time in this investigation. For resolving this conflict, we have adopted the national policy as overriding the forest policy, and from the concepts emanating from this thesis, a review of the forest policy is suggested.

In either of the above situations, the legislature may want to review the reconciliation proposed or effected by the executive as a result of the specific analyses. Sometimes when conflicts are revealed initially in the later stages of the planning process, the executive may choose to delay adopting criteria until further action is taken in the legislative process. In this thesis, however, we have proceeded with systems designing without seeking the review of the forest policy. This is tenable because, as will be seen in the following chapters, the outcomes of the various designs do not, in practice, conflict with this policy for the Kashmir region.

The seemingly unlimited freedom of selection among system components can be circumscribed. This is made possible by using techniques that enable the identification of those combinations of variables that lie on the production function curve and are technologically neither infeasible nor inefficient. These combinations must include the one that has the highest possible value of the objective function. The technique that will be used in this thesis adapts the design problem so that it can be solved mathematically. This allows a simultaneous consideration of a large number of alternatives, conjoining of renewable resource production technology and economics, and adaptation to any reasonable objective and institutional constraint.

Because of the need to synthesize objective analyses and policy-maker's value judgments for producing an acceptable design, absolute maximisation of one or the other objective function is not practicable. Instead, designing is geared to optimization. An optimal systems design would so combine systems units, outputs, and operating procedures that it fulfils the objectives better than any other. An attempt at identifying such a combination will be made in the next chapter.

For any given situation, there can only be one optimal design. However, since a sensitivity analysis is desirable for reaching decisions, more than one optimal design may be identified. Even if the methodology of systems design were unable to identify <u>the</u> optimal design - e.g. because of the need to keep analyses and value judgments reasonably separate - it would be possible to evaluate readily a number of designs optimal for each set of assumptions and design criteria. With the help of relative value weights on different

objectives or criteria, decision-maker would be assured that the 'best' of the possible designs approximates the theoretical optimum. To make it possible to isolate the best from the viewpoint of the policy-maker who oversees resource allocation, or economic development, the economic evaluation of the alternative designs will be attempted in chapter VIII.

vi. Policy, analysis and choice. Some of the conclusions emerging from the foregoing discussion may now be summarised.

Policy, design and analysis are among the key elements of planning, including decision-making. Policy relates to goals and decisions relate to means. And yet, while policy guides decisions, decisions in turn form policy. Just as ends and means are a continuous series, so are policy formation and decision-making.

Decisions should be made with a full knowledge of the possible alternative systems of use of renewable resources and of the consequences of such use. What are the costs and benefits of each alternative? What is the effect of each on future outcomes? These are questions that must be answered. Selection among alternatives depends on the socio-economic environment, goals and resources.

Investment analysis is part of the decision-making process. The analysis helps in objectifying resource allocation decisions by furnishing information about the comparative economic merits of alternative courses of action. The choice is ultimately in the policy maker's realm; planning involves both the analyst and the decision-maker.

The analysis should maximise the relevant information, in order to minimize decision-maker's reliance on value-judgments . Value judgments should not be interjected in the analytical process. This is so for two main reasons. Firstly, choices about expenditure from the public viewpoint are group choices. For these, there is no ultimately correct preferences function, i.e., choices whose preferredness cannot be subjected to any ultimate test. Secondly, it is possible to make explicit decisions for increasing general welfare only if expected outcomes are known explicitly, i.e., without having been distorted by judgments.[1]

The information that an evaluation yields may be restricted to one or more of the policy aims. Therefore, it has to be supplemented by additional information in order to present as complete a picture as possible of the social desirability of different courses of action.

An ex-ante analysis involves predictions and assumptions. Therefore, the comparative feasibility of options is dependent upon the nature of assumptions and is limited by the degree of approximation in the projections about future outcomes. These are beset with risk and uncertainty, and predictions are mere probabilities. Therefore, it is more objective to carry out analyses for different sets of assumptions, so that the decision-maker is free to choose a systems design that is considered most probably attainable and socially desirable.

Once the benefit-cost analyses of systems units or options are done, the above involves repetitive analyses of

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1. For instance, the 'expenditure decisions of public agencies should assume that the government as a whole will strive to attain a certain target employment rate. Spending on a project may be one of the tools used to achieve the target, but this is only a substitute for many other tools which could be used. Therefore, cost-benefit techniques used to evaluate projects should not be adjusted'... (Baxter et al, 1969).

whole systems. For this, systems analysis, by using a theoretical framework for representing the system, is a suitable method. Such analysis allows a conjoint consideration of the many variables, objectives and constraints as well as of the interrelationships between and among options, decisions and objectives.

The approach to decision-making advocated, in general terms, is a systematic way of setting out the pros and cons of the alternative proposals which have to be considered. It forces the proponents of various designs to deploy their arguments within a rigorous logical framework; if it does not produce agreement, it identifies the sources of disagreement. It avoids overlooking options, which would be the components of an optimal design. It quantifies as many of the arguments as possible, so that the relative weight to be given to each is explicitly assessed.

CHAPTER VII

PLANNING AND SCHEDULING

1. Introduction

Kashmir's present renewable resource use pattern has evolved in response to past needs and traditions of the inhabitants. The pattern may be altered to meet changing circumstances and needs. This involves adjustments in the application of human and material capital for resource development. These adjustments require to be consciously determined, as attempted in this chapter.

The procedure evolved here brings together the information generated in chapters III to V. The facts are marshalled within the framework for decision-making provided in the last chapter. The procedure is aimed at producing optimal resource use plans. This would remove the deficiencies of current planning practices in Kashmir, which are not systematic.

2. Place of Planning

In all countries, there is a certain amount of planning. In principle, it need not be tied to any specific form of organisation. It may be applied with or without the price mechanism, in a system of either private or public or mixed ownership of property and productive resources. It may be centralised or de-centralised, partial or total. Because of this flexibility and the different planning practices adopted in various countries, there is room for debating the role of national economic planning.

On the one hand are protagonists of 'comprehensive'

national development planning[1], i.e., planning aimed at directing economic activity both in the private and the public sectors. Among them are Lewis (1966), Rozen (1969), and Tinbergen (1967), who have produced concise treatises on the subject. Since planning requires data and most developing countries lack the right kind of data, some attempt at justifying planning without facts (Stopler 1966); and others emphasize the need for economizing on decision-making capacity in which the developing countries are deficient (Hirschman, 1966). Indeed, the interest in planning is so great that there is a continuous spate of articles, manuals and proceedings devoted to planning. It would be sufficient to record that more than 130 countries and dependent territories have central planning agencies (Waterston, 1969).

On the other hand, Bauer (1969) does not believe planning to be an effective instrument for dealing with development problems. Shenoy (1963) attributes everything amiss in the Indian economy to planning. Jewkes (1968) and Crosland (1963) argue against planning. While advocating reliance on the market economy, the latter, however, makes an important exception - land use and building - where he states that the market works 'ruinously' because 'the ratio of social to private cost or benefit is uniquely high.'

Yet others attack central planning arguing that 'with its rigid schedules and overburdened administrative apparatus, (it) is at a distinct disadvantage compared with the market system' (Sirkin, 1968, p.77). Even so, it is recognized that 'planning is the attempt, by centralizing the management of

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1. This is apart from the central planning adopted in socialist countries.

the allocation of resources sufficiently, to take into account social costs and social benefits which would be irrelevant to the calculations of the decentralized decision-maker' (ibid, p.45). Black (1968) favours 'indicative planning' whereby certain 'bodies are empowered in the public interest to impose certain restrictions on what people may do with what is otherwise their own'. However, he too states that 'positive and regulatory planning.. are necessary..in connection with monopoly and land use'.

This thesis is not aimed at contributing to the above debate. It accepts the fact that 'comprehensive' planning of a mixed-economy is applied in India. Also that even if such planning is not a panacea for the problems of a developing country, planning in the renewable resource sector is upheld on the grounds of the pervasive social costs associated with renewable resource use. In subsection 2 iii, chap. V, it has been shown that social control over renewable resource use is exercised in all countries, including those where even indicative planning is not practised.[1]

The planning exercise in this thesis does not involve a change in the economic philosophy adopted by the Indian society. Any adjustments in renewable resource use that will be required should be within the existing overall framework. Therefore, the investigation is geared to be consistent with the existing socio-economic framework.

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1. It may appear that we conform to Oliver Lyttleton's (1942) view: 'If anybody asks whether there should be more socialism or governmental planning, or more free enterprise, my answer is that there ought to be a great deal more of both.'

From the above, it may be clear that henceforth planning refers to the decision-making process regarding renewable resources (of Kashmir) and not of the economic system. However, this does not omit the scope for recommending changes or improvements in the economic institutions, so as to realise renewable resource-use adjustments.

Essentially the plan will be devised as a tool for allocational efficiency.[1] Such plans are important for developing countries, because there 'the interdependence of investment decisions..has a greater significance than for more advanced countries' (Chenery, 1965a). To achieve the purpose of planning, it will have six main characteristics, some of which have already been alluded to in this thesis:

1. It should encompass an area large enough to cover the problems.

2. It should be comprehensive, i.e. it should take into account all factors - physical, social, economic and institutional - that affect the area of planning concern. This is because uncoordinated efforts are wasteful.

3. It should represent an intention to act. Planning should be designed as a precedent to action. This may imply the need for a unified organisation clothed with development authority.

4. It should operate as a continuing function of management. As time passes, conditions change; data improve; new estimates are required; directives are modified and goals revised; and a new situation emerges. The methodology should allow for flexibility and revision of plans so that they are consistent with the general course of development. Planning is useful in reducing areas of uncertainty and improving calculations about the probability of future events. Despite limitations which make it far from a panacea, planning can contribute to the development and management of renewable resources.

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1. Efficiency defined in the broad sense (c.f. subsection V iv, appendix 6).

5. Planning should be directed to specified objectives. The vague policy statements, e.g. 'development', should be interpreted for use as relevant design criteria.

6. Planning should be governed by policies that conform to public views. Planning involves development policy, i.e., more than project goals (like targets of tons of steel or numbers of people to be rehabilitated). Policy decisions are involved in planning so that choice is made in consistence with society's aims. A professional planner makes recommendations or proposals but indicates value judgments on questions of public policy. The role of the economist is mainly the elucidation of issues involved and in particular exhausting all the possibilities before planning takes refuge in the ultimates, i.e., the value judgments.

3. Conventional Planning

Systems analysis is required for efficient utilisation of an area's renewable resources (c.f. section 5, chap.VI). The purpose of such analysis is the preparation of optimal resource-use plans. Conventional planning fails to recognize renewable resource systems designing as an optimization problem. Since it is merely an adhoc formulation of plans by independent 'planning' organizations, such planning leads to sub-optimum use of resources. The limitations of such practice may be grouped into the two categories: design criteria, and designing.

Design criteria. The objectives for development, e.g. economic efficiency and/or income redistribution are not specified precisely. They are not translated into operationally useful, or adequate, design criteria for planning:

1) At the outset of the planning process, certain physical objectives, or targets, may be specified arbitrarily rather than being developed from design criteria that are in consonance with the basic objectives of a plan. An a priori decision may be made, in advance of analysis, e.g. suggesting that a certain amount of foodgrains are required in Kashmir and must be produced; or that timber must be supplied in given volumes for meeting

domestic consumption demand and industrial needs. In effect, this practice sets up physical in lieu of economic objectives. But physical objectives alone cannot form an adequate frame of reference for acceptable design criteria (c.f. section II, appendix 6).

ii) Tolerable shortage levels for resource products may be assumed without a study of their implications in terms of design criteria. This is another form of arbitrary physical constraint. Sometimes, the need for maintaining or achieving certain minimum targets may be over-emphasised and not analytically evaluated, such as by an economic loss function. For instance, the tolerable limits of erosion may be set in accordance with considered judgment and experience. But while a limit of this type may be reasonable for one design, it may be uneconomical for another in which the savings obtained by conservation farming on a hilly slope may exceed the losses from increased erosion generated.

(iii) Existing institutional constraints may be accepted as binding without adequate consideration of their effect on design criteria. When constraints imposed by existing law, property ownership, administrative policy, or interstate agreements are accepted uncritically, a plan may be overlooked that will provide greater benefits in terms of the design criteria than will any plan honouring these constraints. Over longer periods, as for renewable resource planning, institutional constraints may lose their original force. As such, design criteria should have scope for application with and without the constraints, or with constraints at varying levels.

iv) The current practice is to prepare independently programmes for the various aspects of renewable resource use, e.g., agriculture, horticulture, forestry, soil conservation, animal husbandry, and dependent manufacturing industries. These programmes are then dovetailed into a plan conforming to 'some' sectoral budgetary constraint set in advance. This involves the pruning or modification of the programmes and their component schemes of the agencies concerned. Such a process does not allow for the application of systems design criteria for apportioning resources among competing programmes. Priorities among them as well as the schemes are set by artificially constraining the mobility of resources. Loss of efficiency, and inconsistency in inter- and intra-sectoral development is most likely. This is more so because neither the programmes nor the schemes are evaluated commensurably, e.g., diverse performance standards, such as past expenditures and physical achievements measured in different units, are used to justify allocation to one scheme or programme rather than the other (c.f. subsection 7 i, chap.V).

v) Distinction between objectives and constraints is rarely made. What may be a constraint, such as limited foreign exchange, is specified as an objective (Streeten, 1966, p.40).

vi) With multiplicity of objectives, criteria are used which either ignore the main design criteria or arbitrarily trade-off one objective against the other (Marglin, 1967).

vii) Some renewable resource use criteria may be inconsistent with or inimical to national objectives, e.g., rigid conservation policies in view of the need to convert natural resources into more productive capital for development.

Designing. The techniques for project formulation are ineffective in finding the best design, even though the objectives and design criteria were to be stated precisely:

i) Too few of the many technically feasible options that have economic merit are considered. The techniques used do not ensure a systematic identification and/or evaluation of all possible options. As such, the probability is high that the plan selected will create significantly lower resource use efficiency, or net benefits than actually attainable.

ii) System units may be eliminated without fully considering their benefits and costs. Sites may be excluded from study solely because irrigation facilities or roads do not exist. But these sites may be competitively economical for development because of favourable topography, soil and location, so that total net benefits may be high even if certain facilities have to be provided denovo.

iii) Systems units may be included without considering their benefits and costs. Sometimes it may be economical to leave a resource area unused, because complementary resources are more productively employed elsewhere. But the present planning practice is that if there is an existing use, it is perpetuated as part of the overall system. The reason adduced is that given the pressure on land, it is undesirable to make no use of it.

iv) Plans are often formulated from the suitability of sites for what may be a profitable use by itself, i.e., in a manner tantamount to assuming that 'nothing' or no use exists now (c.f. paragraph 6, subsection V ii, appendix 6). For example, paddy sites in Kashmir are usually proposed for apple production, because the yearly returns from established orchards on similar sites are high. Such generalised prescriptions ignore the cost of adjustments; a shift from paddy to apple

production may, in effect, be less profitable because of no incomes and higher costs during the establishment period for the latter. The present use pattern should not be ignored, i.e., the maintenance of status quo for each possible use must be considered as an option in the context of the overall system.

v) The practice of formulating plans from individually appraised schemes is unlikely to lead to optimal designs. The preclusion of a scheme by accepting its alternative does not consider a combination of the two, which may be superior to either of them. The accept-reject principle is unhelpful even if individual acceptability is 'rigorously' evaluated and even if combined schemes are considered. The interaction may not only affect the independent ranking order but will alter the feasibility of combinations of options and their scales, when considered together. Current planning procedures offer no scope for the simultaneous assessment of options in different mixes nor the chain of effects, and their sum-total, from various possible changes in resource use.

vi) The technique of selecting a tentative plan and applying crude incremental analysis[1], viz., the current practice of enhancing next year's allocation to a scheme when earlier 'expenditure targets are satisfactorily fulfilled', is inadequate. If several widely different designs yield high net benefits on test, and the pilot design itself, as modified by incremental analysis, does not produce close to the highest net benefits, incremental analysis may fail to isolate the optimal design. Some of the conceptual difficulties are discussed in the next section.

4. Marginal Analysis and Constrained Maxima

A planner could isolate an efficient opportunity for resource use from one that is less so with the help of marginal

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1. The so-called incremental analysis as applied at present is not strictly marginal analysis, discussed in the next section. The analysis may be conceived as a procedure for adding to or substracting from a tentative plan substantial segments of purpose, or levels of output. The resulting physical effects on the system as a whole are determined and also the consequent benefits and costs. The difference between the consequences before and after modification would constitute respectively the incremental gross benefits and the incremental costs attributable to each increment.

analysis. This is a decision-making tool for maximising an objective, say profits, by pushing production till marginal cost equals marginal revenue. This principle cannot always be applied however. With side conditions or constraints, e.g., limited resources, production cannot be pushed to the zero marginal net value product level.

The above case may be dealt with as one of finding the largest (profit) values attainable within the permitted range of variables. This is a constrained maximization problem. Here we are not interested in the entire production surface, but only in that part which corresponds to input combinations within the bounds set by constraining limits. This involves the rule of relative activity levels: for optimal results activities should, wherever possible, be carried to levels where they all yield the same marginal returns per unit effort (cost).

A constrained maximization problem can be solved by specifying the constraints as equations. The problem can be converted into an ordinary unconstrained maximization problem by using the constraints to eliminate successively one of the variables through substitution of the equations. The procedure is to differentiate partially for each variable in turn and to set each of the partial derivatives equal to zero. This gives as many equations as variables, which can be solved for optimum values of variables.

The above procedure is often unhelpful if, in addition to the partial-derivative-equal-to-zero conditions, the constraint equations must also be satisfied. Such a problem has more equations than unknowns and is overdetermined. In such cases, artificial variables, as many as the constraints, can be introduced to increase the number of unknowns to equal

the number of partial derivative and the constraint equations. The use of the artificial unknowns, i.e. the Lagrange multipliers, yields Lagrangian expressions. These can be solved by differentiating partially for each unknown and setting the results equal to zero.[1]

There are two main reasons why the above analyses are not satisfactory. Firstly, the marginal maximization condition, though necessary, is insufficient for an optimum. Non-optimal situations can also satisfy the marginal, or the first-order condition. It is possible to have points at which marginal yields are zero but not maximal. Points on flat segments of a curve have zero slope, corresponding to zero marginal yields. Yet, they may be located anywhere below the peak. Such possibility may be covered by a second-order condition. This requires that the curve in the neighbourhood of the maximal point take the shape of an up-side down U. Even the second-order condition may not ensure the attainment of the maximal point

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1. To obtain the Lagrangian expressions for problems with more than one constraint, each of the constraints is multiplied by a different multiplier added to the original expression whose value is to be maximized. Subsequently, it is argued that marginal techniques are inapplicable under certain conditions, among others those involving inequality constraints. But the arguments are not against the scope of Lagrange multipliers. In situations with more than one constraints, Bellman (1957) suggests that a second constraint can be handled by a Lagrangian multiplier: 'The value of λ is varied until the second (original) constraint is satisfied' Lagrange multipliers have also been used to solve problems with inequalities specifically through extensions involving Kuhn-Tucker conditions (Kuhn and Tucker, 1951). However, difficulties exist, such as the problem solved may not be the problem originally stated (Charnes and Cooper, 1965).

owing to the occurrence of local and corner maxima.[1]

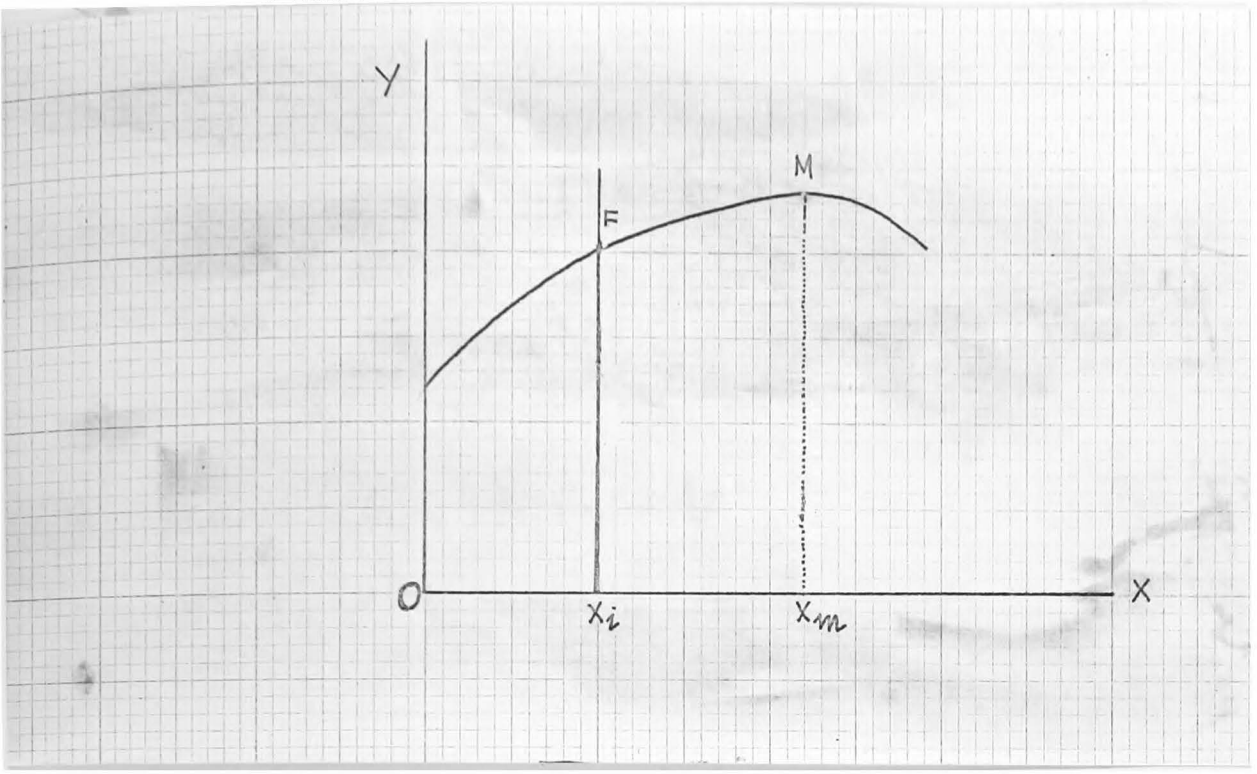
Secondly, marginal analyses dealt with by calculus are applicable only if side conditions, or constraints, are expressible as equations. For this, the constraints should be precise. But usually they are a certain minimum, or maximum, e.g. timber output must not be less than the sustained annual requirement, or, conversely, sugar-cane production must not exceed an agreed quota limit. Sometimes, real-world constraints are more complex. These may be bounded restrictions, e.g., labour use must not be less than the numbers employed now or some other minimum, and also it must not exceed the total availability in a certain area.

Marginal analysis finds the point at which marginal profit (the slope of the total profit curve) equals zero (output OX_m in figure 7.1 corresponding to M the maximum

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1. With the former, this condition holds only for limited ranges of a curve because of the multiplicity of maxima, i.e., a series of inverted Us or hills. The tallest hill carries the highest point or the global maximum. But the other hill-tops equally satisfy boththe first- and the second-order conditions. Corner maxima arise where a curve cuts one of the axes or at some other end-point of its relevant range. Therefore, none of the 'maximum' points correspond to pertinent profit level. A related difficulty stems from breaks and kinks in the production function graph. At such points, the slope, i.e. the derivative, is not defined. One of these points may represent maxima of the functions, but none can conceptually equate marginal cost to marginal revenue.

Fig.7.1 Marginal Principle and limited variable value.



level point). If the output is limited by the inequality constraint that production cannot exceed OX_i , the problem is to find whether the point of maximum attainable profit is OX_i, or some point to its left. For this, the first order conditions of marginal analysis cannot be employed; for at the optimum point, OX_i, the marginal criterion-marginal profit equals the slope of the total profit curve equals zero - is invalid. The first order derivative maximum condition $dY/dX = 0$ is economically irrelevant, being unattainable. The maximum feasible point is F, where $dY/dX > 0$, so that the derivative maximization rule is violated. In this example, the optimal value OX_i is obvious. But when the variables are large in number, as in the use of Kashmir's renewable resources, the solution is far from obvious.

The foregoing does not deny the validity of the marginal principle for efficient resource allocation. It, however, shows that the analytical technique is not operational for dealing with the planning problem considered here. Now, we shall set out a method, which retains the essence of the marginal principle as well as overcomes the difficulties in marginal analysis.

5. Operations Research Technique

It was indicated in subsection 4 iv, chap.IV that there are many ways of using Kashmir's renewable resource area. When considered independently, the sum of the areas possible for the different uses is about 16 million acres as against only 3 million acres available. This disparity arises from the fact that many land classes are suitable for more than one use. This problem of the mutual exclusiveness of options has now to be settled. For this, we resort to operations research.

The essential features of operations research are 'its systems orientation, its use of interdisciplinary teams, and its methodology...The systems approach to problems is based on the observation that in organized systems the behavior of any part ultimately has some effect on the performance of every other part' (Ackoff, 1968). Such approach can be used to solve many different planning and strategy problems, e.g. inventory and transportation problems. Here we shall use it for solving Kashmir's renewable resource use problem in the manner discussed in the remaining part of this chapter.

The above problem is viewed as one of 'allocating limited resources, e.g., land, among different eligible activities[1]

1. These are equivalent to 'options' for resource use thought as a choice variable indicating the level of some operation called an activity or process. Each of these is some physical operation and may be almost any operation, e.g.,consuming land, capital or budget; producing grain, apples or timber; using one or the other technique in consuming or producing. In addition to these real activities are slack or fictitious activities explained in the next footnote.

each of which could absorb resources in proportion to its level of utilisation. Each activity also contributes to the attainment of the objectives in proportion to its utilisation. For solving this problem, we have to discover a set of activity levels attainable within the resource limitations which leads to maximum possible attainment of the objectives, i.e., a set which optimizes resource use.

Such optimization can be attained through a programming method. The latter is discussed in section III, appendix 11. The operation of the method is illustrated below.

Consider land and labour as limited resources for producing commodities C_1 and C_2, with the following production possibilities:

$$.1C_1 + .05C_2 = 200 \text{ (Land)} \quad \ldots\ldots\ldots \quad (1)$$

$$.5C_1 + .3C_2 = 1{,}140 \text{ (Labour)} \quad \ldots\ldots \quad (2)$$

The two production possibilities can be respectively expressed for one commodity in terms of the other as below:

$$C_1 = 2{,}000 - .5C_2 \quad \ldots\ldots\ldots\ldots \quad (3)$$

$$C_1 = 2{,}280 - .6C_2 \quad \ldots\ldots\ldots\ldots \quad (4)$$

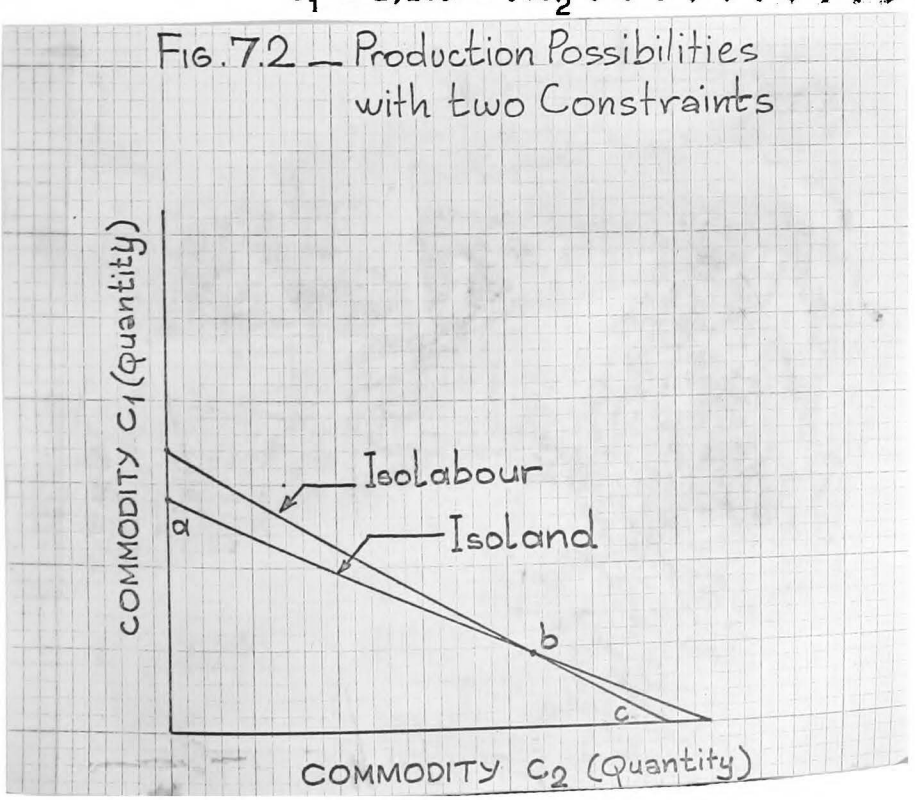


FIG. 7.2 — Production Possibilities with two Constraints

Two isoresource curves can now be plotted for land and labour as shown in Fig. 7.2, each representing all combinations of commodities which could be produced i.e., if the other resource were not limiting. The two curves intersect, denoting that a different resource limits outputs for different commodity combinations. The production possibilities are only those represented by abc. The distance between the isoland and isolabour curves, on either side of b, if converted from commodity outputs to resource requirements, represents the amount of labour and land which must go unused for programs selected along segments ab and bc respectively.

Only a single program, represented by the combination C_1 and C_2 at point b, exhausts the supply of both resources, i.e., a program which is consistent with resource restrictions defined as equalities in the above equations. However, a more desirable program may be one letting some quantity of either land or labour go unused. In fact, a single program exhausting the supply of all resources seldom can be found, if many resources are involved.[1] Slack

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1. From this, it is clear that the real-world resource allocation problem cannot generally be formulated as equalities. Instead, equations 1 and 2 above would be

$$.1C_1 + .05C_2 \leq 200 \quad \ldots\ldots\ldots \quad (1a)$$

$$.5C_1 + .3C_2 \leq 1140 \quad \ldots\ldots\ldots \quad (2a)$$

Now, it is convenient to think of fictitious processes which do not correspond to any physical operation. We may think of a process which uses excess land or labour, so that

$$.1C_1 + .05C_2 + \text{excess land} = 200 \quad \ldots \quad (1b)$$

$$.5C_1 + .3C_2 + \text{excess labour} = 1140. \quad \ldots \quad (2b)$$

Equation 1a and 1b, and 2a and 2b indicate equivalent restrictions, because the excess land or labour, called the slack variables, are inherently non-negative. In this way the introduction of slack, or disposal activities allows for the non-use of resources and wards off inconsistency among resource restrictions. The latter usually arises if more than one constraint is retained as an equality for real activities This is because it is not possible to satisfy simultaneously all the constraints fully, i.e., there may not be a set of real activities which exhausts all the budget, all the land, all

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activities are introduced to allow for this. Starting with inequalities and adding slack variables to production possibilities as equations, the program is not restricted to a single feasible point, such as b in the figure, if such a point does exist. With more than one resource constraint expressed as equations, it may be impossible to have such a point, i.e., no solution exists.

The effective production possibilities in the above examples are represented by the curve abc with corners at the point of intersection at b and at points a and c. The optimum generally never falls between the corner points, because linear segments denote constant rates of substitution. The slopes of segments ab and bc on the possibility curve are marginal substitution rates. Along ab, the rate of substitution of commodity C_2 for commodity C_1

$$\frac{C_1}{C_2}$$ is the ratio $$\frac{\text{land requirement per unit of } C_2}{\text{land requirement per unit of } C_1},$$

or .05/.1 = .5. Similarly, the rate of substitution along the bc segment is determined by the ratio of labour requirements, which is $\frac{.3}{.5}$ = .6. The point a can be selected as one feasible program.[1] It includes 2000 units of C_1[2], the maximum that is allowed by the land production possibility equation (3)[2]. Points b and c represent the other feasible

---

..... ~~the land, all~~ the labour as well as produces as much grain, timber and apples as is demanded. With slacks, the possibility of violating the constraints is eliminated, even though the limits for them are not reached exactly.

1. The program is feasible in the sense that it does not require resources in excess of the total resource supplies.

2. To produce the maximum amount of C_1 would require more land than is available.

programs.

Now the choice problem is to identify which one of the three feasible programs is the optimal program. The optimal program is one which, subject to the constraints, maximizes[1] (or minimizes) an objective expressed as a linear function of the variables, i.e. of the various commodity production options. This can be expressed as the objective function equation:

$$Zo = P_{c1}\ C_1 + P_{c2}\ C_2\ , \ldots\ldots\ldots\ldots \quad (5)$$

Where Zo is, say, the net social benefit or profit, P_{c1} the present social worth or profit per unit of the commodity production process C_1 and P_{c2} that of the commodity C_2. Given these objective function values, the optimum program can be defined with the help of a criterion equation:

$$\Delta Zo = P_{c2} - P_{c1} \quad \frac{\Delta\ C_1}{\Delta\ C_2}\ , \ldots\ldots \quad (6)$$

Where Δ Zo is the change in profit associated with each one-unit increase in the commodity production process not in the feasible program, i.e. the one at zero level, such as C_2 at point a. If the objective function value increases

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1. In this thesis the problem is of maximisation of a function representing the social desirability of alternatives, e.g., benefits over costs. This is possible by determining the benefit-cost objective function values for each activity as attempted in chap. V. If, however, the problem were simpler, e.g. minimising the time taken in completing an operation, or if a benefit-cost analysis were not done, the approach could be merely one of minimisation of time or effort respectively. However, this would be a partial treatment of our problem, for even if costs were minimised they may still be great. This is because costs would not be brought in relation to benefits (c.f. IV vi, appendix 6).

for such change from one feasible program to another, the former is not the optimal one. Such search continues till no improvement is effected, i.e., the optimum program is reached.

To illustrate, suppose P_{c2} is 0.80 and P_{c1} 1.50, the criterion equation is

$$Zo = .80 - (1.50)\ (.5) = .05.$$

Profit can be increased by substituting C_2 for C_1, at least up to point b, where the substitution rate changes from 0.5 to 0.6 and where the second feasible program represents a combination of 600 units of C_1 and 2800 units of C_2 against only 2000 units of C_1 at point a. Applying the criterion equation to determine whether the program should change from b to c, we have $Zo = .80 - (1.50)(0.6) = -.10$. Since Zo is negative, a further increase in C_2 would decrease profit. Thus we have a programming solution to the problem, i.e., point b represents not only a feasible program but it is also the optimum program.

The above example explains the general concept of the programming method. In this example, we drew the production possibility curve, letting slack activities be represented by the difference between the two isocurves, and started with an arbitrarily chosen initial feasible program which included one of the real activities, i.e., the production of commodity C_1. On the other hand, the Simplex computing procedure, a version of which is used in this thesis, begins with an initial feasible program which includes slack activities at non-zero level rather than the real production processes which are placed at a zero level, i.e. are not produced . This is a more systematic procedure for complex problems, such as Kashmir's which include large number of variables and resource constraints.

From the initial feasible program, real activities are introduced one at a time until an optimum program is determined. For this the production possibilities are expressed as a system of linear relationships. These equations, when defined in terms of real activities only, state that the sum of resources required by the several crops must be equal to or less than the individual resource supplies. The input-output coefficients or per unit requirement for each crop is multiplied by the amount of crop produced. The sum of these products indicates the amount of resources, say land, used for all crops in the program. Another equation for the objective function showing the 'profit' coefficient for each activity similarly yields the sum of the profit from different crops in a feasible program. The feasibility of programmes selected is ensured by the use of slack variables. Their number is generally equal to the number of resource restrictions or equations. With m constraints and k real activities, the total number of activities is m + k. The number of activities in any feasible program, including the slack and real activities, cannot exceed the number of constraint equations.

It may be mathematically or physically impossible to force a program which just exactly uses all the given resources. Slack activities, avert the infeasibility of a solution to a problem due to the inconsistency of the various constraints, simultaneously allowing for the transformation of inequalities into equations for solution by the simplex procedure. (c.f. footnote on page 253). They allow for the non-use of one or more resources so that ordinarily the optimum plan will include one or more

slack activities at non-zero level, although it will always exhaust the supply of some resources.

With slack activities added to the production possibility relationships, the objective function becomes

$$Zo = P_{c1}\, C_1 + P_{c2}\, C_2 + 0\, C_3 + 0\, C_4.$$

By selecting the initial program with only slack activities as positive, and real activities at zero level the objective function value is zero. But the program is feasible because slack activities equal resource supplies. Starting with this feasible program, the simplex procedure changes to new feasible programs, increasing it above zero level in order to increase the 'profit'. This iterative procedure selects new real activities on the basis of criterion equation, discussed earlier, till a feasible program is attained which cannot be improved, i.e., the optimal program.

The theoryof the Simplex programming method and its ability to deal algebraically with problems involving interdependent activities and inequality constraints is discussed in section III, appendix 11. It is also indicated there that for designing Kashmir's renewable resource systems we have used the revised Simplex, or the inverse matrix, method (product form). Both this and the original Simplex method are in principle similar, but the product form has different computational procedure which makes it easy to handle accurately a large problem of the size considered here. This procedure is explained in appendix 12, with special reference to the Mathematical Programming System 360 used in optimizing the system.

Before closing this section, it may be repeated that the operations research technique just discussed rests on the marginal principle. The productivity curves of the

programming procedure do exhibit diminishing returns and, in particular, diminishing marginal products. One objection that could be levelled ag inst the method is that the decreases occur in discontinuous jumps, subsuming that the production function is linear and homogeneous. But, as pointed out in footnote 3, appendix 11, we have reckoned with this conceptual difficulty firstly by including individual, competing, activities or processes for different points of the production possibility curve with corresponding objective function values and technical coefficients.

Secondly, the various production activities are computed separately for the different land types; within these the per acre inputs and outputs are homogenous for the individual commodity production techniques.

Thirdly, our approach probes even more deeply than the marginal technique by showing what lies behind the production function in terms of the optimal choice of process combinations for any set of input or output levels. This is because the neoclassical theory assumes that the optimal technical production processes have somehow been already determined and that the production function shows what is the largest possible output for every input combination. From section II, appendix 11, it is clear that the above assumption is not realistic in systems designing, because the choice of an optimal combination of production processes cannot be made directly for attaining a certain maximum objective. On the other hand, the programming approach adopted here involves no such presumption; for the optimal combinations are arrived as a result of the programming solution. In the programming method, the selection of activities, i.e. the production processes and their levels,

is made after simultaneously considering all possible combinations of the production processes and assessing marginal changes through changes in their levels from zero upwards. It may now be seen that the basic points of view of marginal analysis and programming are not so different after all.

6. The Plan Frame

The theoretical plan frame, or the model, for optimizing Kashmir's renewable resource use is set out in section IV, appendix 11. In brief, the model involves five different aspects of the designing problem: i) the objective, ii) the constraints on the pursuit of the objective, iii) the various discrete options or activities for using Kashmir's renewable resources, iv) the relationship between each activity and particular constraint, and v) the values in terms of policy goals associated with each activity.

The objective is the maximization of the relationship between social benefits and social costs, viz., the present social worth, and the benefit to cost ratio. The achievement of the objective is subject to constraints. Foremost among these is the restricted availability of i) the total land, and ii) the lands of various types, each of which are not suitable for all the production processes. The other constraints are for iii) the output levels and demand of various commodities, iv) the use of labour and material inputs, v) the levels of profit to private producers, overall financial benefits, and the budget. These constraints are specified for different periods of the production processes - usually for the year of resource use adjustment, and for subsequent five year periods. The labour constraint is specified also for the peak seasons, i.e.during sowing and harvesting of crops, in a year.

The potential of Kashmir's renewable resources offers opportunity for using them in many different ways. Firstly, there is possibility to produce 23 main types of goods and services from the arable -, forest - and pasture - lands. Secondly, for each of the different commodity types there are many production techniques. Each production process comprises an activity in the model., whether the process produces one or the other commodity. Some processes produce more than one commodity, viz., multiple-use of land, such as timber-cum-grazing activity, or rotational cropping such as paddy-cum-green manure crop production activity. The total number of activities - single commodity as well as joint production processes[1] - analysed in this thesis is 1187, the largest ever considered for such a planning problem.

The relationship between activities and constraints is crucial in determining the optimal combination of the activities. The relationship depends on the nature of each constraint and the 'contribution' that an activity makes in fulfilling it. The contribution is indicated by a coefficient which, when multiplied by the activity level, uses (or so to say takes away) a proportionate amount of the constraining resource when the latter is a less than or equality restriction, e.g., the (maximum) limit on the availability of land. On the other hand when the constraint

---

1. Littlechild (1970) has recently discussed the case of marginal-cost pricing in electricity involving joint production. He too concludes that the various optimal rules may be obtained 'succinctly via a programming approach' and that the cost minimising approach advocated for such cases 'does not yield a unique set of marginal costs' (c.f. footnote on page 255).

is expressed as a greater than or equality restriction, e.g., the minimum limit on fulfilling demand for a commodity or on providing employment, an activity's contribution is indicated by a coefficient for it against that constraint, which when multiplied by the activity level proportionately adds to in attaining or exceeding the minimum constraint limit.

Through the above relationship between an activity and a constraint, the inter-relatedness of activities comes to the surface. For example, the relationship between farm-forestry activity on an acre affects constraint (i) above (i.e. total land) by precluding all other activities from using an extra acre, and constraint (ii) by using an acre from among arable land types. It may specifically use paddy type land, so that paddy production and all other possible activities are precluded.

Furthermore, there is a constraint relating farm-forestry and farming to keep their proportions consistent. This indicates that for every farming acre in the optimal solution 0.1 acre is under farm-forestry. The inclusion of one acre activity for farm forestry, therefore, implies that 9 acres are included in the solution for farming. This means 10 acres are excluded from possible non-farming activities, e.g., apple cultivation. Also, since farm-forestry has a high objective function value, its contribution to the maximand encourages the inclusion of farming options, i.e., a low objective function value of, say, a paddy production activity is compensated by a high value for farm-forestry, because conceptually the two activities share the same acre of land in contrast to other activities which are not 'linked' with farm-forestry.

In the above example, other relationships exist between the activity and the remaining constraints. The relationship for (iii) type of above constraints is indicated by the amount of poplar and willow-wood produced at the felling stages and during thinnings. All other wood production activities, e.g., forestry, are accordingly affected by the constraint on demand for wood in different periods. The willow woodlots yield fodder through intermittent pollarding, so that this activity reduces the deficit in winter fodder supply and augments the summer grazing activities.

The relationship with constraint (iv) is the amount of labour and other inputs required for planting, maintenance, thinning and felling of farm-forests. Since the labour for this activity is required in off-season, it does not curtail other intensive farming activities. The material inputs required for it also do not preclude other investment options to any significant extent. On the other hand, through the activity's relationship with constraint (v) above it contributes to peasants' incomes and does not call for governmental budget. As such, every acre alloted to it relieves the budget for an intensive use of the remaining area; however, it precludes availability of peasant labour to other options during farm-forestry operations, so that they cannot take advantage of incomes possible from other sources during parts of particular years.

Some other relationships between farm-forestry and particular constraints, and through them with all other activities could be traced. Similar is the case with all other activities considered here. Mentioning them too would not add to the point that seems clear now; the importance of these relationships and of the constraints.

All these relationships for each activity are considered during the programming analysis of the model.

Now turning to the fifth feature of the model, it may be recalled that a format for social benefit-cost analysis has been devised in chapter V. The format is intended to measure consequences of options realistically and in such a comprehensive manner that the effects of different renewable resource uses are objectively assessed. Such an analysis has been made for all the 1187 activities and results summarised as the 'value' associated with each. These values are computed for consequences through the course of an action and attached to each activity as a commensurable index of their cost-benefit ranking.

After compiling the foregoing data, a matrix[1] is built showing activities as columns, and constraints as rows. The objective function row separately carries the maximand coefficient for each activity. This is a free row[2], for the objectis to maximise the function as far as possible,

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1. The matrix built for this thesis is the biggest ever for a problem of the kind tackled here. Because of its immensity, it is not reproduced in original; however for record and for giving an idea of the activities and their relationships with constraints, a 'Picture' of the matrix has been drawn up with the help of the computer. ~~The Picture is given in the annexure to this thesis.~~ The coefficients for the variables are symbolically represented; ~~the magnitudes of the various symbols are indicated on Page 2 in continuation of the Picture.~~

2. Actually, we have multiple objective functions; that is we have 9 free rows for this. This complication is introduced to test the sensitivity of optimal combinations of activities to variations in maximand values. However, this does not change the theoretical framework of the model.

i.e., it has no constraint level. For the other rows, there is a right hand side. In it are entered the actual constraint limits. Also indicated in the matrix is the nature of each constraint, viz., equality or inequality; if the latter, whether greater than or less than the constraint level. For each column, i.e. activity, the resource use output coefficients are entered in the same units as are the constraining totals in the right hand side[1].

Now the problem is simply of maximizing the objective function

$$Z = cx,$$

subject to a set of constraints (145 in all)

$$Ax = b,$$

$$x \geqslant 0,$$

where Z is the maximand, and x represents the set of activities, c the value coefficients, b the constraints and A the matrix of coefficients relating the activities and constraints.

The above system consists of a set of simultaneous linear equations. The number of variables, or activities, exceeds the number of equations, or constraints. The number of feasible solutions to such a set of equations is large. By applying the programming procedure, discussed in the earlier section, that feasible solution to the system can be identified which maximizes the objectives function, i.e., the one which is optimal.

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1. A practical point that emerged during programming is that computational procedure becomes complicated if activity coefficients are expressed in widely differing magnitudes, e.g. tens of tons of output as against millions of rupees of budget or labour days. This was rectified by approximating the coefficients within a reasonable extent to each other's magnitudes by appropriate insertion of decimal points. There are other points of practical use too, some new, in the sense that they are not mentioned in literature, and others not so. However, they are not central to the arguments in this thesis.

7. Planning Horizon and Dynamic Scheduling

The Indian national plans are formulated for five year periods. The plans for states, including Kashmir, run concurrently. A five year period is too short for evaluating renewable resource activities, because many of them are long-maturing. The practice is to adopt a hundred year (or infinite) time horizon in forestry planning (Gane,1969). This is too long, because of the (complete) uncertainty of the very distant consequences.[1] In this thesis a 30 year planning horizon is adopted. This is the shortest ever horizon adopted for planning which includes forestry and land development.[2]

Ideally, the planning horizon should coincide with the national planning period to avert divergencies between a renewable resource and a national economic plan. But, because some investments do not start yielding within five years of an outlay, a perspective planning approach is required.[3]

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1. Especially technological, including the rise of substitutes.For instance, certain distant changes, which cannot be forseen even dimly, may invalidate a plan which includes activities whose present values are great owing to benefits that are assumed to accrue a hundred years hence.

2. There is no firm guiding principle in the decision theory about what an optimal planning period is.

3. This applies to durable investments outside the renewable resource sector too. As such, national perspective plans are drawn up in India. Since these plans are for 15 year periods with projections for the subsequent perspective plan period, the adoption of the 30 year planning horizon is satisfactory also from the national view-point. Further, there are projections for various national and international parameters, e.g. population and income growth, available for the year 2000 which is co-terminus with the 30 year planning horizon adopted here.

Then, the above divergencies would be reduced by specifying the consequences of an action for the five year periods during the perspective plan period. This is the approach adopted in this thesis.

Thirty years qualify as the shortest possible planning period, firstly, because it coincides with the longest production cycle, i.e., for horticultural activities such as apple production. Secondly, all other activities are such that they terminate at the end of this period after fully completing two or more production cycles. That is, 30 years are the highest common factor for all the production periods considered here; e.g., 30 cycles for annual agricultural crops,[1] two cycles each of 15 years' length for plantation forests.

A third reason is that the high-forest rotations presently adopted, e.g. 120 years for deodar and pine, and 150 years for fir, as well those proposed as alternatives, e.g. 90 and 60 years, are all multiples of 30. As such, the difficulty of the lengthy rotations for high-forests is conveniently reduced by reckoning their consequences on a sustained-yield basis.[2]

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1. Actually there are only 25 or so cycles because of fallow rotational years during the planning horizon.

2. That is the high-forestry practice has an annual production cycle, with one fifth, one fourth, one third and one half of an eligible acre felled and regenerated every year for rotation lengths of 150, 120, 90 and 60 years respectively. It is not that every one fifth or any other fraction of an acre be actually felled and regenerated annually. This is only a conceptual explanation; instead periodic blocks are adopted for regeneration whose period in practice <u>is</u> 30 years. This too favours the adoption of a 30 year planning horizon.
   The high forests are not to be created <u>de novo</u>. They are already existing and the options are either to fell and regenerate them or to change them to any other possible production process. For the former, the above approach is applicable, and for the latter the problem does not arise because all other processes can be appropriately accommodated within 30 years.
   By using the sustained-yield concept, we do not concede to a case for conserving forests (c.f. pp.26-27, appendix 3). The concept is used as a starting point from which one may

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The sequencing of resource use adjustments during the planning horizon has not been regarded in any renewable resource plan so far. But this is an important aspect of renewable resource planning, because it involves the dynamics[1] of individual production processes as well as their interrelationships through time. The sequencing problem arises from various causes, firstly the age of an investment project. For example, many years elapse between planting of an apple orchard and its first crop, i.e. the maturation period. During this time the investment in apple trees yields no benefit. Even if a project requires no physical maturation period, though many options in this thesis do, it may require an economic maturation period, i.e. the gestation lag.

Another feature of age is that oledity causes a project to deteriorate physically. The result is that its outputs can be maintained at former rates only by expensive maintenance and replacement outlays. Old age eventually drives the net benefit rate of most projects to zero. It is the age factor that conditions the choice of rotation lengths for various crops and the felling dates of a particular kind

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....change to production levels different from those in vogue now. This would depend on costs and returns associated with different production techniques, e.g., a longer versus a shorter rotation, timber production with and without resin production, or production for pulp versus saw-timber. All such options are considered in this thesis with a view to maximise value yields from the high-forests rather than adhering to any rigid norm of sustained production.

1. The word dynamic conveys that time enters in an essential way. No doubt we have already taken time into account by reflecting the expected consequences of activities over time. But such evaluation does not take time into account in an equally essential way, i.e., the impact on an activity's merits of delaying its initiation. It is by the latter quality that dynamic from static rules may be distinguished here. Such distinction would enable the integration of the 'when' with the 'what' of investment planning in yet another way.

of forest differently.[1]

A second cause for the sequencing problem is the role of calendar time. Quite apart from the age of a project, it produces changes over time in the demands for, and hence the benefits, of particular commodity outputs. The demand for foodgrains may be higher in 1980 than in 1970. Therefore, during the planning horizon, a project which starts yielding to the 1980 level right from 1970 would be les beneficial (in net value terms) than the one which is timed according to demand changes. Obversely, local labour may not be sufficient for undertaking all projects now, calling for mechanisation or higher costs for imported labour. But if the projects are phased, all the component units of an optimal design could be implemented (probably with higher net present value), using only the local labour as well as assuring perennial employment.

In view of the influence of calendar time, we have to consider more than simply <u>whether</u> to initiate a resource-use adjustment; we have to consider <u>when</u> to do so as well. For this, we must substitute a dynamic decision framework, in which the initiation date is a choice variable, for a static framework, in which only the yes or no question of the desirability of immediate initiation is answered. For it is possible that the economic merit of an option could be improved by postponing it. It is also possible that

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1. E.g., till senility when growth increment has retarted and decay sets in, till maximum financial revenue when marginal value increment falls below zero with positive average revenue, or till economic efficiency in resource use can be ensured such as an age after which the net value increment rate falls below the discount rate. Such considerations would affect the choice of production cycles for the various crops of fruit and wood for instance.

postponement may even change the present worth of a project from negative amount for construction today to a positive amount for construction at a future date. This is because postponement always reduces the present value of the construction outlay, so long as the absolute cost does not increase over time and the interest rate is positive. Thus, if the calendar time component of the benefit rate is increasing over time, the loss in the present value of benefits from postponement may be more than offset by the savings in the present value of cost.

The significance of the above discussion is that we cannot be guided by a single number, e.g. the present worth and benefit to cost ratio of a project for immediate construction, but must look behind this number and at the underlying benefit stream in order to answer the crucial 'when' question. This is because firstly the postponement of a project beyond the date for which it first shows a positive net present value can increase the present value. Secondly, sometimes the present value reflects distant benefits that can still be captured if a project is postponed. Then the immediate initiation at the time at which it first attains a positive net present value is optimal only if the benefits in nearby as well as distant years exceed the interest cost, i.e., the difference made in the proceeds by discounting.[1]

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1. A corollary is that a project should not be rejected for all time simply because it has a low, or even negative, economic merit for immediate initiation. Among other reasons, postponement may permit demand for the project's output to grow to the point that the project has a high economic benefit for future initiation and operation. A feature, though not considered, in this thesis, could arise if land is to be reserved for a future touristic use or a local park. Some action, although not necessarily the initiation of the project, may have to be undertaken now. Otherwise another investment may preempt the site. Optimizing investment decisions in the light of the possibility of preemption is an important area for further research on the dynamic interrelatedness of investment options.

A third cause for the sequence problem is the existence of constraint on resources, viz., a limited budget. The problem of a budgetary constraint in renewable resource planning attempted so far is looked at as one of choosing which projects of the available set are to be initiated today. But this is not a complete view of the problem; for it is a rare budget constraint that is once-for-all effective so that there is inaction after a single burst of outlays. Generally, opportunities not selected for immediate exploitation are not lost for ever; capital will be available in subsequent years for initiating projects until all worthwhile projects of the available set are undertaken. The usual practice of ranking projects by their net present value or benefit to cost ratio for 'period-one' and initiating as many activities as the budget for this period permits leaves no instructions for the remaining activities. This is comparable to the planning of projects from their 'absolute advantage' in each period instead of looking at their 'comparative advantage' in different periods.[1]

To illustrate, suppose we have a set of investment opportunities which entail the same outlay, and that limited budget prevents us from undertaking all of them at once. The traditional, static, rule would have us undertake those opportunities immediately which have the highest merit for immediate initiation. But, such an approach can lead to incorrect decisions. This is because the opportunities with the highest merit for immediate investment may not be those which lose the most from postponement; and it is the differential effect of postponement on the systems merits e.g. net present benefits, that should govern the

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1. i.e., intertemporal comparative advantage like the international comparative advantage for guiding the location of economic activity.

selection of options to be undertaken in each period.

Now we may recapitulate that dynamic scheduling of investment is necessary because of a) calendar time effect, i.e. the date of starting b) the project age, and c) the change in benefit rate over the planning horizon because of changes in the economy's structure. The sequencing problem becomes particularly complicated in the presence of budgetary constraints. We have dealt with this problem[1] in three main ways: i) assigning the eligible projects or activities to different locations in time through the planning horizon, ii) varying the budgetary and other constraints in descrete steps, and iii) specifying the various constraints and the outcomes of all activities separately for each period. By simultaneously considering the sequential variables in the programming procedure, a design can be chosen which has received the due consideration for the dynamic aspects of the activities.

The third point above (i.e. about a multiperiod analysis) has been referred to in the penultimate paragraph on page 10 of appendix 11[2]. The second point is discussed in section

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1. Essentially, it is an assignment problem such as of assigning factories to locations or personnel to jobs. Such a problem could be made to fit the format of a particular class of linear programming, i.e., transportation problem format. But it may be unable to consider explicitly interdependence of projects but for the link of budget. That is, it may assume away intertemporal interdependence of projects on account of labour, demand, divisibility, and possibility for stage construction of the various component activities.

2. That more attention is focused on the earlier periods is reasonable because the decisions for them are unlikely to be seriously affected by end conditions. This is so also because the model can (and ought to be) re-run to assess new information long before the last period. So even an approximate method of fixing final inventories could be considered 'good enough'.

9 infra. Here, we shall consider the first point. It is about the date of initiation, and also about the age of each project or resource use, during the planning horizon. Each activity eligible for the optimal design is re-evaluated for different starting dates, viz., for 1st, 3rd, and 5th years in the first 5 year plan period, for the 2nd and 4th years of the second 5 year period, for the 2nd year of the third period, and for the 1st year of the fourth plan period, i.e., the 16th year of the planning horizon. In this way new activities are generated with different objective function values, resource constraint and output coefficients.

The new activities are compound activities for those starting after the first year of the planning horizon. This is because in the intervening period the present use pattern is continued on lands on which resource use adjustments are postponed. Thus these activities include old and new resource uses for the earlier and the later years, respectively. A separate program had to be devised for an automatic computation of the consequences of varying the combination of the old and new activities. ~~This is presented in the annexure to this thesis.~~

However, one problem that arises is the evaluation of activities which as a result of delayed start do not complete their production cycle during the planning horizon. For example, for the farm-forestry and the plantation forest activities, there is no problem if they are initiated in the 16th year instead of the first because their crop rotation age is 15 years. But if these activities are initiated in any other year in between, the planning horizon will be over before the felling stage (of the second rotation crop). Such problem for all non-annual crops is dealt with by

salvage valuation of the unrealized assets built up during the planning horizon. This is congruent with the benefit-cost evaluation schema in which all historical costs as well as the opportunity cost of capital unutilized in the past is ignored (c.f. section 5 iv, chap V).

The salvage value may be seen as a residual benefit or in terms of avoiding or deferring future costs which are not considered in the next planning horizon.[1]

8. Ranging and Shadow Prices

'Ranging' has been used to generate information about the present right hand side (RHS) values and the objective function coefficients. Answers are thus made available to questions : With a given constraint row, how far can

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1. Consider an apple orchard with a useful life of y (=30) years installed in 0 (= 16th) year whose benefit stream will be cut-off in year 30-r, when it will have a remaining useful life of r (= 15) years. Its residual value in year y-r (= 15 years) is defined as the excess of: a) the present value of costs as they would be then if it were not available for re-use; over : b) the present value of costs as they will be with it available. Let C be the cost of establishing a new orchard. If A is that y-year annuity whose present value is C, this has the same present value as a perpetual annuity of A commencing in year y-r. If a orchard is available for continued use in year y-r, a new one need not replace it till year y. Only it will be replaced every y years thereafter. Hence costs will include a cost of C in year y and once every y years subsequently. This has the same present value as a perpetual annuity of A commencing in year y. The residual benefit, which is equivalent to negative replacement cost or the liquidation of assets at the cut-off horizon, can now be equal to the 'present' value at year y-r of a constant annuity of A starting then and lasting for r years: Ay-r + Ay-r+1...+ Ay. This approach requires modification when the assumption that an activity may be perpetuated after the planning horizon is not considered realistic. To reduce such uncertainty for some activities, e.g. firewood production, the assets of which can be liquidated at the end of the present planning horizon, the salvage value is directly estimated for the existing stock. Often it turned out to be commensurate with the residual values, but whenever the two diverged the lower of the two (i.e. the former) value is incorporated.

the RHS value move in either direction, while holding all other RHS values constant, before the optimal basis will change? The technique used for objective coefficients is similar: Over what range on a given coefficient does the optimal basis remain the same? The answers have been derived from an analysis which includes i) the effect of cost changes on optimum activity levels; ii) the cost of changing an activity from optimum level and the activity range for which this cost is valid; iii) the value of changing the row activity level and the interval for which this value is valid. Such information indicates how a problem may be adjusted to increase profit and when problems should be rerun (on the computer) because of 'cost' changes in the future.

The above ranging was done separately for all the discount rates under the existing 'cost' conditions. ~~The results for one such (appropriate) model are shown in the 'Ranging computer output' in the annexure. An explanation for the interpretation of the results is given there.~~

The results show that the activities chosen in the optimal system are not instable and that no advantage would flow from any further restructuring of the problem. Also the results make it self-evident as to how much loss in the objective function would emanate from including one unit of any particular non-optimal activity or from changing the level of any particular optimal activity.

The 'reduced costs' in the above output can be as interesting as the solution. These are recorded for each variable or the column activity. When, for instance, the reduced cost is 1, it indicates a unit rate of increase of

cost with the variable with which it is associated. The reduced costsof slack or artificial variables have a special significance. They are the 'shadow prices' on the rows of the problem, and indicate the rate of change of the objective function with respect to the RHS of the restraint equation. Of course, the reduced cost for the land restraints are not of much importance since it would be physically meaningless to change their RHS. But the other reduced costs represent the effects of small changes in the other limits.

9. Bounded Constraints and Parametric Analysis.

In subsection 4 vi, chap. VI, the need for a sensitivity analysis was discussed. For this reason, five optimal designs for Kashmir's renewable resource system are attempted. They are tabulated in appendix I of appendix 11. Each design is optimal for a different discount rate used for deriving the present values of options' consequences.

From the said table, it is clear that the results of models OMI and OMIV are closer to each other only in a few instances, but those of models OMII, OMIII, and OMV are so for most cases. The latter set exhibits a fairly close consistency in the use of land and other resources as well as outputs. For example, while OMI and OMIV widely diverge in paddy output from 195000 to 913800 tons per annum, the other models vary from 572200 to 581500 tons only. While OMI leads to a deficit in firewood supply and OMIV to a surplus, the other set of models all yield the same average surplus in the first period. OMI employs, on an average, about 8 million in contrast to about 21 million man-days by OMIV. On the other hand the other three models each employs about 19 million man-days. During the first 5 years of

the plan, OMI yields about Rs. 72 million private producers' profit, while OMIV yields about Rs. 172 million. In contrast, the other three models each yields about Rs.294 million.

The above sample results are useful as well as important. On the basis of the theoretical framework evolved in appendix 10, we have seen that the appropriate discount rate for conditions prevailing in India is 10 per cent or a little more (c.f. pages 19 ff. appendix 9, and section 9, chap. V)[1]. Since the systems models are stable at discount rates at and above 10 per cent, Kashmir's resource plan need not be subjected to further sensitivity analysis for discounting. If, however, the decision-maker is interested in models less than 10 per cent, he can weigh his choice from the effects on the economy of one such model presented in table 2, appendix 13.

It may be seen that the models designed in appendix 11 are constrained only by technical limitations, viz., quality and quantity of land. This was achieved by placing i) less than or equal to restrictions on the various land types and sub-types and ii) greater than or equal to restrictions on other constraints, the levels of which were defined at zero instead of the actual limits for the former constraints. Such designing could lead to unrealistic plans, e.g., commodities may be produced in excess of demand, or resources other than land may be used in excess of available supply.

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1. Though their reasoning is different from ours, Tinbergen (1967, pp.154-7), and Baumol (1968) too have argued that the appropriate social discount rate for investment appraisal in developing countries is 10 per cent or more.

The optimum-solution for a given situation depends upon the resources available (including their opportunity costs) and the level of demand that may be required to be fulfilled. A change in any one of these gives rise to the possibility that the optimum plan will change. To study the sensitivity of the system to such changes as well to produce a realistic plan, we make use of the technique of parametric analysis and of what may be called the 'bounded constraint' analysis.

The latter involved the specification of double constraints on the various rows some of which are illustrated below.

Paddy Production: (000 Kg. per annum)

1st Period $\geqslant$ 250,600 $\leqslant$ 600,000
2nd Period $\geqslant$ 300,000 $\leqslant$ 750,000
5th Period $\geqslant$ 0

Firewood Production: (00 cft. round per annum)

1st Period $\geqslant$ 70,000 $\leqslant$ 83,300
2nd Period $\geqslant$ 80,000 $\leqslant$ 130,000
5th Period $\geqslant$ 0

Fodder Production: (000 lbs)

Average per annum $\geqslant$ 1,243,000 $\leqslant$ 4,376,000

Saffron Production: (Tolas)

Average per annum $\geqslant$ 0 $\leqslant$ 2,000,000

Pulpwood Production: (0 cft.)

Average per annum $\geqslant$ 661,000 $\leqslant$ 1,983,000

Labour: (00 man-days per annum)

1st Year $\geqslant$0 $\leqslant$2,385,243
Plan Period $\geqslant$0 $\leqslant$3,000,000
Peak Season $\geqslant$0 $\leqslant$ 400,000

The rationale for the above constraints is derived from the results of the models with land constraints only and from the existing socio-economic conditions. For instance, the lower and upper bounds on foodgrains production ensure that the domestic availability per head is at least at the present level with scope to attain self sufficiency;

similarly on firewood production with scope to meet projected demand including substitution of dung burnt as fuel; on pulpwood production to suffice for a viable pulping facility, viz., 150 tons per day, with scope for capacity expansion. Saffron production has been constrained within limits set by international demand and to prevent economic loss through overproduction. The need to ensure peasant producers' profit in spite of population increase at least at the existing levels has also been met. The labour used in the first years and during peak seasons in the earlier optimal models (c.f. appendix 11) was far in excess of availability. This too has now been guarded against.

So far we have been assuming that budgets will be available as required by an optimal plan subject to other resource, demand and output, and institutional constraints. But budget may itself be a severe constraint of the latter type. To allow for this we have varied budget levels parametrically[1], i.e., in discrete steps on the RHS of the budget row from levels attained in non-constrained models. In this way a number of solutions are produced including the one which is consistent with the earmarked budget for the agriculture production sector (including forestry) for the 4th 5 Year Plan, i.e. the first period of the planning horizon. The results so obtained also ensure a combination of activities which considers their intertemporal comparative advantage (c.f. section 7 supra).

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1. Parametric programming is a means of continuously varying either any subset or all of the constraints in a systematic way. It seems to be nearly an ideal technique for varying constraints over a fairly wide range. Each new solution generated here is for a Rs.10 million budget different from the previous level. As will be seen by comparison of the results in the next section with earlier models (c.f.appendix 11), we have been now able to have a combination of resource uses and production processes which use about Rs 35 million and Rs 150 million less in the first year and the first five year period respectively. However, there is not such a significant change in budgetary requirements in subsequent periods and in the planning horizon as a whole.

10. Optimal Systems Design

The outcome of the optimization procedure devised in this chapter is the final[1] optimal solution to the planning problem. The solution ~~is recorded in 'optimal Systems Design Computer output' in the annexure,~~ shows detailed quantitative results for activities included in as well as excluded from the solution[2]. The important results are abstracted in Table 7.1.

In the main, the optimal plan maximizes the overall efficiency in resource use while honouring constraints legitimate to policy goals, viz., employment, redistribution[3], self-sufficiency in essential commodities such as foodgrains and firewood.

In a multi-period analysis based partly on those data obtained by forecasting future behaviour on certain assumption, e.g. international border prices, there is uncertainty about the accuracy of the forecasts. Therefore,

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1. It includes results derived from post-optimal analyses, e.g., bounded constraints. It is final in the sense that it is comparable to and based on the set of models which are stable prior to applying postoptimal procedures; also because it incorporates discount rates at and over 10 per cent. It is final because it does not violate constraints, some of which the other models did.

2. Thes data are useful for future analyses of the system and for studying the feasibility of increasing or decreasing an optimal activity or for including a non-optimal activity, if required. Such feasibility can be seen from the associated shadow prices and particularly from the stability ranges of various variables, as discussed in earlier sections.

3. This is so in the sense that the incomes as well as the net profits of the private producers, including the peasants and other low-income groups, is enhanced considerably from their present levels.

Table 7.1. Optimal Renewable Resource Plan.

I Socio-economic efficiency

Benefit: Cost Ratio - 14.50 as against 4.69 for present use-pattern[1]

Discount Rate - 15% for first 15 years, 10% for later 15 years.

II Land Use Pattern

Major land uses	Area in acres	Remarks
Paddy	341057	3 new production processes requiring nitrogenous fertilizers and improved (dwarf) seed variety, but no new irrigation structures required. Mainly on existing paddy land; little on least-eroded, low-lying and irrigated culturable land. About 33000 acres less than the present area.
Maize	294081	4 new processes, and one present technique. On maize, oilseed and wheat lands.
Oilseeds	11300	Existing technique on part of present oilseeds land. Area greatly reduced.
Sericulture	14800	No change.
Apples	29891	New techniques on parts of pyrethrum and culturable land, and existing technique on present land.
Walnuts	41958	No change.
Almonds	37832	About 36000 acres from presently scrub land; remaining area is the present almond land. New area is converted to orchards with a technique which does not involve an immediate clearance of scrub; the latter is phased through the earlier planning periods.
Deodar	112388	New production technique, viz. 90 years' rotation, thinnings in stock over 18 inches diameter, pulpwood from stock less than 12 inches diameter.

1. See subsection Ve, appendix 11 regarding the evaluation of the efficiency of an optimal system via the ratio.

Table 7.1 continued

Major land uses	Area in acres	Remarks
Kail (Pine)	260533	New production technique, viz. 90 years' rotation, thinnings cum pulpwood production, resin tapping with 4 channels per eligible trees.
Fir	318754	A reduction of 22800 acres in the total area presently classed as fir forests. New production process, viz. 120 years' rotation; 25% prescribed yield as thinnings for timber in stocks over 12 inches dia., timber-cum-pulpwood production.
Poplars	125688	3 new techniques besides the present technique. The latter is on about 10,000 acres mainly of present wheat land (irrigable). The new areas are largely from presently paddy and culturable fallow land. In two cases, the activities are compounded of present and new resource uses as a result of dynamic scheduling (c.f. section 7 supra).
Farm Forestry	64643	New area added from wheat-land transferred to maize production. Technique includes willow as well as poplar wood production for timber as well as firewood.
Sylvo-pastoral	136808	2 new techniques, one for the existing area and one for new area of blanks in presently fir forests. Mainly involving rotational closures.
Village Grazing	153000	New Technique involving controlled grazing and range improvement.
Alpine Grazing	519437	No change in area; new production process involving more intensive production.
Watershed Protection	706477	No change in area; new technique involving joint production with protection, i.e. of wood, including firewood and pulpwood.

Table 7.1 continued

Major land uses	Area in acres	Remarks
Culturable land	10,000	Most of the presently uncultivated area brought under various production processes. The area shown here is suitable only for closure and afforestation with soil conserving species.
Total Area Used	3207080	No area is left unused.

III Production Pattern

Major Commodities	Production in 1st Period	Production in 2nd Period	Remarks
Paddy	5234	5234	00 tons.
Maize	1583	1815	00 tons.
Oilseeds	12	12	00 tons.
Apples	150	191	00 tons; 19900 tons/yr in the plg. horizon.
Walnuts	117	119	00 tons.
Almonds	301	6157	tons; 7270 av./yr.
Saffron	217	217[1]	tolas (000).
Silk Cocoons	168	168	000 lbs., R.S.Eq.
Firewood	8	12[2]	million cu. ft.
Construction timber	3.85	3.85	million cu. ft.
Sleeper timber	26.45	26.45	million cu. ft.

1. This is in contrast to 12.5 million tolas produced in comparable models in appendix 11. The world prices prevailing now would be depressed by producing such large quantities, so that those models would not be realistic in their optimality.

2. In the comparable models, there was overproduction by about 50 per cent; here it equals the projected demand without involving any waste.

Table 7.1. continued

Major Commodities	Production in 1st Period	2nd Period	Remarks
Shooks timber	5.68	32.34	mill. c.ft., av. per annum 31.32 m.cft.
Pulpwood	12.76	12.76	m.cft., increasing to an average annual production of 18.50 m. c.ft.
Oleoresin	17.46	17.60	00 tons (Crude)
Fodder	3090	3033	mill.lbs. (Grazing Eq); av. annual production at 3044 m.lbs. (Includes agricultural residues,.

IV Budget:	1st Year	1st Period	2nd Period	Total
Rs.0 million	21.99	59.61	36.43	274.64

V Revenue	1st Period	Total
Rs.0 million[1]	19.11	249.16.

VI Producers' Profit		
Rs.0 million[2]	153.95	1118.59

VII Net Financial Benefit:		
Rs.0 million	173.16	1367.75

VIII Employment[3]	1st Year	1st Period (av.)	Planning Horizon (av.)	Peak Season (av)
Ten million Man days	23.85	22.96	18.59	4.0
Per cent	100	95	62	100

1. The direct treasury revenue increases by Rs.123 million and Rs.2084 during the first period and the planning horizon, respectively. Therefore, government could afford higher budget allocations to the sector than in the past.

2. The net increase in incomes of producers, other than government, is Rs.278 mill. and Rs. 3617 mill. during the first period and the planning horizon, respectively.

3. The comparable models (c.f.appendix 11) required seasonal labour and that for initiating resource use adjustments in the first year far in excess of availability. Here, only full use of such supplies is made. Yet, because of scheduling the activities unemployment is less than in those models through the various periods, especially in the earlier ones when other sectors of the economy would be unable to absorb excess labour.

once a 'long-run' plan has been prepared by the method devised in this study, it should be subject to revisions whenever conditions indicate the necessity.[1] The program may be re-run periodically to see if revised production-function data, resource and institutional constraints, and demand and price forecasts would change the original plan. A convenient rule may be laid down, i.e., to re-run the program at intervals equal to the shortest time period used here, viz. 5 years. It also has the advantage of being consistent with overall economic planning.

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1. The programming system used here has the capacity to undertake modifications with ease by using the instruction 'Revise' and for 'subduing' a portion of the problem by using 'Flags'. The former may be more important for future research on the problem and the solution generated here. Therefore, the problem format and all the input data have been stored on discs, as well as on interpreted cards for checking the data at any time. The 'Revise' instruction will allow for deleting, adding, modifying or over-writing of an existing variable, whether rows, columns, ranges, bounds, objective function or the right-hand side. New activities can also be included.

CHAPTER VIII

THE IMPACT AND THE IMPLEMENTATION OF THE PLAN.

1. Introduction

An optimal plan for the use of Kashmir's renewable resources has been produced in the last chapter. How to evaluate, and what are the effects of the plan on the economy? What measures may be adopted to implement the plan? These are the questions to which answers are attempted in this chapter.

2. Impact of the Plan

The renewable resource planning, applied in the past, stops with an analysis of the direct effects of a plan.[1] These effects are similar to those recorded in Table 7.1, chap. VII. Such an analysis does not reveal the full implications of a plan. It does not illuminate the changes that would ensue in the other sectors and the economy as a whole. To remedy this, we have adapted the technique of inter-industry analysis to evaluate the impact of a plan. The methodology for this is given in appendix 13.

The method, in essence, involves the preparation of intersectoral input-output tables. The tables are devised to illustrate the configuration of the economy before and after adopting a plan. Since the aim is to pinpoint the effects of the renewable resource-use adjustments, sectors are explicitly assigned to major resource-uses. The rest of the industries may be aggregated into one sector, without

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1. There has never been an attempt at the preparation of an integrated renewable resource plan as conceived here. Notwithstanding that, this criticism applies to resource plans of whatever kind have been prepared in the past, be they only for forestry, or agriculture, or grazing, or for reclamation of land or development of water resources.

TABLE 8.1 INTER-INDUSTRY FLOWS WITH OPTIMAL RENEWABLE RESOURCE-USE PATTERN

Rupees 000

Sectors		Agri-culture	Horti-culture	Cash Crops	Forestry	Plant-ations	Livestock & Grazing	Seri-culture	Other Sectors	Total Intermediate Output	House-holds	Stock Change	Exports	Total Final Demand	Gross Output
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		← Quadrant 1 →									← Quadrant 2 →				
Agriculture	1	6198	3	0	0	0	62098	0	0	68299	162684	0	0	162684	230983
Horticulture	2	0	96	0	0	0	0	0	3420	3516	5235	0	45801	51036	54552
Cash Crops	3	0	0	381	0	0	0	0	0	381	17	0	2816	2833	3214
Forestry	4	0	2764	0	2072	201	3105	0	98824	106966	7505	0	214249	221754	328720
Plantations	5	2385	2913	0	0	126	0	0	72699	78123	10543	0	0	10543	88666
Livestock & Grazing	6	58692	1884	8	0	310	72325	0	45535	178754	91283	0	0	91283	270037
Sericulture	7	0	0	0	0	0	0	31	533	564	0	0	2294	2294	2858
Other Sectors	8	4003	329	7	114235	890	2633	30	0	122127	28556	2123	369229	399908	522035
Total Intermediate Inputs	9	71278	7989	396	116307	1527	140161	61	221011	558730	305823	2123	634389	942335	1501065
		← Quadrant 3 →									← Quadrant 4 →				
Households	10	428798	8492	2175	49757	17309	48935	2234	39904	597604	41129	0	0	41129	638733
Other Value-Added	11	-276289	37859	643	162042	69769	76089	556	193567	262236	0	0	0	0	262236
Imports	12	9196	212	0	614	61	4852	7	67553	82495	22315	732	0	23047	105542
Total Primary Inputs	13	159705	46563	2818	212413	87139	129876	2797	301024	942335	63444	732	0	64176	1006511
Gross Total Inputs	14	230983	54552	3214	328720	88666	270037	2858	522035	1501065	369267	2855	634389	1006511	2507576

losing the efficacy of the technique.[1]

The table 8.1. shows the inter-industry relationships if the optimal renewable resource plan is implemented. By comparing it with a similar table for the present resource-use pattern,[2] the impact of the plan is brought to surface in quantitative terms. This is summarised below:

1. The gross output in the economy will grow by about 215 per cent of that generated with the present use-pattern.

2. The contribution to the national income flowing from renewable resource-based activities is about Rs.1000 million. This is more than twice the comparable income flows, if present resource-use pattern is continued.

3. The per capita incomes will be about doubled, if the plan is implemented. Then it is likely to be about Rs. 585 per caput (i.e. about £ 80).

4. The value-added within the renewable resource sector will become positive in contrast to a negative value-added at present. It will be about Rs. 334 million more than for the present renewable resource production processes and dependent industries.

5. Assuming an unchanged taste and consumption pattern, the disposable income is estimated at about Rs. 532 million in contrast to Rs.121 million with the present resource-use pattern. If the plan is implemented, it is theoretically possible to siphon-off resources for investment 425 per cent more than the current potential, if society so wishes.

6. The effect on the economy's trade is about four and a half times increased surplus than possible now. The positive trade balance touches Rs.529 million. The other sectors dependent on capital goods and other imports will be able to expand in proportion to this increase and/or the overall trade-deficit will be reduced correspondingly.

7. On an average, the employment that will be generated in the economy will be about 213 million man-days per annum. This contrasts with about 166 million man-days of gainful

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1. This is evidenced by an experiment, the results of which are recorded in appendix 3 to the appendix 13. Such aggregation is particularly justifiable for an economy like Kashmir of which renewable resources are the main part.

2. Such a table is presented in appendix 4 to the appendix 13.

employment with the present renewable resource-use pattern. Only 5 per cent of the work-force in the rural sector will remain unemployed during the first-five year period. Such unemployment will be covered by the phenomenon of disguised or low productive unemployment, which at present accounts for 41 per cent of the work-force. The high employment is ensured in a feasible manner by proper phasing of new activities and by adopting such a combination of the production processes that labour requirements at peak seasons are commensurate with its availability.

8. The existing deficit of 1128 and 1322 million kilo-calories during the first and the second planning periods will be wiped out. Besides such self-sufficiency in foodgrains, firewood as well as fodder demand will also be met. Shortages in all these commodities have had recently arisen and would widen with the present resource-use pattern.

9. The shortages in the supplies of shooks with consequent loss of exportable fruit will no longer persist. The increases in supply will enhance in the future to be commensurate with increased production of some fruit and other goods through the planning horizon. Also the increased future production of poplar wood will permit of the expansion of the existing match factory. The latter is at present short of poplar-wood and has, therefore, been unable to expand in line with demand, which is met mainly from imports. Such import will become unnecessary, if the plan is implemented.

10. There is no change indicated in the sericulture industry. But, pyrethrum production will no longer continue, being unprofitable. The national economy will benefit by importing cheaper pyrethrum with higher pyrethrin content or by a substitution of this material, rather than by relying on Kashmir's source. Saffron production will expand to the extent of demand estimated by the State Trading Corporation. It will yield foreign exchange and enhance the producers' revenue in Kashmir.

11. The livestock and grazing industry will nearly double its output. About 30 per cent of it will be consumed domestically. This will offset the present practice of live meat imports, relieve milk shortages and enable an increase in the protein content of foods in spite of population increase. Importantly, a large part of the output will be in the form of wool, milk-products such as purified butter (ghee), and processed hides. The bulk of these goods will be exportable.

12. It will be possible to establish a pulping facility with a capacity of 150 tons a day. After a gestation lag of 15 years, raw-material production will increase by 50 per cent to enable a corresponding expansion.

13. The pine oleoresin production will enable the production of 100 tons of synthetic camphor annually, all of which is presently imported into India. The rural base will be diversified also through a fillip to the sawmilling and conventional wood-processing industries, including joinery, furniture, sports-goods as well as cheap plyboards. For the latter, a nucleus is existing. But the

mill is out of commission because of the lack of raw-materials. This position will be remedied, if the plan is implemented.

14. The impact of the renewable resource-use adjustments will be of a direct benefit to the other sectors of the economy. Their production will increase by about Rs.330 million. That is, it will be enhanced by about 170 per cent. Such change implies a direct support to secondary and tertiary activities including processing, transport and other service industries besides the diversification of the rural base.

3. Implementation of the Plan.

An attempt has been made to prepare a plan consistent with society's objectives and resources. A plan sound in theory must be sound in practice. Yet a difficulty may arise. This is because the plan involves adjustments in privately besides publicly owned resources. The execution of the plan could meet resistance in the private area of the economy[1]. This could cause divergence from the optimal resource use.

The above difficulty arises in democracies where State's interference with the usage of private property is kept to the minimum. But even in democracies, absolute freedom is a myth. Non-totalitarian states also direct and control the use of land and related resources. Most importantly, therefore, the plan's success rests on the policy maker's will to implement it[2]. If the will is there,

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1. Though here it is confined to the agricultural land area, which is much less than the remaining area covered by the plan.

2. The implicit assumption in this thesis is that such will exists. This is realistic. Firstly, formal planning has been practised for nearly two decades. Recently, this practice has been strengthened in its weak link, i.e. of implementation. For this, measures are being proposed and others adopted for social control over resources. These include nationalisation of banks. This is aimed at achieving plan targets by channelling resources according to priorities set in the national plan. Secondly, the plan prepared here is aligned to the expressly stated policy aims. As such, there should be no rational reason for not implementing it. However, it is not unlikely that the decision-maker's subjective valuation of the expected outcomes of the plan render it sub-optimal, i.e., from a so-called overall policy viewpoint. Then the plan could be adjusted, as and if required. The procedure proposed here provides scope for making such adjustments, so that the plan can be as practicable as may be desired.

he can deploy tools with which resource use is approximated to an optimal manner within the democratic framework.

Fiscal, legislative and administrative measures, each complementing the other, may be adopted to induce the resource-use adjustments. Fiscal measures[1] by themselves are useful only if the concessions, subsidies, grants and loans are attractive enough to bring about a change in habitual use. A judicious pricing policy and satisfactory credit arrangements together with adequate marketing facilities (c.f. section 5, appendix 21) can be a potent incentive for adopting optimum production processes. Combined with legal sanctions, however, they form a powerful means of tempered coercion (c.f. section 9, ibid). These may be employed even in individualistically minded societies; for evidence exists that even peasant-producers respond to economic incentives (c.f. section ~~12, ibid~~ P. 54). No doubt, the degree of response varies from places to place, depending on socio-cultural and psychological factors. For this reason, the application of legislation, geared to local needs, in conjunction with incentives would be useful. The laws or fiscal measures would thus depend upon the ideology of the policy planners and the attitudes of the majority of the voters.

The aim in instituting the above measures should be to elicit the cooperation of the people, especially the private producers, so that there is popular support for the plan. These measures have been used in Western countries as instruments of policy rather than as tools designed to assist

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1. These imply the adoption of commercial policies by which such changes in the overall levels of incomes, prices and employment are affected that are conducive to the implementation of the plan.

the implementation of a scientifically formulated plan. But there seems little to prevent the making of such a plan and its implementation by the various legal and fiscal methods.

It is also suggested that a new, interdisciplinary approach to the institutional organisations of the departments which control and advise on renewable resource uses be considered. The present autonomy of these departments was perhaps necessary to permit of the separate development of the different disciplines at a time when laissez-faire attitudes prevailed, work-study was unknown, and Parkinson's law unstated. For coordinating the actions of diverse users of renewable resources, a small closely-knit department is required for overseeing the implementation of an integrated plan.

The work of the agriculture, horticulture and animal husbandry departments is mainly advisory. That of the forest department is both advisory and managerial. Together they comprise the two major wings of Kashmir's renewable resource sector. But their differing roles preclude their merger. The organisation proposed above would bridge the gap which so often exists between the two major wings. It would also help the implementation of complementary policies.

The various aspects of the above organisation are discussed in section 13, appendix 21 (especially pp. 33-34). The organisation would include economists besides technical and administrative expertise. It should also have access to operations research, including pert and critical path analysts.[1]

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1. Though this thesis is concerned with overall resource allocation, the plan prepared here will yield the intended results if the lower-level decisions in its execution are deliberated equally carefully to maximise efficiency (c.f. Footnote 2, p.201). The use of operations analysis techniques,

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4. Conclusion

The plan prepared here contributes to society's aims. It will create a stronger rural economy in Kashmir through the exploitation of more productive opportunities than at present. It will produce increased incomes, employment and output. It will enable the diversification of the rural base. It will also help the development of the economy as a whole. The plan will bring into play the potential wherewithal that is latent in Kashmir's renewable resources. This will benefit the rest of the country too, which presently supports Kashmir's development programme to a very large extent.

The plan will lead to an efficient allocation of resources. This is ensured by ranking the investment options by their economic efficiency.

The aim of efficiency is not attained at the cost of practicability or feasibility. The plan is oriented to the real-world conditions by identifying investment opportunities from an assessment of the existing biotechnical potential. The plan is feasible because the latter has been collated with what is possible. For this, socio-cultural and institutional aspects have been taken into due account. For instance, only those combinations of production processes, i.e. product-lines and techniques of production, are chosen in the optimal plan which do not lead to shortages in the so-called essential commodities, e.g., foodgrains. Nor will the plan heighten the distance between income groups. On

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.....such as critical path method and programme evaluation review will be useful for this. These aids will help to identify the optimal strategy for sequencing of activities, for avoiding delays, and for allowing for random factors such as weather. These will also be useful for identifying the priorities and timing of further investigations for continual improvements. A succinct review of the scope of these techniques has recently been made by Sengupta and Fox (1969, pp. 345-353).

the contrary, the distribution of incomes is likely to be more equitable than before. This can be ensured by adopting suitable fiscal measures. The plan will engender greater scope for applying them as a result of the increased output from and commercialisation of the hitherto subsistence sector as well.

The techniques of production included in the plan can be implemented in practice. None of them require changes which are either drastic or are difficult of quick execution. For instance, they do not call for mechanisation which requires ancilliary systems that are wanting, or which involves consolidation of holdings or lifting the existing ceilings on them. The techniques do not call for the construction of new irrigation structures or the production of commodities which are contrary to local traditions or religious customs. The execution of the plan will not require skills which are either difficult to acquire or are locally unavailable.[1]

The plan is not rigid. It can be adjusted to meet contingencies that are not foreseen today. This is because it does not involve irreversible, once-for-all, actions. No renewable resource-use adjustment is proposed which involves such changes of the site or the environment that it cannot be regained to its original status. For instance,

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1. This is not to deny the need for organisational improvement to enable the dissemination of information and coordination among producers. Apart from technical knowledge, organisational and entrepreneurial skills require to be fostered by the government, so that private producers as well as the various departments innovate for higher productivity envisaged in the plan. (c.f. section 3 supra).

there is no recommendation for the 'reclamation' of the wild-life reserves or sanctuaries, or the clearance of the forests, or the resettlement of people in the tourist resorts. Similarly, no long-maturing, durable investment, e.g., an extensive drainage scheme or a multi-purpose dam, is required. On the other hand, the proposed industries, such as a pulping facility, are assured of raw materials and demand for time horizons longer than their pay back periods.[1]

The procedure by which the plan is arrived at here embodies flexibility without any loss in the accuracy of the estimates or the optimality of the solution. The flexibility of the plan is built in by means of sensitivity analyses, which can be repeated through the course of its implementation.[2]

The features of the plan may now be summarised. These are consistency, efficiency, feasibility and flexibility.

The plan should be implemented if it is good, i.e., if it is consistent with policy aims. Hence, by implication, the plan is in consonance with what society considers as good. But, a suitable machinery designed to implement,

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1. However, this does not include uncertainty about the future political configuration. This is an area of almost complete ignorance for the analyst anywhere in the developing countries, though more in some regions than others. However, the politicians are the decision-makers in democracies. Their judgment and preferences may be sought after the process of objective analysis. This can then be brought to bear upon more closely on the final decisions about investments requiring heavier outlays.

2. A provision has been made for this.

follow-up and control[1] the plan is as essential as to engineer a good plan. This requires to be taken up by the Kashmir Government.

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1. The follow-up and control will include further research and continual adjustments in order to respond to changing circumstances. These functions of the implementing organisation are no less important than the execution of the original plan. This is because of the inability to conceive all possible future states; i.e., the inability to forecast the future without error. Therefore, the various plan operations require to be so conditioned that they not only adapt to major changes in the future but also adjust for any short-run fluctuations in demand on them, e.g., overcutting or, conversely, retaining the forest growing stock in a standing form in response to market conditions.

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APPENDIX 1

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THE RENEWABLE RESOURCE PLANNING PROBLEM WITH SPECIAL REFERENCE TO KASHMIR

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of capital. Net inflow of capital is also considered to be a savings by certain economists. But such treatment of imported al is likely to give an erroneous picture of savings. Savings are, refore, based on the marginal efficiency of capital. The marginal

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1. N.C.A.E.R. "Saving in India" 1965 pp. 11-12.

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This paper focusses attention on the interdisciplinary nature of the problem of planning renewable natural resource use for socio-economic development. The disciplines involved are (a) ecology, for bio-technical assessment of the use-possibility of a resource base; (b) sociology, for considering the social, cultural and institutional constraints in an area; and (c) economics, for evaluating and ranking the uses in an order of priority for meeting developmental aims. The integration of the three disciplines for the preparation of an optimal plan can be achieved by systems analysis with the help of a mathematical programming model. The essential feature of the model would be the incorporation of a quantitative relationship between social costs and social benefits of options, e.g. social benefit: cost ratio, as the objective function. The maximisation of the function would be subject to the constraints of (a) the social, cultural and institutional factors quantified as restrictions of demand† for different commodities and minimum levels of employment or incomes to producers vis-a-vis their present occupations, and of (b) the renewable resource potential quantified in terms of output of various commodities possible with different feasible technologies. The model should allow for the mutual exclusiveness of options by imposing the restrictions of the total area available for all the uses against the extent of area possible for each use, and of the overlap among different possible uses within each resource class. It should also consider the interdependence of options. This may be done by specifying the seasonal and annual labour requirements and their total availability, the budgetary limits through the course of action, and by comparing the effects of varying schedules of initiation and operation of the interdependent options.

RENEWABLE resources are those natural resources which, because of their flow characteristics, can be produced and used in perpetuity. These include the attributes of soil and landscape, the biotic and water resources.

RENEWABLE RESOURCE POLICY AND PLANNING

No country has an explicit renewable resource policy, save for the formal forest policies in most developing countries and for the water resource policies in many developed areas especially North America. This may arise because of the many disciplines involved in the management of farm, forest, range and recreation lands, livestock, wildlife and fisheries, surface and ground waters, and the difficulty in co-ordinating and dovetailing the use of these diverse resources within the socio-economic framework. But the need for co-ordinated use through the planned development of these resources is axiomatic if resource allocation is to be made in consonance with the community's objectives. This is

* Based on a lecture delivered at the Third Forest Research Course at the Commonwealth Forestry Institute, Oxford during September 1969. Thanks are due to Mr. J. J. MacGregor, Forest Economist, Oxford University for going through the draft. However, for any omissions and the views in the paper, the author is solely responsible.

† This would include the legislative requirements and the non-market demand for various products.

an important requirement in poor areas, like Kashmir, where resource scarcity is a more severe bottleneck for development and where misallocation should be particularly avoided.

In this context, the aim of planning would be to prevent unco-ordinated development by providing a pattern that harmonizes competing renewable resource uses; these should complement rather than interfere with one another and the other sectors of the economy, so as to promote the objectives of economic development as closely as possible. For this purpose, renewable resources need to be appraised in the light of their contribution to the development effort. The evaluation of gains and losses ensuing from different methods and intensities of use should be the key to assigning a role to different resources. This warrants an inter-disciplinary examination of overall resource situations; it entails not only a physical and biological review of renewable resources and their renewal over time, but also social and economic analyses, i.e. total environmental assessment is called for.

The scope of this paper does not permit the spelling out of the approach to the evaluation and co-ordination of different uses. Nor should it be laid down rigidly because different resource situations deserve different treatments, especially in the absence or lack of precision of renewable resource policies. Even if such policies do exist, they should be consistent with and geared to achieve the overall development strategy; otherwise their pursuit may be inimical to society's objectives. Since the object is to evolve a management schema aimed at resolving conflicts while meeting society's goals, the planning process becomes flexible in that the use of renewable resources will vary according to social needs. In the following discussion, emphasis will be laid on the analysis of the problem of planning the use of renewable resources for realizing the objectives of a developing country.*

REGIONS AND RESOURCES—RECONNAISSANCE

Renewable resources are the components of a system, comprising a "set of objects together with relationships between the objects and between their attributes" (Hall and Hagen, 1956). The use of one unit or kind of resource is likely to influence the use of others. It is misplaced isolation to plan their use atomistically or independently, as is the general practice. The preparation of integrated plans for all these resources would be ideal. However, the interdependence of their use exists not only among themselves but also between them and the man-made capital and the human resources of a country. Because of these interdependencies and the related factor of demand conditioned by economic, institutional, cultural and political features, integrated planning of all renewable resources in any large country would be a stupendous problem. This is so also because there can be no once-for-all integration and adjustments have to be made from time to time.

Two main possibilities exist to render the problem manageable as well as realistic. One is to plan the use regionally while keeping national objectives in view. This could be more useful than an excessively aggregated treatment in a country with diversity in renewable resources and socio-economic conditions. Renewable resource planning "should be based upon detailed regional descriptions and analyses" (Kuerger *et al.*, 1963), because national aggregates can only be broad and indicative to cover the heterogeneity of prevailing circumstances and purposes.

* The nature of the problem and the broad stages of its analysis are summarized in the diagram and the table at the end of the paper.

The inherent vagueness in the nationwide treatment of resource uses is exemplified by the all-embracing forest policies of different countries.* Gane (1969) has cited the ambiguity of Trinidad's national forest policy. In India the main aim of the policy is to have 33.3 per cent of the total land area under forests (Govt. of India, 1968). The rationale behind this figure is wanting, having been established on an *ad hoc* basis. Such a policy can cause conflicts in land use because it considers neither the demands of competing uses nor the overall resource situation and their relationships with developmental aims. These defects apart, it is imprecise about the regions or kind of forest cover desired and the implementation of its objective is problematic. It cannot but be so because the demand of industries and consumers for commodities, the comparative advantage and suitability for producing different products, including protection needs, vary immensely in different regions. Questionable in itself though the aggregate objective of 33.3 per cent of forest land area is, here we need only point out that it should not imply that Kashmir should reduce its existing forest area of 58 per cent or that afforestation is technically and economically superior to covering the largely desert area of Rajasthan State with grass merely to extend its forest cover from the present 12 per cent. These instances show that national policies for renewable resources can be a proper guide through regional planning. A national plan would be more realistic if it is an appropriate sum total of the regional plans which cater to regional considerations while keeping the country's developmental aims in view.

The second way to make the problem manageable is through stage by stage analyses, feeding back the results of one analysis on to another to incorporate the dynamic relationships between different use patterns. Planning would then become practical by dividing the renewable resources into say two broad categories of land and water-based resource. This conforms to the institutional and organisational arrangements and macro-planning strategy in Kashmir and most other countries, where land resource development is dealt with under "agricultural production sector" separately from that of water resources.

Such a division is convenient and less arbitrary. Either resource has physical and economic characteristics of its own besides being somewhat independent. This division is realistic in many developing areas where one of the two resources can be treated peripherally, because either it is abundant to such an extent or the demand for it is comparatively so small that such analysis could be made more clearly. Little could be gained from dealing jointly with both the land and water resources of Kashmir giving equal emphasis to each, because water availability over the predictable future will not be a limiting factor in development. Almost three quarters of the entire flow of the many rivers of the Indus basin is contributed by the rains and snowfall in their catchments in Kashmir (Khan, 1961). The region abounds in perennial water potential and the problem in the water resource field is to use its development so that other sectors can benefit at the same time. The intensification of water-using activities within the region would be complementary because these would not involve diversion of the flow or any significant diminution of the downstream water. The conceivable land resource use adjustments in Kashmir are, therefore, unlikely to cause economically adverse effects on water resource uses or vice versa. Nevertheless, a complete evaluation would allow for the costs and benefits of the watershed protection and erosion influences of various adjustments and of the water requirements of different production and processing techniques. If that is done, an initially weak relationship between analyses

* An exception seems to be the proposed revision of the forest policy for Queensland in the Australian Commonwealth. If formally accepted, it will be the first case of a specific policy for a region, no doubt simultaneous to the existence of a National Forest Council which looks at plans in a "Federal" way.

of the two main resource categories is not likely to jeopardise the theoretical ideal of an integrated treatment of the entire renewable resource base.

A broad division is not inapt because the results of a few main analyses can be adequately synthesized for higher level decision-making. This may be achieved by forward and backward redesigning of the few renewable resource systems till the analytical process strikes a chord in tune with total developmental objectives and constraints of complementary resources. Caution, nevertheless, has to be exercised to ensure that the problem is not decomposed in a way that it does not meet the realism of a particular situation. In any case, decomposition should be limited only to what is necessary to make the treatment of the problem tractable in practice. An integrated solution would be nearer the optimum than one that is less so, even if subsequent synthesis is possible, because many disjointed analyses cannot be synthesized easily without some mutual inconsistency.

The division between the water and land resource sectors would be more realistic if the latter were delineated co-extensively with a watershed region so that the two analyses can be integrated for comprehensive planning of a river basin that may constitute a composite, identifiable, economic unit. Thus the division has to be considered together with the problem of identifying geo-economic regions. This is a reason why planning the use of renewable land resources for the entire Kashmir valley as a region would be theoretically suitable and practically useful.

To facilitate a proper demarcation of regions and resources, a reconnaissance of the renewable resources of an area is necessary. This may be considered parallel to the preliminary survey reports of industrial projects that precede detailed surveys of raw materials and markets, the approach to which we shall now consider. The results of the "preliminary survey" may, of course, be subject to amendment as a result of subsequent surveys and analyses.

INVENTORY

After delineating the scope of the problem, the starting point for its analysis is the appraisal of the nature and magnitude of the present renewable resource uses. This would include mapping the present uses on geotopographic sheets, now available for most developing countries. These may be augmented by quick aerial and other surveys, especially when proper field maps are unavailable, and enlarged to enable the relevant detail to be distinguished. Besides the data about production functions, information about infrastructure, rural socio-economy, tenure systems, seasonal and spatial variations should be simultaneously collected. Such data are essential for subsequent stages of the analysis and their lack is often a practical planning problem.

A detailed survey of the present use pattern gives clues to local resource conditions and socio-economic, cultural, institutional and historical features, in response to which it has emerged. The need for this survey is fundamental because it provides a basis from which to gauge the desirability of bringing about changes. Its importance deserves to be stressed as renewable resource planning in practice tends to assume a Utopian frame by ignoring the existing uses; either because data about them are difficult to come by and both their collection and processing need considerable skill or because they are considered as an irrational outcome of traditions. King (1963) argues for disregarding the present land use on the grounds that it "will not necessarily indicate the possible productivity of land" and may not be the "best use commensurate with the suitability of land", being influenced by "social pressures".

Here we must point out the distinction between technical and economic efficiency in order to suggest that the best use cannot be defined in an *ex-ante* manner only from the suitability of a renewable resource. This is because technical efficiency measures use of inputs and production of outputs in physical terms and economic efficiency measures these in terms of costs and benefits. The problem of how to use different renewable resources is not merely to examine their suitability in producing different products, but of choosing among different technically suitable combinations the one that represents the least sacrifice or the maximum profit to society. This would depend upon the relative prices of factors and products which reflect their scarcity in relation to demand. This distinction should reveal the conflict in arguments of King's type. These are a plea for technically "best uses", being divorced from "social pressures" and other factors. The latter would include the effect of location on the feasibility of a resource use.

The economically and socially most desirable use geared towards society's objectives need not necessarily be technically most suitable, for the costs of such a use may be prohibitive or its products may not be in demand or so scarce as those resulting from a technically less suitable use. A sloping area may be technically most suitable for use under permanent vegetation such as a forest or grassland because it is most efficient in protection against losses of soil and excessive run-off. But an appraisal of present use may show that the area is already well terraced to prevent these losses, and irrigation and other facilities stand established so that the continuance of the present cropping practice may produce more social gains than conversion to other uses. This can happen because the latter involve immediate investment and delayed returns compared with the existing use, for which capital costs are already sunk and only maintenance and operation costs are required for uninterrupted benefits.

Present-use survey portrays the rural socio-economic structure. It yields information about the assets on the ground and capital works of land and water development such as bunds and terraces, drainage and irrigation, animal and other draught power, logging facilities, plantations and propagation nurseries, commodity processing plants, harvesting equipment and warehousing. It involves a study of the existing management and supervisory machinery and its scope for handling capacity expansion and modifications in use pattern. Through it data accrue about the current solvency of various renewable resource producers, shown by the royalty and tax revenues from sale of timber and grazing rights, the incomes, indebtedness and liabilities of peasants, and about local demand, marketing, lines of export and communications network. Such an inventory is a pre-requisite for the further development of renewable resources.

The advantage of surveying current use will be to identify reference points for change towards a potentially better use; it will show where deficiencies and impediments exist. The present use pattern may not be socially the best because societies are dynamic and their objectives change, if they are not to stagnate. In developing countries, much of the rural sector activity does not undergo market exchange. Considerable distortions and imperfections in renewable resource-based production and consumption exist because of physical inaccessibility and economic disequilibria including resource immobility, share-cropping and other practices, which act as disincentives to producers for investing to the level of marginal productivity. Agents of change in the renewable resource sector are scarcer than elsewhere. Since the masses concerned with these resources are ignorant, changes to ensure socially desirable realignments cannot be expected to permeate this sector without much delay. In developed countries too, know-how is not readily applied by producers

because technological progress outstrips the capacity of communications media. For these reasons, the next two steps in the analysis are firstly to explore alternative possibilities of using a renewable resource and secondly to evaluate their comparative merits.

FEASIBILITY STUDY

The two aforementioned steps are analogous to a feasibility study in conventional project analysis in that they show whether a particular renewable resource use is feasible or not, i.e. whether it is technically suitable and economically (and/or financially) justifiable. The difference is that they analyse not only whether an option is worthwhile but also place the various options in a ranking order. This is important as our problem is not restricted to the usual accept or reject options of a particular project. It cannot be solved by an independent or single feasibility test, because the problem is of choosing among the numerous production activities possible over a renewable resource base.

The first step involves a biotechnical assessment of renewable resources. Since these resources comprise a biome of living elements, such an assessment can be best devised ecologically by taking into consideration the interactions between the fauna and flora and their environment. This complexity is unique to renewable resources. Hence the need to combine the investigation of the biogeocoenotic relationships of an ecosystem with the technical opportunities of using it.

The above relationships are often innumerable depending upon the array of climatic, edaphic and biotic factors and their local and regional variations. To make the investigation operational, the problem may be approached by identifying the factors which are limiting, in descending order of their constraining influence on different uses. The problem then is to evolve a sieving mechanism suitable for an area, which successively concentrates on an apparently more dominant or discernible environmental factor among a number of multicollinear variables related with the suitability of some uses, and eliminates other factors and corresponding unsuitable options.* One may classify broad climatic groups which occupy certain localities or elevation zones in the region and which are individually compatible with certain kinds of uses. Each of them may include sub-zones classifiable by edaphic or vegetational features and vice versa. By further subdivision of a region according to locally limiting factors correlated with other sub-dominant factors of the environment, its suitability may be assessed for the entire area on a micro-locality basis, so that total areas possible for different uses and their location become known.

Use–possibility is not to be assessed purely on the inherent features of a resource base. That would be a faithful reproduction of the natural potential. Different techniques of using a resource should be considered for each successive broad limiting group so that the lower level environmental factors do not act as constraints unless they appear so in conjunction with feasible technological options. The adoption of all available technologies especially those of advanced countries, such as of the use of heavy combine harvesters, may not be possible or useful in a developing area. This problem involves the study of current techniques in different localities of a region, in neighbouring regions and similar areas abroad, of relevant experimental evidence for possible improvements and crop and livestock responses, of the scope for providing new input mixes and materials including increased credit and ancilliary requirements, and of the demand and consumer tastes

* Multicollinearity in a renewable resource eco-system exists because explanatory variables are highly correlated; i.e. omitted variables may affect but cannot be isolated.

vis-a-vis changes in quality and proportion of different products. The choice would be limited to technologies suitable for the stage of development, standards of present skills and capacity to acquire new ones, and the climatic and topographic conditions. Nevertheless, the scope in renewable resource use remains immense through a diverse and wide choice of input substitution and kind and quality of commodity production.* This is more so in backward areas like Kashmir, where prevalent technology is primitive and adoption even of feasible intermediate technology could be a leap forward.

Considered together with techniques of renewable resource uses, there will usually be many mutually exclusive options or possibilities of using an acre of land or any other resource. This leads on to the second step of ranking the options according to their social costs and benefits. Such analysis is the relevant appraisal technique when the purpose of planning is to meet society's objectives. This is germane to renewable resource utilization because the problem of planning concerns the entire society, these resources being dispersed spatially and economically with many externalities manifest in their use. This argument no doubt rests on the assumption that society is willing to plan the use of these resources in the interests of development and has an adequate institutional infrastructure for planning and follow-up action. Nevertheless, the planning process itself should unfold the problem of follow-up in a particular region and the need for strengthening the existing or establishing new implementing agencies.

The evaluation criterion should be devised to rank the comparative efficiency of options in using the bundle of renewable resources and complementary factors of production such as labour and capital. Efficiency in resource utilisation is an appropriate criterion because in resource-poor† countries the criterion should be one by which the admissibility of options remains unaffected by their magnitude. This would ensure that the limited resources are allocated to more productive options to help mitigate the overall resource scarcity. This would avoid the waste of resources likely through projects aimed to maximise the absolute sum of net benefits and which is the criterion usually favoured in developed countries. Absolute maximisation may not be irrelevant in economies where resource shortage is not acute or

* The choice of techniques exists not only in factor combinations for producing a unit output as usually understood, e.g. the choice between labour-intensive and capital-intensive or between extensive and intensive renewable resource use. It extends to the method of producing a commodity, e.g. artificial or natural regeneration of a forest, snow skidding or water floating, road or skyline crane haulage, fertilizing or manuring, irrigating or moisture-conserving, sequential crop rotations or inter-cropping, compact tree blocks or linear strips along farm boundaries. Both the alternative factor proportions and the methods of mixing them need to be explored.

† Resource poverty refers to the deficiency of economic resources at the command of society for meeting its developmental ends. Resources imply that a demand exists for them and that factors of production exist to exploit them. The mere abundance of a renewable resource, such as forests in Kashmir, does not contribute to resource availability unless it is economically accessible, which, among other things, involves the removal of physical inaccessibility. Similarly, a "resource" is not an economic resource if it is not in demand or is not scarce, such as water in cycle in Kashmir. The development of a renewable resource for economic use is then possible either by creating demand through the development of other sectors of the economy or by combining it with other resources such as capital, through which it becomes utilisable. In either case, investment is required. Resources for this are more deficient in developing economies giving rise to their overall resource poverty and stagnation, though other reasons may also contribute. Therefore we deduce that economy of investment resources through deployment on an efficiency basis should rank supreme in judging the merits of options. It should thus not be surprising to have a result from our analysis where no use of a renewable resource may be a better use than using it for producing something. It is an erroneous argument of most renewable resource producers (and planners in Kashmir) that it is better to make use of their resources than say leaving land fallow or a forest unexploited. But, no use may be economical than some use when the latter, even though profitable in absolute magnitude, may involve diversion of society's limited resources from a more productive opportunity within or outside the renewable resource sector.

where opportunities for alternative investment are insufficient and the choice is between one or the other large (and often prestige) project. In addition to the fact that the floor and ceiling for scale in renewable land resource use-possibilities are wider apart than in industrial and power projects, these assumptions do not hold in poor countries where investment opportunities are many compared with total resources especially capital, as in Kashmir.

For a realistic appraisal of efficiency, prevailing prices cannot be relied upon because of greater price distortions in developing countries, particularly in the renewable resource sector where the prices hardly correspond to real factor costs or product benefits. Renewable resource activities, including forestry monopolised by the state in Kashmir, are little exposed to inter-regional and international comparisons of production efficiency. This is in contrast to some industrial projects, for they may be explicitly export or import-substitution oriented or simply because similar projects exist abroad and comparison is easy. Thus the comparative disadvantage or desirability of renewable resource activities is masked. This is more so for peasant agriculture and livestock activities, because many inputs and products may not be priced at all.

To permit the economy to derive the benefits of international trade and resource flows, the various commodities need to be compared with foreign products and substitutes. Thereby investment can be channelled in activities which are more efficient on the basis of a region's factor proportions and location in comparison to its trading partners. Factors of production like labour in a socio-economic evaluation need to be priced in a manner that reflects their social opportunity cost to the economy, so that resources are transferred only when they are less productive in the foregone alternative. Besides the social* pricing of factors and products commensurate with the degrees of unemployment and scarcity, the main problems in the efficiency appraisal of options lie in the proper measurement of their economic consequences, including non-marketable and spill-over effects, and of the discounting of costs and benefits over time to weight them by society's† time preference rate.

PREPARATION OF PLAN

The choice among options cannot be made directly from their ranking because of mutual exclusiveness and interdependence among them. The choice is complicated by restrictions associated with resource availabilities and renewable resource products' demand, product flow patterns and input requirements of different activities, by institutional constraints of budget, organisation, ownership, incomes and seasonal labour fluctuations, by employment, distribution and other subsidiary objectives, and by lower and upper bounds acting upon different renewable resource uses. The bounds may operate endogenously such as the minimum requirements for watershed protection or the maximum area possible for a particular renewable resource use on the basis of bio-technical suitability. Or they may be set exogenously through the economy's structure, because of, say, limitations of transport such that not only the effective demand for but also the production

* Social refers to a measurement from the economy's point of view so that divergencies between private and social costs and benefits, because of externalities and imperfections including trade barriers and artificial exchange rates, are also taken into account.

† Society's as against private time preference would be consistent with the growth rate target set by society and, therefore, with the savings rate necessary for reaching this chief economic objective. This reflects society's normative judgement about foregoing present consumption for increased future consumption through investment and is the social rate of transformation at different points in time. Alternatively, it is the premium placed on enjoyment by society now rather than later. This would influence the choice of techniques, e.g. capital intensive long maturing projects vs. quick yielding less durable options.

of certain goods and services is constrained to a maximum. Alternatively, legislation or the demand for an immobile commodity, such as outdoor recreation, amenity or national defence, may warrant at least a minimum magnitude of certain activities. Priorities among options then cannot be struck in a straightforward manner according to the descending order of their efficiency; the problem is no longer the maximisation of efficiency but of optimization of resource allocation so that those most desirable options are selected which are compatible with each other and do not violate the aforestated constraints and bounds.

In industrial project planning, a feasibility study plays the role of initial selection of the most suitable option or the overall design, so that preparation of the plan or the project report can proceed directly after that. But, because of the nature of our problem and the difficulty of choice pointed out above, the use of an appropriate operations research technique* is called for at this stage of renewable resource planning. This is because an optimal plan can be framed only after simultaneously taking account of all the inter-relationships. The latter represent the objective function of efficiency, the constraints and bounds acting differently on the various component activities, and the mutual exclusiveness, the effect of which cannot be specified in advance. These relationships may be expressed as an algorithm, i.e. they are described as a succession of interconnected equations and/or inequalities juxtaposed in relation to each other.

For reaching a solution, quantification of the parameters in the algorithm is an essential prerequisite. This may be done ordinally or cardinally, depending upon the objective of the analysis. In renewable resource planning in developing countries absolute figures cannot be very reliable. Nor are they crucial, because the choice is not about independent magnitude of a particular component or project but of the comparative effectiveness in the use of society's scarce resources. Therefore, a method which can evaluate ordinally the efficiency of options is appropriate enough.

The technique should be capable of linking dependent activities such as farming and farm forestry and of transfering substitute activities such as production of commodities from a resource base or their importation from outside. It should be amenable to parametric manipulation or experimentation, to incorporate the effect of ranging resource and other constraints and to reveal the opportunity costs associated with each, so that changes that can contribute to objective maximisation are pinpointed. The analysis should commensurately reflect the flow of economic consequences of different uses during their initiation and operation and the comparative magnitudes of their influence over time during the planning period on financial, institutional and social features. It should also allow for generating a number of optimal plans† to cater for different assumptions and purposes.

* The technique should be a prescriptive aid for objectively studying the renewable resource system. The system would be cast as a model with explicitly defined relationships between the parameters which society is willing and capable of adjusting and the measures of merit or the objective function. The model would be aimed at determining optimal values of the decision parameters, keeping in view the input and output relationships of alternative renewable resource uses, total resource availability and demand for different products. Such an aid can thus help solve the problem of finding optimal combinations and quantities of different commodities to be produced and the production process by which the activities can and should be pursued.

† The prefix *an* to *optimal plan* in one paragraph earlier and elsewhere signifies that we do not claim to attain *the* best of all possible economic decisions, unless by coincidence. The true optimum is difficult to achieve in the renewable resource sector where institutional and other non-economic constraints heavily militate against reaching it. Here, we suggest that it is possible to have more than one "optimal" plan in the sense of sub-optimizing, depending upon the optimality premises made in building the model and in attaching value to its various parameters. This is useful because the data about renewable resources in particular

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This would be on the lines of sensitivity analysis involving initially different as well as changing time preference rates, varying demand and price estimates, riskiness of alternatives and multiplicity of objectives. This would help ensure a choice which is more suitable from the public view-point and a better complement to the overall development plan, because high level decision-making can then be more flexibly and effectively co-ordinated with information available through macro-level planning.

For all this, the use of a computer is inescapable; otherwise it is practically inconceivable to attain an optimum solution for a set of simultaneous equations comprising a large matrix, many activities in which have feed-back effects on the rest and vice versa. Computer models are useful because once constructed, the data can be re-run for changes over time and for redesigning and subsequent analyses of the system.

We aim to integrate renewable resource planning with regional and national development planning through analyses based on society's objectives, social time preference and social costs and benefits and by imposing socio-economic and institutional constraints in the process of selecting an optimal plan. But, there is an inherent distinction between the two planning processes. This arises because some renewable resources such as of forestry and horticulture are subject to long production cycles. For a realistic appraisal of their efficiency, our planning horizon has to be longer than the short periods adopted in economic planning, such as five years in Kashmir. No doubt, this requires that the consequences corresponding to the economic planning period should be spelt out separately and in detail to match resource constraints and rest of the economy's requirements as closely as possible; this should find expression in the optimisation model itself. But, for a commensurate evaluation of options, efficiency ranking should be done on the assumption that all the renewable resource use adjustments are carried out simultaneously in the first year. Thus the effective economic length of each option would extend over the entire resource planning period, irrespective of the number of crop rotations involved.

Therefore, though we should allow for the periodicity and timing of consequences, so that the optimisation process includes a multi-period analysis of labour, capital, budget, incomes, product output levels and demand, this process does not explicitly deal with inter-temporal interdependence of options and phasing of priorities. This is the problem of investment scheduling. It necessitates an analysis to evaluate the effect of varying the dates of initiating different projects or options so that the overall efficiency is maximised by postponing certain options in favour of diverting resources for starting others earlier. Such dynamic investment planning may be done either during or after the optimisation process. Its aim is to improve upon an "optimum" plan by pinpointing the most efficient scales in relation to timing of mutually consistent options without violating any restrictions.

The analysis to study the effect of different installation dates involves successively shorter periods of economic life of options within the planning period. Since the likely benefits in the subsequent planning period of options of which their economic lives actually extend to that period is irrelevant for the present period, one has to attribute the salvage value of the assets and disposal costs at the cut-off limit. This conforms to the principle that at the beginning of a planning period, sunk costs are not to be counted in the estimation

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are not accurate in developing countries, especially those involving technological forecasting, and because the ultimate decisions are subject to the vagaries of policy makers. Nevertheless, given an explicit statement of the assumptions behind an optimal plan, it will be closer to the optimum if arrived at through the analysis than without it. This will also help to remove subjectivity in resource allocation and rationalise the decision-making process.

of the consequences of an option. Besides the problem of valuation of assets at different points in time of their economic lives, scheduling involves the identification and evaluation of activities that would be pursued during the intervening periods.

IMPLICATIONS OF PLANNING

The problem that remains to be studied after producing an optimal plan, which considers both the interdependence of the options and their dynamic aspects, is of the impact of the plan and the complementary measures necessary for its implementation. The impact analysis should reveal the difference that would ensue in the course of the economy through the proposed renewable resource use adjustments. It would help the co-ordination of overall planning and in guiding the development of the rest of the economy in relation to the potential of resources employed for, and generated through, utilising the renewable resources. This analysis is useful for the success of the plan itself by virtue of properly directing the orientation of concomitant activities such as the development of necessary infrastructure and renewable resource product processing facilities. Importantly, it will facilitate higher level decision-making when confronted with more than one feasible plan, the desirability of which has been advocated earlier, because the one which produces the most congenial impact on other sectors and the objectives of society would become easily discernible. The chief requisite of this analysis then is to relate the consequences of optimal plans with the requirements of the rest of the economy. Though designed for some other purpose, the input–output analytical technique may be suitably used for studying this aspect of the problem.

The inter-industry analysis would not bring out the nature of the effects of social and institutional obstacles on renewable resource use adjustments. The planning process cannot be rounded off without an analysis of these impediments and accordingly for proposing suitable measures for counteracting them. While placing reliance on the involvement and agreement of the people through co-operation, extension and demonstration, because the plan cannot succeed without public consent, these measures may include legal, monetary, fiscal and organisational reforms for the implementation of the plan.

Since the causes of some of these impediments traceable to the socio-psychological, cultural and religious background of the people may be deeply rooted, these may be difficult to remove merely through a planned* development of renewable resources. Some of the impediments may be mutually causative so that they have to be considered in the total developmental context, of which economic development is one aspect among the factors constituting the human ecological framework. Therefore, the study of these factors in a detailed manner for their implications on the optimal plan is necessary not only towards the end of the problem analysis, but should also precede the use-possibility assessment for a proper feasibility study. This avoids wasteful effort in considering options which society is not conditioned to accept. One such example is the option of beef production in an economy where Hindus are the main consumers and producers as in India, where society is resistant to changes in religious mores.

THE OVERALL PROBLEM

In a nutshell, we have attributed three main dimensions to the problem of planning the use of renewable resources. These involve the sciences of sociology, renewable resource

* Unless planning can be centralized and its implementation enforced from above. Our schema does not consider such a situation.

ecology and economics. Accordingly, the problem can be broken down into three successive analyses to find out (a) what is adoptable or not, i.e. socio-cultural, (b) what is possible or not, i.e. bio-technical, and (c) what is gainful or not, i.e. economic.

Though the problem analysis may be done along the above lines the stages cannot be rigidly followed because of their interplay on each other and because the total problem is a blended sum of the three dimensions, involving both the inter-temporal and the inter-resource relationships among and between themselves. The problem of renewable resource planning can, therefore, be properly classed as a systems analysis* in which changes at one end of the system are properly reflected further on in the chain of relationships, as well as their feedback effects. Systems designing should evaluate the effects of all relevant changes in the total framework through the stages of analysis, of different resource use coefficients and influences on constraints, bounds and maximand(s), and at different points of time.

This may be done in two main ways. One is to simulate the basic model of the system and then to carry out successive changes in the model till a design which is an improvement over the present use pattern is achieved. Simulation technique, however, may not lead to the optimal design either because it may fail to incorporate changes which would be even better and/or because all combinations of component changes may not be explored. The chosen design, though an improvement over the present one, may represent a hump in the successive simulations before reaching the peak, which may be separated by one or more depressions. Thus, one would neither know when to stop the analytic process nor be sure of having struck the best design even if one has. An alternative, which involves more labour and complexity but does not suffer from these disadvantages, would be first to evaluate all feasible changes for each resource use and then to try *all* permutations and combinations† of the options. There would be no distinction between the components of the basic model and their options such that combinations among and between the present and possible uses are explored jointly as well. Such an iteration technique would go through all the humps and depressions and it would be possible to locate a design in which the overall efficiency in using the bundle of resources is at the peak.

Our planning problem pertains to the mode of moving from the present use of renewable resources and not to producing an idealised future. Abstract objectivity is, therefore, neither the aim nor could that be useful. We should not restrict ourselves to the conventional line that "good scientists should ask only 'How?' never 'What for?' " (Schultz, 1967). Without asking both the questions, renewable resource planning may not cater to the aims of development. Systems designing should handle both the questions by marshalling facts on either account. "Planning results in blueprints for future development; it recommends courses of action for the achievement of desired goals" (Bollens and Schmandt, 1965). The systems analysis cannot find what is "best" unless the purpose of the analysis is known. The study of society's objectives vis-a-vis renewable resources is indispensable. In poor countries, this will generally be simpler, because the problems of environmental quality are less pressing especially in rural areas. A quantitative approach is important because the major concern is economic development and alleviation of material poverty. The problem there is the more mundane one of maximising an objective function which suitably expresses the socio-economic efficiency of alternative systems designs. Nevertheless, this expression

* In general, systems-analysis is the process of reviewing a complex organisation taking into account the interactions of parts of the organisation and their effect on the whole.

† Permutation means arrangement and combination means selection (Liu, 1968). The idea is to select options in such an order and magnitude that the objective is maximized without violating the constraints.

needs to be weighted for other objectives or they have to be introduced as constraints in efficiency maximisation, because besides economic growth, developing societies often set redistributional and other goals.

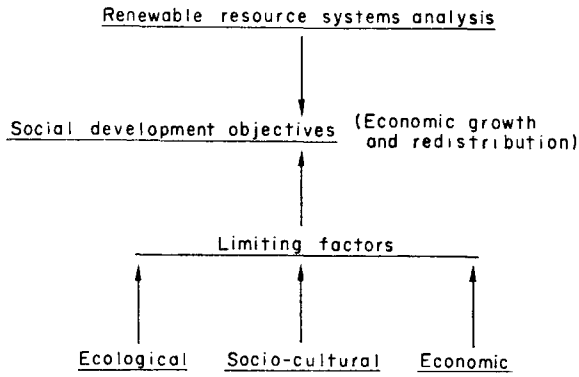


FIG. 1. Diagram showing the framework of renewable resource planning.

To conclude, the planning process should be able to combine purpose, facts and considered estimates of an area's renewable resource potential. A rational plan will be the product of integrated analyses of the limiting rôles of socio-cultural, ecological and economic factors in a total environmental context, in which national and regional developmental aims and relationships with other sectors are taken into account. The approach to such a systems analysis is schematically represented in the above diagram (Fig. 1) and the various steps of the analysis are tabulated (Table 1).

TABLE 1. SHOWING THE CHRONOLOGICAL STEPS IN THE SYSTEMS ANALYSIS

0	Object of analysis (policy and development strategy)
1	Delineation of problem (total problem analysis—regions and renewable resources)
2	Present use survey (basic model analysis—mapping, review of techno-economic data and obstacles to resource adjustments)
3	Use possibility assessment (biotechnical analysis)
4	Options appraisal (benefit–cost analysis)
5	Optimization (operations analysis)
6	Investment scheduling (dynamic analysis)
7	Inter-industry relationships (impact analysis)
8	Implementation of the plan (administrative and institutional infrastructure analysis)

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APPENDIX 2

THE CONCEPT OF RENEWABLE RESOURCES

M. K. MUTHOO

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THE CONCEPT OF RENEWABLE RESOURCES*

M. K. MUTHOO†

'Land is an element of nature, inextricably interwoven with man's institutions.'

Polyani (1957)

NATURAL RESOURCES

IT is inadequate to consider natural resources as those 'existing in, or formed by, nature' (Oxford English Dictionary, 1933). According to such definition, only one of the five types of forests identified by Poole (1968) would be considered as natural resources, viz., 'those established by natural regeneration without deliberate assistance from man'. But, natural forests managed and perpetuated by man may be more important for human welfare, for otherwise they would not be managed. This illustrates that a rigid definition is not useful and that natural resources need to be viewed in relation to man. Nature and natural resources influence human welfare in many ways. They yield materials for production, such as petroleum, and psychic goods for consumption, such as enjoyable landscape. Nature causes distress to man, such as through floods and bush fires. It may act as a barrier to development, such as through distance in the space resource and rugged terrain.

All kinds of wealth can be sources of human prosperity. To treat natural resources differently *because* they are nature's gifts is not rational, if the end is human welfare. The origin of a resource is immaterial; natural as well as non-natural resources are the constituents of social capital. That a resource may have been created naturally instead of by the 'coagulation' of past labour inputs is irrelevant to present and future use of resources. For being harnessed,[1] natural resources require to be combined with other economic factors,

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1. For providing the material or consumption benefits, for controlling their harmful effects and for overcoming their influence as impediments to development.

such as labour. They constitute economic resources, depending upon demand and accessibility; lack of demand or inaccessibility to factors and markets leaves them economically unimportant to society.

In the process of harnessing natural resources, their occurrence in Nature is altered. Nevertheless, they retain the character of natural resources in so far as these are the vehicles by which mankind draws upon Nature's physical power for production and regulation. They differ from purely man-made capital, like machines, in that their role in human welfare is constrained by environmental factors. They occur in a natural flux, amenable to working within the framework of geosphere, of which man is but one of the elements. It is realistic to group natural resources as a separate form of capital, subject to natural changes in addition to the wear and tear engineered by man.

Natural resources may, as such, be defined as the features and products of Nature[2] amenable to use as factors of production and consumption goods. Originating in Nature, they are subject to manipulations depending upon the amenability to such process on the one hand, and the objectives, skills and complementary resources at society's command on the other. The main natural resource *types* may be listed as herein-below[3]:

1. Land (including site and soil),
2. Vegetation,
3. Animal Life,
4. Water (in cycle),
5. Atmosphere, and
6. Minerals and Fuels.

RENEWABLE RESOURCES

Allen and Leonard (1966) arrange natural resources into three 'groupings', of which the first comprise the 'inexhaustible resources.' Hammar (1942) too makes the 'foremost' distinction between 'exhaustible' and 'inexhaustible' resources, including 'water power sources, the elements of soil fertility, brick clay' in the latter group. Such classifica-

2. Nature operates as the creative and regulative physical power; it includes the environmental phenomenon which occur unhindered or unaided by human agency, such as climatic changes, geological upheavals and evolution of species.
3. These do not include resources which arise as attributes of the basic resource types. One or more of them may form an 'integrated resource', e. g., amenity, recrea-
an d space utility.

tions seem to be so motivated that services required by mankind, whenever obtainable from 'inexhaustible' as well as 'exhaustible' resources may be secured from the former. If it is so, they are in the same category of importance as the statement that if labour does all the work, there need be no depletion of energy resources. Another consideration in such classifications is the physical availabilities of resources. Even assuming a static state of arts, it is arbitrary to distinguish resources as exhaustible and inexhaustible on the basis of such availability. The 'availability' depends on the relative proportions required for use, accessibility and demand. It varies by additions through discovery and other changes. It is not possible to identify objectively *an* amount that demarcates the line of exhaustibility and inexhaustibility of a resource.

The above classification is static in concept. The role of resources varies from time to time and place to place. The degree and manner of resource use depend upon society's development. Forests may have appeared as an inexhaustible resource to Amer-Indians just as brick clay appears to Hammar. Similarly, water power sources are not necessarily inexhaustible when considered in the three dimensions of resource, time and space. Examples are not wanting whence sources at a particular place do not hold the same potential as in the not-too-distant past. Changes manifest in the drying up of rivers, like Saraswati in India, and the accelerated run-off and sedimentation have reduced the water power sources of many areas. Such *exhaustibility* is a feature of immense economic significance by warranting expenditure on water conservation and allied measures. Indeed all resources are capable of exhaustion and it is a misnomer to call any resource as inexhaustible (Darling, 1969).

Hammar (op. cit.) may be right that the elements of soil fertility are 'inexhaustible', if considered in terms of geological time spans or the basic components of a resource. But peering into either the remote future or the elements of resources neither identifies nor changes the relationship of resources to man at present and in the relevant future. Such a view renders all resources 'homogeneous' in being basically 'inexhaustible', because the *elements* of no resource are exhaustible. A classification so based is tantamount to no classification. In practice, spatial changes take place even in elements, say through rivers flowing to seas and winds blowing across deserts. That apart, even if the elements of soil fertility are 'inexhaustible', soil fertility in many circumstances runs down and gets exhausted. Soil fertility is exhaustible. For soil as a natural resource, it is the liability to exhaustion and not the so-called inexhaustibility of soil fertility elements that

matters. Soil fertility elements, if divorced from soil, are not exhaustible, because they may be technically perpetuated by manufacturing and applying fertilizers. But soil fertility elements that can be captured from soil, through the medium of which these are available for man's use, are exhaustible. It is this feature that necessitates fertilization and other measures for maintaining soil productivity, so that the exhaustibility and not the inexhaustibility is of practical importance.

Ciriacy-Wantrup (1942) defines resources as 'flow resources if different units of a resource become available at different units of time...(and) as stock resources if the total quantity of resource available either does not vary significantly or decreases with time.' Kelso (1961) comments that being a 'stock' or a 'flow' resource influences the functioning of a related industry. Crawford (1952) too separates 'flow resources' of 'land, forests and water' from what he calls 'fund resources like coal and iron.' Heady (1950) distinguishes 'stock-derived products' from 'flow-derived products', for being with and without scope for substitution between time periods, respectively.

Since such distinctions focus attention on the composite supply of 'stock and flow resources', the objective is shifted to the substitution of 'stock resource' services in the current periods by 'flow resource' services in order that the former might be 'conserved.' In this respect, this classification is not different in theme from that of 'exhaustibles and inexhaustibles.' It would serve as a sequel to a policy for 'conservation' of 'stock' resources. Such classification is applicable only when the conservation of 'stock resources' is decided *ad lib* and not from an objective assessment of the spatial as well as temporal desirability of substitution and relative conservation needs for human welfare.

It is inapt to distinguish resources as being inherently either 'stocks' or 'flows.' These are economic terms. The interpretation of 'stock and flow resources' is not in accord with the economic significance, causing confusion between economic concept and physical quantities of resources. Additional conceptual difficulty arises in making categories of resources into 'stock' or 'flow' resources. A forest can be both a stock and a flow resource. At a particular time the quantity of wood is the stock. The amount of wood added through growth increment to (and/or reduced through decay or removal from) the original quantity of the stock is the flow from the date of the last inventory. One and the same tree holds a stock and a flow; it is a stock resource in static sense and a flow resource in dynamic sense. Considered through time

dimension, minerals too exhibit flows. Kelso's (op. cit.) classification of ground water as a 'stock resource in contrast to other water sources regarded as 'flow' resource is ambiguous. Ground water need not be of 'limited life span' (Davis, 1960), if a balance is struck between the rates of pumping and recharge. Parallel considerations are warranted for 'flow' water sources. Water drawn from a lake has to be balanced by inflow as otherwise it will dry up; a river cannot sustain an irrigation system larger than its discharge pattern and hence the real-world interstate river basin problems.

Scott (1955) recognizes the 'two classes' of 'stock resources' and 'renewable resources'—the former 'are lying ready for further processing...(and) are the subject of decision about depleting by employing current factors' and the latter 'are the subject of decision about employing...factors of production.' But the 'stock' resources need not always be the subject of depletion. They may actually be added to existing reserves such as by importing. The other objection is the conceptual incompatibility in interpreting 'stocks', as discussed earlier.

The concepts of 'stock' and 'renewable' resources are simultaneously applicable to most resources; the distinction is blurred for an objective analysis. Soil resource, for instance, may be depleted or mined 'by employing current factors' without investing for maintaining its present state and/or fertility. Contrariwise, it may be actually built up or, what is tantamount to that, improved from its existing state by proper husbanding that involves employing 'factors of production.' An example of the former is the practice of destructive, shifting cultivation in the tropics. Soils are used up or devastated and the erstwhile good soil resources stand depleted like a 'stock' resource (Jacks and Whyte, 1939). An opposite example is strikingly presented by Ladakh where lamas actually 'create' soil by meticulously gathering it from all over and spreading it on fields protected against erosion by building stone walls. Price (1954) records a similar practice in Malta where 'hard rock (was) slowly reduced to small pebbles and then covered with scraps of soil collected laboriously from cracks and crevices.' Another example is the floating fields in Kashmir's Dal lake, built up by weaving mats of reeds and spreading weeds, soil and debris collected from the lake. Terracing for paddy cultivation in the East is another kind of example where soil gets treated as a 'renewable' resource by employing the 'available factors of production.'

A particular young tree can be regarded as a 'stock' which might be cut down. At the same time, it can be an object of further expenditure for producing more wood thirty years later. In such cases, the two

categories blend together. Scott (op. cit.) dismisses the paradox by saying that 'there is no need to create further categories.' The problem, however, is not of having more than two categories but of classifying less ambiguously and more appropriately.

The primary consideration in classification should be the relationship of resources to man, i.e., their amenability to use and the influence of man's actions on resources. The objective in resource use should be to economize on scarce means of production and enjoyment, not on human welfare for the sake of the 'welfare' of resources. There is no inherent distinction between one or the other resource except for the relative scarcity and the scope for their renewal through use. No resource is intrinsically more valuable than others. The value depends upon the demand for resources and the ease with which they can be made available for use. Given an endowment of resources, an indifference between the inherent merits of different resources allows objective decision-making by society that relies on them as economic factors. A distinction for the prospects of renewability permits society to avoid the consequences of scarcity and depletion i.e., by reducing the chances of rising prices for more supplies.

The distinction between renewable and non-renewable resources[4] is that the former could be used and yet be renewed subject to the limitations set by the frame of Nature and available technology. Of the six main types of resources listed earlier, all but the minerals and fuels may be considered renewable, i.e., capable of renewal. These resources may not be depleted, exhausted or destroyed while consuming or employing them for production in combination with other factors. This is possible for soils by using their content only to the extent of new additions through soil formation and other processes, including conservation farming; for animal life by restricting the manner and size of catch so that communities continue reproducing; for vegetation by not exceeding its removal in excess of regrowth; for underground water by tapping in accord with the rate of recharge; for water in rivers and lakes by using watersheds for logging, grazing, recreation and other purposes without damaging water production; and for atmosphere by using it in conson-

4. Barlowe (1961) uses the 'relative renewability' as the basic criterion but distinguishes between 'fund resources, flow resources, and a composite group of resources that have some characteristic of both fund and flow resources.' This concept involves the same inherent weaknesses as in those aiming to distinguish between stock and flow resources. The 'composite group comprises the biological and soil resources akin to renewable resource class, but discrepancy arises by the inclusion of non-natural resources of man-made capital such as 'houses, office buildings, farm service buildings, highways.' (Ibid).

ance with natural recycling and purification capability. Thus renewable resources could be maintained in quantity and even increased or altered for what may be cansidered an improvement in their quality during the process of use. There is no such scope for non-renewable resources which are depleted as and to the extent these are used up.

The above distinction of resources on the basis of their nature in use relates their consumption and renewal through time with technology. It does not presuppose a given or immutable economic policy and can be operated for varying economic structures. In addition to bringing out the scope of different resources in the overall context, it enables the adoption of a planning strategy most suitable for each of them separately too. In contrast, the earlier classifications are oriented mainly to the treatment of resources in a composite manner so that one kind could substitute the other. The latter approach fails to take notice of the problem beset in renewable resource planning and management, which is greater than that for non-renewable resources. This is so because renewable resources may have to be operated upon with the twin objectives of use and renewal, with mutual effects. With non-renewable resources, only the rate of use of a resource to meet demand requires to be determined from time to time. The distinction made is thus useful not only in providing an objective exposition of the relationship between resources and man but also in use planning under different economic conditions.

The classification into renewable and non-renewable natural resources does not involve any arbitrary limit of the quantities of a resource nor does it anticipate policies such as conservation of a particular resource. It avoids ambiguity between the natural resource classes and conflict in the use of terminology does not arise. It takes the relationship between man and resources into consideration through technology. But it does not presume any particular aspects of the relationship as being less or more important, for the role to resources is assigned from what they are used for and how they are usable. It is simple: all it stresses is the amenability or otherwise of resources through use (or misuse). It does not anticipate that use of renewable resources should substitute that of non-renewable resources in order to extend the quantity (and/or quality) of the latter over time; such decisions would vary from economy to economy and from time to time.

RENEWABLE RESOURCE SYSTEM

Air, land and water together comprise an ecological whole, characterised by growth, decay and transformation of matter and energy.

Change is perpetual and the ecosystem is ever developing like any living organism. Renewable resources include living things and occur in an ecological flux. Their study and use should consider the aspects of living nature, so that the constituent parts, including the human society, operate in mutual harmony and adaptation.

Organic nature, furnishing renewable resources, constitutes a complex dynamic system of interacting components. They are equilibrated and interrelated in such mutual dependency that change in one component entails changes in the rest of the system. Such systems can have no truly isolated parts. Technological measures considering the ecological requirements can improve upon conditions found in raw nature, in the sense of increasing 'yield' and reducing waste. But they will fail in a compartmentalized approach, because of the disregard of the cohesiveness of the total network of interrelations. The treatment of such multifactorial and multivariant systems requires suitable new methodologies. This author (1970) analysed the nature of the renewable resource problem. Instead of confining attention to limited aspects, he proposed systems analysis which can cope with the interrelatedness and interdependence of the factors involved, including man's objectives and attitudes. Suffice it to say here that the singling out for study individual components of a complex network is artificial, because component members do not actually exist in isolation.

The survival of an ecological system depends on the coexistence of interdependent mixtures of components and environmental conditions in requisite proportions. Their relative significance cannot be judged from statistics on bulk or averages. Therefore, an essential prerequisite for ecologically sound management of renewable resources is a quantitative as well as qualitative inventory and the study of the present use pattern for both absolute totals and spatial distribution.[5] However, existing equilibria are not necessarily optimal. By alterations of the mixture of components, on a scale short of endangering the integrity of the whole system, improved combinations could be discovered which come closer to maximising the total 'yield.'

Optimizing the *total* should become an objective at par with the current general practice of maximizing a specific *partial* result at the sacrifice of their interrelated parts. This requires the introduction into the total perspective of the system a sense of proportions. For instance,

5. This enables the assessment of use - possibility of a resource endowment, required for optimization discussed hereinafter.

one need investigate not only how to eradicate a given pest or wastage, but also the lower limit to which such reduction could be carried and still remain harmless for the continued thriving of the afflicted system. A certain minimum of 'pollutants' or admixtures of organisms and inorganic items is often not only compatible with, but essential for, optimum results.[6] Onesided preoccupation with standards of purity is not only utopian but also undesirable.

Because of the net-like character of the renewable resource system, the prevailing concept of cause-to-effect chains of natural events is organically unreal. Accordingly, the conclusion that any deviation of a link along such chain irrevocably leads to a deviant result is untenable. By contrast, the network type of causal relations in an integrated system with re-anastomosing lines of interdependencies ensures equilibriating adjustments and development of the system as a whole. This establishes a multiplicity of alternative routes toward a given end, viz., optimization. Only that, in view of the living nature of the ecological systems, matching combinations of steps for groups of components will be harmonious than isolated steps for individual components. Nevertheless, the idea is that equivalent improvements, i.e., same degree of optimization of the *total* result, can be achieved by a variety of combinations of steps involving different parts of the system. The management's task, therefore, should be to unravel the opportunities for potential major progress by trying a much wider variety of heretofore untried novel combinations. The scientific task is to circumscribe the degrees of recombinative freedom and to define the margins of tolerable adaptive flexibility within a given ecosystem.

The optimization of renewable resource system cannot be achieved by fragmentary and sporadic attention to isolated parts of the problem. It requires a systematic process of investigation and evaluation in reference to total perspective. What by itself might be an insignificant contribution to total resource structure might, by its position in the total network, assume strategic significance beyond its independent quantitative rating.[7] Or, small component improvements may contribute to a

6. While in the interests of suitable environment the exhaustion of the renewable natural reservoirs of dilation and assimilative capacity needs to be prevented, the deleterious side effects (or externalities) associated with residual discharge may appear only at certain threshold values. The values 'are relevant only at some stage of economic development and industrial and population concentrations' (Ayres and Kneese,1969). It is for such reasons, besides their resource poverty, that the implications of 'conservation' in developing as distinct from industrial countries are different (Muthoo, 1969).

7. The far-reaching role of the earthworm in soil fertility or of cowdung if used as manure are some of the example .

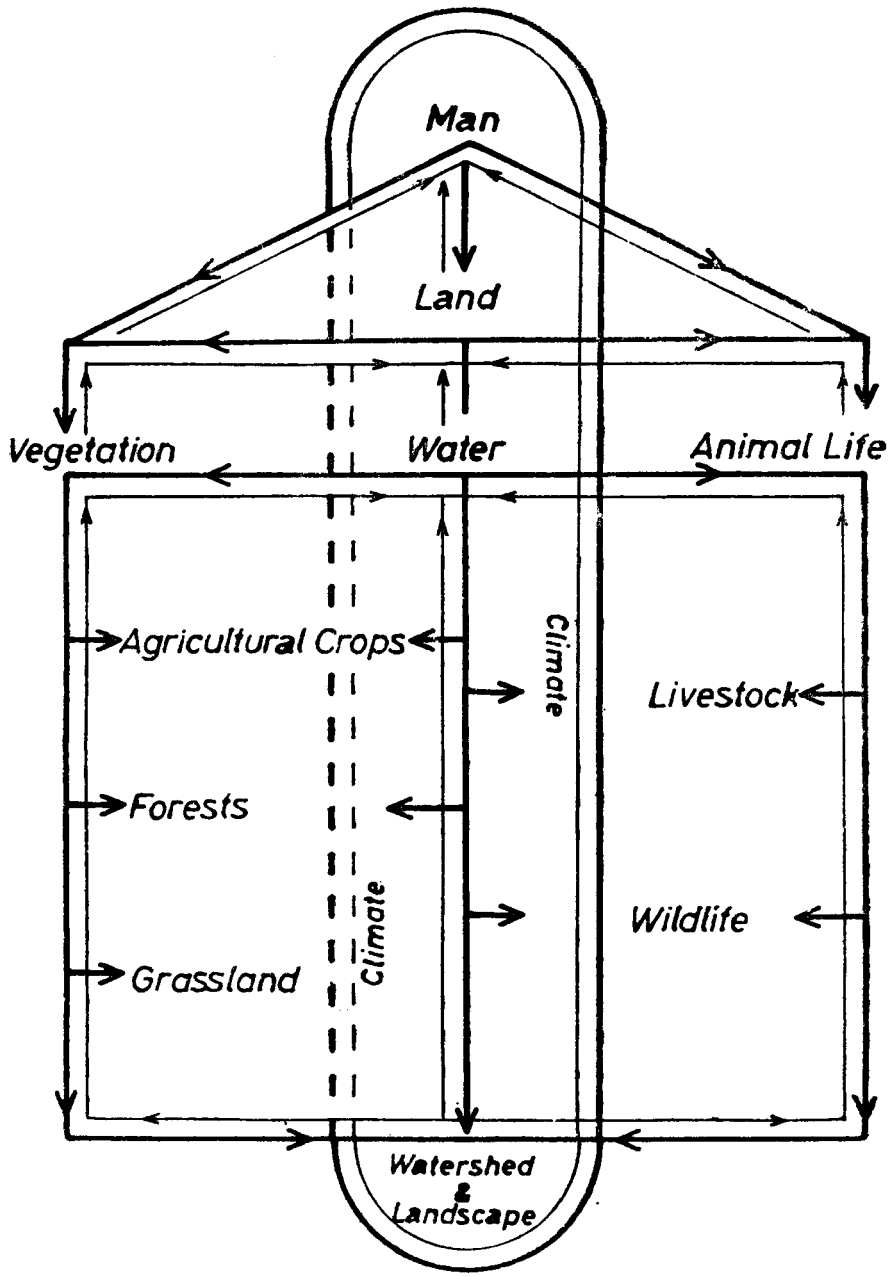
large sum total. Conversely a big single improvement may negate the effectiveness of other components, so that the net result is insignificant. It is important to trace the linkages in a system and the interrelatedness of different courses of action at various points in the system.

MAN AND RENEWABLE RESOURCES

The present human environment, i.e., the earth, may be conceived as a spaceship (Boulding, 1966). In this, the throughput is not the desideratum, but the nature, extent, quality and complexity of total resources, including the state of human bodies and minds. Successfully manipulating the environment for the continuing benefit of man depends on the degree to which the whole environment is considered. Actions considering only the benefits to a part of the landscape or the lack of understanding of the chain of events that follow a large-scale manipulation are unhelpful. The zealous application of DDT affecting beyond threshold levels (Bloomfield, 1969) exemplifies the ignorance about cycling in systems. One-problem-one-solution approach fails to consider the side-effects, which in totality may result in more loss than gain to human welfare. Instead, some form of systems analysis which considers man as part of, not apart from, the environment is required.

Land, the first of the natural resource types listed earlier, occupies a unique position in the renewable resource system. An area of 'land expresses all the various natural factors existing in the area' (Graham, 1967). It can be captured as a resource through its attributes and not by itself, i.e., land represents the fundamental resource to which other natural resources are related and are a part of. Ely and Wehrwein (1964) conceive land as 'nature, space and property'. A more complete concept is that it is 'the sum total of the natural and man-made resources over which possession of the earth's surface gives control' (Barlowe, 1961). Land is the area unit on which human enterprises are conducted. But it is within the frame of renewable resource system that land as a factor of production is amenable to continued use by man. Besides minerals and the non-renewable role of rocks as the substratum, land provides the renewable resource of soil. Formed and developed, *inter alia*, under the influences of atmosphere and water, soil sustains the biotic resources of vegetation and animal life. Of the last named, human resources conventionally comprise the separate economic factor of labour and enterprise. All these resources are inextricably linked with each other. Man, circumscribed by other economic, political, socio-cultural, technological and physical conditions, plays a key role in the renewable resource system. The entire system may be con-

ceived as a conglomerate of the mutual interactions between man and the resources. Such a biotic pyramid of which man is the apex and a dependent on all that is below him is illustrated here.



From the attributes of land as soil, landform and site flow the resources of vegetation, water in place, and animal life. Their amenability as factors of production or consumption goods depends upon the nature of these attributes within the framework of environment, including man and climate. The complex is represented by the form of watershed and landscape. A watershed or landscape may include agricultural, forest and grass lands, and, besides man, may carry livestock and wild life. All these are renewable resources.

The system depicted above embodies interdependent physical and biological features of the environment. The system may be defined as a biological organization comprising the organisms in a given area —i.e., the 'community—interacting with the physical environment.' The systems analysis calls for an 'ecological way of looking at nature' (Cain, 1968) so as to weld together the diverse sciences involved in the use of resources. Since man is the pivotal agent in directing the use and the end is his welfare through harmony with the environment, biological and physical analyses alone are inadequate. The economic, political and social parameters also require to be incorporated. However, conflicts may arise due to such diversity. As Odum (1969) says, the 'natural strategy of "maximum protection" (i.e., trying to achieve maximum support of complex biomass structure to buffer physical environment) often conflicts with man's goal of "maximum production" (trying to obtain the highest possible yield)'. Such conflicts stem from the contrasting characteristics of different ecosystem types, as abstracted below :

Characteristics of Ecosystems

Young	*Old*
Production	Protection
Growth	Stability
Quantity	Quality

The burning of chirpine forests and of grasslands in Himalayas by nomadic graziers is an example of the practice to maintain vegetation at an early development stage. The young type is favoured to achieve high rates of production of readily available harvestable products with little standing crop left on the landscape, i.e., high production/biomass efficiency. On the other hand, nature's strategy is directed towards a high biomass/production ratio, which is attained by mature-type ecosystems said to be in a natural balance (Lotka, 1956). Since the environment is our living space as well as a supply source for food and

fibre, its gas exchange, waste purification, climatic effects, and recreational and aesthetic capabilities are no less important than the throughput. Many of these 'protective' or 'living-space' functions are better served by the mature-type ecosystems. Therefore, we need to have a balance between 'productive' and 'protective' landscape; a systems analysis would be incomplete if protective watershed resource use is not considered, as is often the case.

The above conflict between man's and nature's strategy is germane to renewable resource management strategy. Nothing is redundant among the contrasting aspects of production-protection, growth-stability. quantity-quality. All the six characteristics are desirable. The dilemma is: can we have the cake as well as eat it ? From the foregoing two paragraphs, we can think of any species to be harvested as subject to a 'technological' law of growth governed by the ecological characteristics of the biosystem in which it resides.[8] Commercial exploitation, say fishing and logging, is equivalent to the entry of man as a predator. Smith (1968) illustrates that in such a scheme, the commercial production from a renewable resource

> 'need not in time destroy the resource. Exploitation by man *may* disrupt a delicate balance which destroys a resource. But the existence of external diseconomies does provide a built-in mechanism tending to resist annihilation of the resource: harvesting depletes the stock, costs rise and, *ceteris paribus*, discourages harvesting with the possibility if not a guarantee of an equilibrium.'

The crucial point is the recognition of external diseconomies, which does not always happen resulting in exhaustion of a species like the whooping crane. Renewable resources do exhibit production externalities, but these are not significant to the industry if the resource is unappropriated. Then the resource becomes a free for all good, like the early treatment meted out to supposedly limitless forests and soils in North America, which gave rise to 'grapes of wrath.' The externalities are usually ignored by entrepreneurs, for the aim is maximisation of their objectives (viz. profits). This results in the generally uncompensated social costs of private enterprise (Kapp, 1950), such as the exhaustion of fish in a lake or river by the effluents discharged by woodpulp

8. That is, the *mass* growth will depend upon certain internal biological characteristics of the species and on its environment, i.e., the abundance of nutrients, and the existence and efficiency of other species which have predator or symbiotic relationships with the given species.

industry. Thus, if perpetual resource use, to which renewable resources are amenable, is desired to be maintained, producers need to recognize externalities so that production is not pushed to exhaustion. Among other measures, the objective can be facilitated by unifying resource management. This may be done through corporate or public ownership or by social control over the use of resources, so that externalities of one component felt elsewhere in the system are captured by the management.

The conflict between prevalent practices adopted by man and the nature's strategy can be resolved by renewable resource usage which respects the contrasting aspects of ecosystem types. From a strictly 'technical and scientific point of view, quantity and quality do not necessarily constitute alternative, or even complementary, attributes of the resources of nature' (Lepawsky, 1967). Instead, they are intertwined in decision-making and the management strategy should be aimed at the optimization of the system, as conceived in the last section. Since the *extremes* of production—protection, or quantity—quality, cannot be had at the same time and place on the landscape, the optimizations should consider averting conflicts and effecting compromises which enhance human welfare. The multiple-resource use concept is relevant to this (Muthoo, 1968). It is the deliberate and carefully planned integration of various uses, so as to interfere with each other as little as possible. It may involve no use of some resources, e.g., protective watershed forest, for the optimization of the total benefits from the renewable resource system. It does not imply that every acre of the landscape should produce multiple benefits, i.e., a little of protection, of production, of quantity. Instead, it implies that since people's needs are variegated and should be met as best as possible from the limited resources, each landscape type needs to be used in the manner which is compatible with its characteristics and the socio-economic climate.

CONCLUSION

In the use of renewable resources, Nature has put constraints on the manipulative ability of man. Though their use is for human welfare just as is of any other resource, the influence of natural 'laws' in their use gives them a class of their own. In the natural ecosystems, or the biosphere, solar radiation, moisture and soil nutrients are absorbed and processed in a complex, interwoven chain for the growth of plants, on which animals and man 'feed.' The economy also uses water and biological products through complex technological media, substituting natural processes and products, for meeting man's demand. The difference is

that while the biosphere is a selfcontained system organized to provide all its own needs and to break down, disseminate and re-use its waste materials, 'the technosphere is dependent on the biosphere not only for much of its input but also for important outlets at the far end of the production chain.' (Nicholson, 1970). The co-ordination of environmental science (i.e., the understanding of the biosphere) and the environmental technology (i.e., man's manipulative skills) can lead to optimization in more satisfactory manner if larger systems are considered. Then there will be scope to adapt different resource areas to what they are suited for rather than if optimization is sought over smaller parcels of a forest or agricultural land. The integration of ecological and socio-economic systems is a challenge to those desirous of improving the environment and increasing the benefits to mankind from the renewable resource endowment. The implementation of landscape designs based on such analyses require co-operation from resource users and the will of society to enforce integrated use.

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APPENDIX 3.

CONSERVATION POLICY AND RENEWABLE RESOURCE PLANNING IN DEVELOPING COUNTRIES

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Planning and Policy

The object of planning is the conscious determination of courses of future action, by making choices explicit and furnishing information about their consequences. Like other resource allocation problems, decision-making about the use of renewable natural resources 'should be based on purpose, facts and considered estimates' (Koontz and O'Donell, 1968).

Human welfare is the aim of all positive activity. The yardsticks of total welfare, however, are elusive and specific policy goals are necessary for objective planning. One such goal in planning the utilisation of natural resources is that their use should alleviate the prevalent scarcity of resources[1] at the command of society. Scarcity does not mean absolute scarcity, but that wants run ahead of the means of satisfying them. There is a continuous resource-gap that does not decrease as more wealth is accumulated. This stifles the development of poor countries where the need, therefore, is to direct the planning of renewable resources towards reducing scarcity. It is with regard to this foremost objective that the relevance of conservation as a guide to policy should be examined.

Conservation and Preservation

Conservation seeks to increase the potential future rate of use of natural resources through investment of current social income, including the 'reservation and hoarding of stocks' (Scott, 1955). If conservation connotes reservation because it is a 'good thing' or because 'we must think of posterity', it is mere preservation.[2] Preservation is useless, for natural resources become resources only if they are usable and are put to use. Nevertheless, even preservation takes on the form of conservation *if it is geared to society's interests.* This does not however imply that 'if conservation involving wise use does not include some preservation, there will be a significant lack' (Connaughton, 1969).

[1]'Resources' imply all the accessible means of production in demand including both natural and man-made resources. 'Renewable resources' are those natural resources which, because of their flow characteristics, can be perpetuated over time through use, such as soil, water and forests as against the stock resources of coal, minerals and oil.

[2]How or who is to decide how much or what is a 'good thing' to 'conserve' among so many kinds of natural resources, their types and location? Or, how can we predict that we may not be ridiculed by posterity for such acts, as future tastes and needs may be different? Some even ask, 'what has posterity done for us?'

Futurity

It can be argued that we ought to protect future interests against the 'harmful' effects of 'our preference for ourselves over our descendants' (Pigou, 1932). This warrants the evaluation of these effects so as to ensure that protection costs do not outweigh the benefits that are envisaged from it over a reasonable period of time. The time horizon need not extend over centuries, because the distant future in our fast changing world is enormously uncertain with or without conservation.

In choosing between providing for the needs of the present or for the needs of the future, developing countries should provide first for the present, because by becoming less poor today they can plan for tomorrow's wealth but not vice versa. Facing a dearth of material capital as these countries do, they cannot, for the sake of the future, afford to lock up their natural resources or to use them sparingly. Their stagnation due to capital shortage (Schatz, 1968), can be mitigated by combining their natural resource capital in lavish doses with complementary factors of production, according to accessibility and abundance so as to augment the scarcer resources required for growth. Conservation of natural resources for the future, therefore, is not prudent during development; if man had been a true conservationist, he might have remained a savage.

Dynamics of Production

The principle of sustained yield is advanced to buttress the case for conservation. Apart from the fact that it is an unattainable ideal, 'traditional insistence on sustained yield will slow development' (Nautiyal and Smith, 1968). Rigid annual or periodically sustained production is unsuitable because of ever-shifting demands and pressures on resources, accentuated by changes in technology and tastes including the rise of substitutes.

A balance between increment and use may be desirable for preventing physical depletion. Depletion can occur through primitive use, but does not necessarily occur from organised intensive use and the balance can vary within a wide range depending upon choice of technique. Maximising production in such a way as to avoid endangering the ecosystem, by perpetuating the balance at a particular replenishment level, is unhelpful if unrelated to human needs. Production should not be pushed beyond the effort justified by the value of the products and should be aimed at producing commodities in such proportions that the sum of net social value yields is maximised over time. This necessitates the avoidance of both over- and under-investment in the natural resources sector *vis-à-vis* other activities.

If it is assessed in value terms, production can be optimally adjusted not only to balance demand and supply at socially profitable levels but also to make full use of comparative advantages of localities and countries. If this process strengthens the foundations of a lasting welfare for the community, even a transitory dis-

welfare to the renewable resources should cause little alarm. The fact that the Americans ran down their forest capital in days gone by helped their economic take-off and they are now so far advanced that they can invest in the re-creation of forests (Zivnuska, 1966). In drawing this parallel, we do not advocate irrevocable damage to a beneficial renewable resource base, but that priorities should be struck with changing emphases and values in response to varying scarcities and needs as development goes forward. Sustained yield can then be a useful concept, a starting point from which one should change circumspectly to other kinds and levels of production, whilst keeping in mind the long term trends of costs and demands.

Role of Renewable Resources

Conservation, akin to protection and extensive management of renewable resources, did not conflict with the needs of earlier decades. It created an awareness about renewable resources that led to organisations being developed to 'look after' them. With the original intentions now fulfilled, conservation in this unmodified form is no longer in tune with the current problems of natural resource management; we must find new answers to the questions of why, for whom, when and how to conserve.

Natural resources need to be appraised in the light of the contribution that they can make towards development effort. Quantification of losses, if any, and of net gains to development with different degrees of protection, including no protection, and different methods and intensities of use, is the key to assigning a role to natural resources. This involves interdisciplinary examination of overall resource situations, which entails not only a physical and biological review of renewable resources and their renewal through time but also social and economic analyses as an overriding segment of the planning process, i.e., total environmental assessment is called for.

In this context, conservation implies the managed used of natural resources aimed at meeting defined goals as closely as possible. This makes planning flexible in that natural resource use will vary according to social needs.

Conservation versus Economic Efficiency

There need be no conflict between meaningful conservation and economics if efficiency in the use of renewable resources is sought through integrated consideration of the limiting roles of ecological, socio-cultural and economic factors. As Perks (1968) says, a rational plan is the product of three successive analyses: firstly technical—what is possible or not; secondly socio-cultural—what is adoptable or not; and finally economic—what is gainful or not. Natural resources should be appraised as a system within the framework of development, the crux of the latter being economic growth.

A conflict in this schema may stem from different valuations of particular conservation policies. As Boulding (1966) points out,

ecologists regard the extinction of a species as a major tragedy, whilst economists ask 'what will it cost to prevent its disappearance?' Onerous though the quantification of non-marketables and externalities is, that should not prevent the rationalisation of decision-making through the use of social profitability criteria in place of a subjective approach. To minimise diseconomies and to maximise linkages helpful to development, economists would, however, do well to fall in line with those conservationists who plead for public measures, including intervention in the imperfect market mechanism, in the interests of society as required.

The increasing physical scarcity of natural resources is a premise that encompasses the conventional conservation policy. This premise can be said to rest on the assumption of sociotechnical constancy. Such an assumption is untenable and Barnett and Morse (1963) have empirically demonstrated that nature does not impose 'an inescapable general scarcity'. Scarcity fosters the development of alternatives equal in economic quality, i.e., without increased costs, and often superior to the commodity replaced.

Notwithstanding the lack of proof of the above conservationists' premise, one has to tread warily in pressing for material gains and ensure that economic evaluation also caters to the needs of environmental quality. Redeemingly for the economists, pioneering voices are being raised on this issue (Mishan, 1967; Jarrett, 1966). Though quantity is the dominating aspect of the use of natural resources in developing countries, the case for planning is stronger as it can be used to avert the onslaught on quality suffered in developed countries. The problem of quality can, therefore, be yet another meeting ground between conservation and the economics of natural resources.

Conclusion

Conservation, through faulty conceptual implications and misplaced application, can jeopardise the efficient harnessing of renewable resource potential. Conservation should be consistent with an orientation in the use of renewable resources to augment scarce resources to meet the pressing demands of development. An optimum pattern of natural resource management should consider both the needs of society and the relative availabilities of complementary factors of production for natural resource development, which must be dovetailed within the perspective of total development.

A multidisciplinary appraisal of the natural resource base, combining both technical and socioeconomic information, will prove useful in planning. The natural resource economist should appreciate the philosophy of the conservation movement in so far as it relates to divergences between private and social costs and benefits on the one hand, and biological needs for ensuring renewal over time at economically efficient levels on the other. Contrariwise, the conservationist must concede that economic efficiency in the allocation of resources is of paramount importance to development and

that renewable resources are a form of capital which must be released from the shackles of puritanic conservation.

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APPENDIX 4.

INVESTMENT, SAVINGS AND CAPITAL ACCUMULATION: A CASE STUDY OF KASHMIR

Introduction

A study of investment, saving and capital formation is primarily assumptive in nature. These assumptions, though not hypothetical, have been employed to make up the deficiency of requisite data. At one place, whereas statistical techniques are utilised to obtain the missing data, at another, the indirect in place of direct method has been devised to get the required information. Under these circumstances, a proper analysis of almost all the terms becomes not only essential but imperative.

The data regarding investment has been obtained from the yearly-published budgets of the Government for capital expenditure. In spite of this term being devoid of private investment, it has been accepted on the basis of two assumptions: one - private investments in proportion to public investments are not only insignificant but practically negligible; and two - most private investments carry direct or indirect support of the State which forms part of public expenditure on capital account. Investment, consequently, is the composition of domestic savings on the one hand and the net inflow of capital on the other.

As against the "Direct Approach", the "Indirect Approach" has been utilised for estimating the "savings" in the State's economy. "Direct Method" could not be used for want of data in all the three sectors (Government, Corporate and Individual) of economy. Therefore, the "Indirect Approach" of the "Investment Method"[1] has been employed with slight modification to obtain the savings in Kashmir.

Here, savings are only pure domestic savings without including the net inflow of capital. Net inflow of capital is also considered to be a part of savings by certain economists. But such treatment of imported capital is likely to give an erroneous picture of savings. Savings are, therefore, based on the marginal efficiency of capital. The marginal

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1. N.C.A.E.R. "Saving in India" 1965 pp. 11-12.

efficiency, on the other hand, has been derived by setting aside the previous year's income from the income of the current year. The amount so obtained is presumed to have been invested in the subsequent year. Capital formation is the summation of domestic savings and the net inflow of capital from outside. This should be equal to investment by implication.

Growth of Investments

Table 1 shows that investments have increased by about 700 per cent in a period of twelve years time. The average annual investments come to Rs. 611.25 lakhs* but the rate of investment has increased from 40.4% in 1960-61 to more than 70% in 1961-62. Not more than 7.4% of the total income (on average) is invested every year, which corresponds more or less with the all India estimates of investment. It is interesting to note that the percentage of State's income invested has been increasing continuously from 2.5 in 1953-54 to 10.7 in 1964-65.

Table 1

GROWTH OF INVESTMENTS

Year	Investments[2] in lakh Rs.	Index No.	Derivation from Col.3	Rate of Growth	Percent of Total Income	
					[3]State	India[4]
1	2	3	4	5		6
1953-54	145.67	100	---	---	2.5	5.4
1954-55	335.02	229	129	129.0	5.6	8.4
1955-56	451.60	310	210	105.0	6.6	10.4
1956-57	355.42	243	143	47.7	4.8	12.9
1957-58	271.07	186	86	21.5	3.8	11.3
1958-59	505.25	346	246	49.2	6.6	10.6
1959-60	524.18	359	259	43.2	6.3	10.5
1960-61	616.66	423	323	46.1	7.2	13.2
1961-62	1069.36	732	632	79.0	12.0	11.9
1962-63	1082.10	741	641	71.2	11.9	12.7
1963-64	963.86	660	560	56.0	10.4	n.a.
1964-65	1014.82	695	595	55.0	10.7	n.a.
Yearly average	611.25			55.0	7.4	

2. Total of capital investment in all the four sectors of economy consisting of Agriculture, Mining, Manufactures and Small enterprises, Commerce and Transport and Other Services. Source: Digest of Statistics 1960-61, J. & K. Government and Some Basic Statistics 1963-64.

3. Calculated from the income figures taken from the Supplement to the Estimates of State Income 1950-51 and 1955-56 to 1958-59.

4. Eastern Economist: India's Progress since Independence - A Statistical Bird's-eye view p. 12. May 1966.

* 10 Lakh = 1 million

Composition

There are five major heads of investment: (1) Agriculture; (2) Mining, Manufactures and Small enterprises; (3) Commerce and Transport; (4) Other Services; and (5) Miscellaneous.

Table 2 shows the direction and the pattern of investment during the period under review. Agriculture which accounted for 46% in 1950-51 now forms only 9% of the total investment in 1964-65. On the other hand, the major portion appears to have been diverted towards other services: from 28% they have increased to 57% within a period of fifteen years time. Commerce and transport have also made tangible progress in regard to total investments. The investments in this sector have increased from Rs. 2.81 lakhs in 1950-51 to Rs. 183.69 lakhs in 1964-65. Mining, Manufactures and Small Enterprises maintain a uniform percentage of investment between 1950-51 and 1964-65. But the value of investment has increased from Rs. 4.69 lakhs to Rs. 150.78 lakhs in the period under review.

Plan-wise analysis shows that whereas agriculture and industry have lost their shares in the total investment, Commerce and transport and other services have gained considerably during the First Plan period. The loss in agriculture has been estimated at 63% (from 46% to 17%) and the gain of commerce and transport works out to be 244% (from 9% to 31%). The Second Plan, on the other hand, is of comparative prosperity to agriculture, industry and services but of unprecedented adversity to commerce and transport. Whereas agriculture, industry and services have gained by 26.17 and 100 percent respectively, commerce and transport have registered a fall of 77% within five years time. The Third Plan, analytically speaking, brings exceptional prosperity to commerce and transport and moderate adversity to agriculture and industry.

Sectoral Analysis

A sectoral analysis will present a complete picture of each sector separately regarding capital/output ratio, efficiency of capital and investment composition.

Agriculture[5]

The trend of income, investment and capital/output ratio may be obtained from Table 3.

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5. Agriculture includes forestry and animal husbandry.

Table 2

COMPOSITION OF INVESTMENTS

Year	Agriculture		Mining, Manufactures & Small Enterprises		Commerce and Transport		Other Services		Miscellaneous		Total	
	Amount lakh Rs.	% to Col. 12	Amount lakh Rs.	% to Col. 12	Amount lakh Rs.	% to Col.12	Amount lakh Rs.	% to Col. 12	Amount lakh Rs.	% to Col.12	Amount lakh Rs.	Per Cent
1	2	3	4	5	6	7	8	9	10	11	12	13
1950-51	15.29	46	4.69	15	2.81	9	9.25	28	0.51	2	32.55	100
1951-52) 1952-53) -	47.19	22	39.13	19	27.40	13	88.67	43	7.06	3	209.45	100
1953-54	20.85	14	28.66	20	20.89	14	71.02	49	4.25	3	145.67	100
1954-55	99.69	30	39.42	11	87.35	26	107.57	33	0.99	-	335.02	100
1955-56	75.98	17	55.83	12	141.27	31	172.25	38	6.27	2	451.50	100
1956-57	78.41	22	30.38	8	-	-	246.63	70	-	-	355.42	100
1957-58	46.27	17	23.13	9	-	-	161.67	60	40.00	14	271.07	100
1958-59	59.11	12	39.47	8	254.82	50	151.85	30	-	-	505.25	100
1959-60	123.37	23	83.44	16	55.28	11	262.09	50	-	-	524.18	100
1960-61	173.17	28	105.43	17	-164.16	-27	502.22	82	-	-	616.66	100
1961-62	97.08	9	184.45	17	152.83	14	607.77	57	27.23	3	1069.36	100
1962-63	220.31	20	217.56	20	128.81	12	491.95	45	23.47	3	1082.10	100
1963-64	94.18	10	183.39	19	197.14	20	481.93	50	7.22	1	963.86	100
1964-65	37.77	9	150.78	15	183.69	18	585.19	57	7.39	1	1014.82	100

Table 3

INVESTMENT, INCOME AND CAPITAL/OUTPUT RATIO

Year	Investment Lakh Rs.	Income[6] lakh Rs.	Efficiency of capital[7]	Capital/Output Ratio (col.2÷4)
1	2	3	4	5
1950-51	15.29	2,605.26	-	-
1951-52) 1952-53)	47.19	2,753.49	147.93	.33
1953-54	20.85	2,819.67	66.18	.32
1954-55	99.69	3,134.43	314.76	.32
1955-56	75.69	3,374.06	239.63	.32
1956-57	78.41	3,508.53	134.47	.58
1957-58	46.27	3,123.02	- 385.51	- .12
1958-59	59.11	3,687.03	564.01	.10
1959-60	123.37	3,875.13	188.10	.65
1960-61	173.17	4,084.27	209.14	.83
1961-62	97.08	4,228.49	144.22	.67
1962-63	220.31	4,250.59	22.10	10.00
1963-64	94.18	4,205.59	- 45.35	- 2.10
1964-65	87.77	4,281.94	76.70	1.10

Whereas the value of investment in agriculture has increased, the efficiency of capital on the other hand has gone down. Apart from the detailed examination of the efficiency, it may, however, be pointed out here that the efficiency of capital in agriculture has been falling from year to year which is evident from the growing capital/output ratio.

On the basis of the efficiency of capital and the total investments, the extent of net inflow and outflow of capital in agricultural sector has been calculated in the following manner.

6. Income figures for the years 1951-52 to 1954-55 have been derived by setting aside the income figures of 1950-51 from 1955-56 as given in the supplement to the Estimates of State Income. The income figure so obtained has been divided under four parts in the proportion of investments made in the years 1951-52, 1952-53, 1953-54, 1954-55 and 1955-56.

7. Marginal Efficiency, as already pointed out, has been derived by subtracting the income of the previous year from the income of the current year.

Table 4

TREND OF SAVINGS AND INVESTMENTS IN AGRICULTURAL SECTOR

Year	Savings lakh Rs.	Net Inflow of Capital lakh Rs. (Col. 4-2)	Investments[8] lakh Rs. (Cols. 2 + 3)
1	2	3	4
1953-54	147.93	- 127.08	20.85
1954-55	66.18	+ 33.51	99.69
1955-56	314.76	- 238.78	75.98
1956-57	239.63	- 161.22	78.41
1957-58	134.47	- 88.20	46.27
1958-59	- 385.51	+ 444.62	59.11
1959-60	564.01	- 440.64	123.37
1960-61	188.10	- 14.93	173.17
1961-62	209.14	- 112.06	97.08
1962-63	144.22	+ 76.09	220.31
1963-64	22.10	+ 72.08	94.18
1964-65	- 45.35	+ 133.12	87.77
Total	1,599.68	- 423.49	1,176.19

There appears to be a net outflow of capital to the tune of Rs. 423.49 lakhs from the agricultural sector. This outflow has perhaps been utilised either towards revenue expenditure, or other heads of capital investment in different sectors of State's economy. Perhaps, agriculture has received insufficient attention.

Mining, Manufactures and Small Enterprises

The trend of income, investment and capital/output ratio may be obtained from table No. 5. Investments have increased from Rs. 4.69 lakhs in 1950-51 to Rs. 150.78 lakhs in 1964-65. This implies an increase of about 30 times between 1950-51 and 1964-65. As against this marked increase in investments, the efficiency of capital has gone down by more than 400% over 1951-52 figures. The performance of capital, on the whole, was good in the First Plan, better in the Second Plan and worst in the Third Plan period. In short, the total investment of Rs. 1,185.76 lakhs has only yielded an income of Rs. 872.67 lakhs.

8. Source: Digest of Statistics 1960-61 and Some Basic Statistics 1963-64 of Jammu and Kashmir Government.

Table 5

INVESTMENT, INCOME AND CAPITAL/OUTPUT RATIO

Year	Investments in lakh Rs.	Income in lakh Rs.	Efficiency of capital lakh Rs.	Capital/output Ratio Col. 2 ÷ 4
1	2	3	4	5
1950-51	4.69	1,353.18	-	-
1951-52) - 1952-53)	39.13	1,399.36	46.18	.85
1953-54	28.66	1,480.20	34.34	.82
1954-55	39.42	1,473.12	46.50	.83
1955-56	55.83	1,546.83	66.62	.84
1956-57	30.38	1,689.02	142.20	.21
1957-58	23.13	1,914.49	235.47	.09
1958-59	39.47	1,986.20	71.71	.54
1959-60	83.44	1,982.89	- 3.31	-27.67
1960-61	105.43	2,018.12	35.23	3.00
1961-62	184.45	2,059.51	41.39	4.49
1962-63	217.56	2,135.43	76.46	3.00
1963-64	183.39	2,205.43	69.46	2.69
1964-65	150.78	2,215.82	10.39	15.10
Total	1,185.76		872.64	

The pattern of Savings, Investments and net inflow of capital is summarised in Table 6.

The behaviour of savings and investments is so jerky that it will form a zig-zag curve of their growth. In spite of these variations in the growth pattern of investment and saving, at least two facts can certainly be established: one - there is a net inflow of capital to the extent of Rs. 279.69 lakhs in Mining, Manufactures and Small Enterprises from outside, and two - both saving and investment have increased in 1964-65 over 1953-54 level. Such increase is more spectacular in investment than in saving. Whereas savings have increased by about 50%, investments, on the other hand, have increased by more than 500 per cent within a period of eleven years time.

Table 6

TREND OF SAVINGS AND INVESTMENTS IN MINING AND INDUSTRY

Year	Savings lakh Rs.	Net inflow of Capital lakh Rs. (Col. 4 - 2)	Investments lakh Rs. (Col. 2 + 3)
1	2	3	4
1953-54	46.18	- 17.52	28.66
1954-55	34.34	+ 5.08	39.42
1955-56	46.50	+ 9.33	55.83
1956-57	66.62	- 36.24	30.38
1957-58	142.20	- 119.07	23.13
1958-59	235.47	- 196.00	39.47
1959-60	71.71	+ 11.73	83.44
1960-61	- 3.31	+ 108.74	105.43
1961-62	35.23	+ 149.22	184.45
1962-63	41.39	+ 176.17	217.56
1963-64	76.46	+ 106.93	183.39
1964-65	69.46	+ 81.32	150.78
Total	862.25	+ 279.69	1,141.94

Commerce and Transport

Investments under this sector have been obtained in two ways: one - capital outlays of government on roads and transport; and two - capital expenditure on private transport. Capital expenditure on private transport has been calculated on the basis of the value of private transport (buses and trucks) added every year. The value of each transport, on the average, has been estimated at Rs. 60,000-. Where separate figures for government and private transport are not available, the total number of vehicles has been broken down in the ratio of 18:82. This has been done on the basis of past averages.

A picture of income, investment and capital/output ratio in the commerce and transport sector may be obtained from Table 7. There seems a very low rate of capital return in commerce and transport. Capital/output ratio on the basis of governmental expenditure alone has gone up from 5.4 to 14.1 in 1964-65 without considering the abnormally high ratio of 17 in 1958-59. The capital/output ratio together with private investments

Table 7

INVESTMENT, INCOME AND CAPITAL/OUTPUT RATIO

Year	Investments[9] lakh Rs. (Public Sector)	Investments[10] lakh Rs. (Public & Private)	Income[11] lakh Rs.	Marginal Efficiency lakh Rs.	Capital/Output Ratio	
					col. 2÷5	Cols. 3÷5
1	2	3	4	5	6	7
1950-51	2.81	18.37	635.44	-	-	-
1951-52) 1952-53) -	27.40	109.60	640.72	5.28	5.4	22.00
1953-54	20.89	111.78	644.83	4.11	5.2	28.00
1954-55	87.35	251.00	664.75	19.92	4.4	13.00
1955-56	141.27	581.34	689.19	24.44	5.9	24.20
1956-57	-	347.90	703.19	14.00	-	25.00
1957-58	-	315.00	716.17	12.98	-	24.00
1958-59	254.82	615.34	731.03	14.86	17.0	41.00
1959-60	55.28	150.38	748.23	17.20	3.2	9.00
1960-61	- 164.16	- 611.12	764.79	16.56	- 9.6	- 36.00
1961-62	152.83	358.36	777.46	12.67	11.7	27.54
1962-63	128.81	564.27	803.89	26.43	5.0	21.69
1963-64	197.14	515.84	817.42	13.53	14.1	36.79
1964-65	183.69	487.73	829.99	12.57	14.1	37.54
Total	1,088.13	3,815.76		194.55		

9. Digest of Statistics 1960-61 and Some Basic Statistics 1963-64 of Jammu and Kashmir Government.

10. Value of private buses and trucks @ Rs. 60,000 added to the figures of Col. 2.

11. Supplement to the Estimates of State Income 1950-51 and 1955-56 to 1958-59.

goes up from 22.00 in 1953-54 to 37.54 in 1964-65. This may go up further in case the investments of banks and insurance companies are also taken into account, though the contribution of banks and insurance companies is not more than 2.6 per cent of the total investment.

The conspectus of savings, investments and inflow of capital has been formulated as follows:

Table 8

TREND OF SAVINGS AND INVESTMENTS IN COMMERCE AND TRANSPORT

Year	Savings lakh Rs.	Inflow of capital lakh Rs. (Col. 4 - 2)	Investments lakh Rs. (Col. 2 + 3)
1	2	3	4
1953-54	5.28	+ 104.32	109.60
1954-55	4.11	+ 107.67	111.78
1955-56	19.92	+ 231.08	251.00
1956-57	24.14	+ 557.20	581.34
1957-58	14.00	+ 333.90	347.90
1958-59	12.98	+ 302.02	315.00
1959-60	14.86	+ 600.48	615.34
1960-61	17.20	+ 133.18	150.38
1961-62	16.56	- 627.68	- 611.12
1962-63	12.67	+ 345.69	358.36
1963-64	26.43	+ 537.79	564.22
1964-65	13.53	+ 502.31	515.84
Total	181.98	3,127.96	3,309.94

Savings in commerce and transport (table 8) have increased by more than 500 per cent in 1963-64 and by 280 per cent approximately in 1964-65 over 1953-54 level. On the basis of these savings and investments, the net inflow of capital has been estimated at Rs. 3,127.96 lakhs.

Other Services

Except for housing, major investment in Services has been done by the Government. Housing, in fact, accounts for slightly more than 15% of the total income which may be more or less equal to the investments in this sector of the economy.

Year-wise estimates of income, investment and capital/output ratio are given in the following table:

Table 9

INVESTMENT, INCOME AND CAPITAL/OUTPUT RATIO

Year	Investments[12] lakh Rs.	Income in[13] lakh Rs.	Marginal Efficiency of Capital lakh Rs.	Capital/ Output Ratio (Col. 2÷4)
1	2	3	4	5
1950-51	9.25	960.16	-	-
1951-52) - 1952-53)	88.67	1006.07	45.91	1.9
1953-54	71.02	1042.70	36.63	1.9
1954-55	107.57	1098.42	55.72	1.9
1955-56	172.25	1187.28	88.86	1.9
1956-57	246.63	1298.43	111.15	2.2
1957-58	161.67	1340.18	41.75	3.9
1958-59	151.85	1376.55	36.37	4.2
1959-60	262.09	1651.34	274.79	1.0
1960-61	502.22	1736.47	85.13	5.9
1961-62	607.77	1834.85	98.38	6.2
1962-63	491.95	1936.61	101.76	4.8
1963-64	481.93	2041.12	104.51	4.6
1964-65	585.19	2155.12	114.00	5.1
Total	3940.06		1194.96	

There has been a vast increase in the yearly rate of investment under the services account. The investments have increased from Rs. 9.25 lakhs in 1950-51 to Rs. 585.19 lakhs in 1964-65, 65 times within a period of fourteen years time. On the other hand, the return on investment has been depreciating from year to year. We find that the capital/output ratio has increased from 1.9 in 1951-52 to 5.1 in 1964-65. In short, the total investment of Rs. 3,940.06 lakhs has not yielded more than Rs. 1,194.96 lakhs between 1950-51 and 1964-65. This return is not more than 31% of the total investment.

The above efficiency of capital under the services should not cause an alarm. The return on social services can never be equal to or more than the investment made in this sector of economy. These investments are made

12. J & K Govt. Digest of Statistics 1960-61 and Some Basic Statistics 1963-64.

13. Supplement to the Estimates of State Income etc.

to provide social amenities and not to reap profits out of them directly.

Table 10 has been designed to give a complete picture of saving, investment and net inflow of capital in the services sector. Out of the total investment of Rs. 3,842.14 lakhs a sum of Rs. 2,761.18 lakhs accounts for the net inflow of capital from outside. The savings, on the other hand, are not even 50% of the total inflow of capital.

Table 10

DISTRIBUTION OF SAVINGS AND INVESTMENT

Year	Savings lakh Rs.	Net Inflow of capital lakh Rs. (Col. 4 - 2)	Investments lakh Rs.
1	2	3	4
1953-54	45.91	+ 25.11	71.02
1954-55	36.63	+ 70.94	107.57
1955-56	55.72	+ 116.53	172.25
1956-57	88.86	+ 157.77	246.63
1957-58	111.15	+ 50.52	151.67
1958-59	41.75	+ 110.10	151.85
1959-60	36.37	+ 225.72	262.09
1960-61	274.79	+ 227.43	502.22
1961-62	85.13	+ 522.64	607.77
1962-63	98.38	+ 393.57	491.95
1963-64	101.76	+ 380.17	481.93
1964-65	104.51	+ 480.68	585.19
Total	1080.96	+2716.18	3842.14

A consolidated picture of the total investments in all the sectors taken together and the trend of the capital/output ratio may be obtained from Table 11. The percentage of the total income invested has increased from 0.6% in 1950-51 to 10.7% in 1964-65. In 1962-63, it becomes more or less equal to the all India percentage of 12.7.[14] As against such healthy traits there exist certain elements of inefficiency which make the economy weaker. Mention in this regard may be made of the growing capital/output ratio. But this growing ratio should not be solely attributed to the elements of inefficiency. It may also be due to the gestation period which is required for every fresh investment. The investments of

14. Eastern Economist: India's Progress since Independence: A Statistical Bird's-eye view 1966 p. 12.

Table 11

OVERALL TREND OF INVESTMENT AND CAPITAL/OUTPUT RATIO

Year	Investments lakh Rs.	Income in lakh Rs.	Percentage of Income Invested	Marginal Efficiency of Capital lakh Rs.	Capital/Output Ratio
1	2	3	4	5	6
1950-51	32.55	5554.34	0.6	-	-
1951-52) - 1952-53)	209.55	5779.64	3.6	245.30	0.86 : 1
1953-54	145.67	5940.90	2.5	141.26	1.10 : 1
1954-55	335.02	6377.80	5.6	436.90	0.81 : 1
1955-56	451.60	6797.35	6.6	419.55	1.10 : 1
1956-57	355.42	7199.17	4.8	401.82	0.86 : 1
1957-58	271.07	7093.86	3.8	- 105.31	- 2.60 : 1
1958-59	505.25	7780.81	6.6	686.95	0.75 : 1
1959-60	524.18	8257.59	6.3	476.78	1.10 : 1
1960-61	616.66	8603.65	7.2	346.06	1.80 : 1
1961-62	1069.36	8900.31	12.0	296.66	1.60 : 1
1962-63	1082.10	9127.06	11.9	226.75	4.80 : 1
1963-64	963.86	9269.21	10.4	142.15	6.80 : 1
1964-65	1014.82	9482.87	10.7	213.66	4.70 : 1
Total	7577.11			4615.48	

the Third Plan may generate income in the Fourth or even in the Fifth Five Year Plan.

Savings

Conceptually, savings are equal to the efficiency or the productivity of capital. The efficiency of capital in a particular year is derived from the net contribution of the capital to the total income. Ordinarily speaking, the marginal efficiency of capital is equal to the difference between the total income of the current year and the income of the previous year. This is the "Indirect Approach" of getting the savings.

It is a slightly modified form of "Investment Method" which includes the inflow of capital also from outside. For purposes of investment savings of the previous year become partly the investment in the succeeding year. The year-wise distribution of savings and investments are given in the following table which have been derived on the basis of Table 11.

Table 12

DISTRIBUTION OF SAVINGS AND INVESTMENTS

Year	Savings in lakh Rs.	Net Inflow of capital in lakh Rs. (Col. 4 - 2)	Investments lakh Rs.
1	2	3	4
1953-54	245.30	- 99.63	145.67
1954-55	141.26	193.76	355.02
1955-56	436.90	14.70	451.60
1956-57	419.55	- 64.13	355.42
1957-58	401.82	- 130.75	271.07
1958-59	- 105.31	610.56	505.25
1959-60	686.95	- 162.77	524.18
1960-61	476.78	139.88	616.66
1961-62	346.06	723.30	1,069.36
1962-63	296.66	785.44	1,082.10
1963-64	226.75	737.11	963.86
1964-65	142.15	872.67	1,014.82
Total	3,714.87	3,620.14	7,335.01

The domestic savings generated Rs. 3,714.87 lakhs within a period of 12 years time. In addition, the net inflow of capital from outside has been to the tune of Rs. 3,868.40 lakhs. Adding together, the total investments come to Rs. 7,583.27 lakhs.

Growth of Savings

Table 13 gives the growth of savings from 1953-54 to 1964-65:

Table 13

GROWTH OF SAVINGS

Year 1	Savings in lakh Rs. 2	Index No. 3	Derivation from Col.3 4	Rate in Percentage 5
1953-54	245.30	100	-	-
1954-55	141.26	58	- 42	- 42.0
1955-56	436.90	178	78	39.0
1956-57	419.55	171	71	23.7
1957-58	401.82	164	64	16.0
1958-59	- 105.31	- 43	- 143	- 28.6
1959-60	686.95	280	180	30.0
1960-61	476.78	195	95	13.6
1961-62	346.06	141	41	5.1
1962-63	296.66	121	21	2.3
1963-64	226.75	92	- 8	- 0.8
1964-65	142.15	58	- 42	- 3.5

Savings have fallen by 42% between 1953-54 to 1964-65. As compared to the First Two Plans, the performance of the Third Five Year Plan has been poor. The rate in the last two years has become negative.

Composition of Savings

The constituents of savings, it may be noticed from table 14, are different from the widely accepted heads of government, corporation and individuals.[16] The difference is due to the change in the approach of obtaining the savings in the economy. Government, corporation and individuals form part of direct approach whereas sectoral heads of economy become sources under indirect approach. Services have now replaced agriculture as the top contributor. The savings from agriculture are likely to go down consequent to the fall in the share of investment.

16. N.C.A.E.R.'s Savings in India 1965 and V.K.R.V. Rao and Others: Papers on National Income and Allied Topics Vol. I 1960.

Table 14

COMPOSITION OF SAVINGS

Year	Agriculture		Mining, Manufactures & Small Enterprises		Commerce & Transport		Other Services		Total	
	Amount lakh Rs.	Percentage to Col.10	Amount in lakh Rs.	Percentage to Col.10	Amount in lakh Rs.	Percentage to Col.10	Amount in lakh Rs.	Percentage to Col.10	Amount in lakh Rs.	Percentage
1	2	3	4	5	6	7	8	9	10	11
1950-51	-	-	-	-	-	-	-	-	-	-
1951-52) - 1952-53)	147.93	61.42	46.18	19.78	5.28	0.02	45.91	18.78	245.30	100
1953-54	66.18	48.00	34.34	25.00	4.11	0.03	36.63	26.97	141.26	100
1954-55	314.76	72.00	46.50	10.70	19.92	4.50	55.72	12.80	436.90	100
1955-56	239.63	57.14	66.62	15.96	24.44	5.71	88.86	21.19	419.55	100
1956-57	134.47	33.43	142.20	35.42	14.00	3.54	111.15	27.61	401.83	100
1957-58	- 385.51	-406.31	235.47	247.87	12.98	13.83	41.75	44.61	- 95.31	100
1958-59	564.01	82.10	71.71	10.48	14.86	2.18	36.37	5.24	686.95	100
1959-60	188.10	39.49	— 3.31	- 0.63	17.20	3.56	274.79	57.65	476.78	100
1960-61	209.14	60.43	35.23	10.12	16.56	4.49	85.13	24.54	346.06	100
1961-62	144.10	48.58	41.39	13.90	12.67	4.48	98.38	33.04	296.66	100
1962-63	22.10	9.89	76.46	33.48	26.43	11.65	101.76	44.98	226.75	100
1963-64	- 45.35	- 31.69	69.46	48.39	13.53	9.76	104.51	73.54	142.15	100
1964-65	76.70	35.98	10.39	4.67	12.57	6.07	114.00	53.28	213.66	100

Capital Formation

Capital formation is the summation of domestic savings and the net inflow of capital from other sources. Capital formation in Indian Union consists of domestic savings, official donations and net borrowings from abroad.[17] Whereas the net inflow of capital has not been more than 20 to 25 per cent of the domestic savings between 1960-61 to 1962-63 at the country level,[18] it has increased from more than 200 to 600 per cent between 1961-62 to 1964-65 at the State level. Consequently the rate of capital formation becomes as high as 49.3% if the net inflow of capital is taken into consideration. As compared to this rate of little less than 50% per annum the rate of capital formation at all India level is not more than 20.4% per annum.[19]

Table 15 reveals that such a high rate of capital formation is mainly due to a heavy rate of inflow of capital. This rate would have been negative had there been no capital inflow from outside. In spite of this fact, the rate of capital formation has been declining since 1962-63. This is mainly due to the fall in domestic savings.

Conclusion

The conspectus of investments reveals a change in the choice of investments. As against agriculture, higher and higher capital outlays have been committed to services, commerce and transport and mining, manufacturing and small enterprises. It is interesting to note that the total investments are not less than 10 per cent of the total income of the State. This percentage has increased from 0.6 per cent in 1950-51 to 12 per cent in 1961-62 and 10.7 per cent in 1964-65. The income/investment ratio more or less tallies with the all India figures.[20]

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17. V.K.R.V. Rao et al: Papers on National Income and Allied Topics 1960 in Proceedings Indian Conference on Research in National Income. Vol.1 p. 121.

18. Ibid and Eastern Economist: India's Progress Since Independence - A Statistical Bird's-eye view May 1966 p. 12.

19. Ibid (calculated)

20. Investments have a large aid component from the central government. Of the proposed outlay, Rs. 2,250 million for the Fourth Plan, Rs. 1,260 million are proposed central assistance. Central grants in aid are Rs. 52 per capita as compared with an average of Rs. 9 for the rest of the Indian states. The tax revenue is only 9 per cent of the total revenue in contrast to 44 per cent in other states.

Table 15

GROWTH OF CAPITAL FORMATION

Year	Savings in[21] lakh Rs.	Net Inflow[22] of capital in lakh Rs.	Capital formed lakh Rs. Col. 2 + 3	Index No. on the basis of Col. 4	Rate in Percentage
1	2	3	4	5	6
1953-54	245.30	- 99.63	145.67	100	-
1954-55	141.26	193.76	335.02	229	59.5
1955-56	436.90	14.70	451.60	310	70.0
1956-57	419.55	84.13	503.68	345	61.2
1957-58	401.82	- 30.75	371.07	254	30.8
1958-59	- 105.31	610.56	505.25	346	41.0
1959-60	686.95	- 162.77	524.18	359	39.0
1960-61	476.78	139.88	616.66	423	40.0
1961-62	346.06	723.30	1,069.36	732	70.2
1962-63	296.66	785.44	1,082.10	741	64.1
1963-64	226.75	737.11	963.86	660	50.9
1964-65	142.15	872.67	1,014.82	695	49.3
Total	3,714.87	3,868.40	7,583.27		

A healthy sign relates to the inflow of capital. It has already been pointed out that the net inflow has been to the tune of Rs. 3,868.40 lakhs within eleven years of time. This capital which has flown from outside constitutes more than 51 per cent of the total investment in the State's economy. The growth of savings, on the other hand, is discouraging. It has been continuously falling since 1960-61. The domestic savings are even less than 50% of the total investments. The savings may be low on account of two factors: one - the rate of income generation in the two major sectors - agriculture and mining, manufactures and small enterprises, has gone down during the period under review;[23] and two - the investments which have been made in recent years require some gestation period to fructify.

The marginal efficiency of capital is in these circumstances not likely to improve unless the tools of management are properly applied to rationalise resource allocation and the framework of productive institutions.

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21. On the basis of Table 12.

22. Ibid.

23. The rate of growth in agriculture has gone down from 5.2% in 1955-56 to 4.5% in 1965-66; similarly in the industries sector it has declined from 5.9% in 1957-58 to 4.6% in 1964-65.

APPENDIX 5

DEODAR BELT OF KASHMIR

LOLAB VALLEY

By

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The vegetation of the Kashmir valley is predominantly formed of conifers. In this, it differs considerably from the general vegetation of other parts of the Himalayas, which have both the coniferous and the hardwood-oak communities. This feature of the vegetation of Kashmir has an interesting phytogeographical significance and seems to show greater resemblance with Europe and Central Asian region than with the other parts of the Himalayas.

Some studies on the flora and general vegetation of the valley have been published by Brandis (1883,1887), Troup (1921), Meebold (1909), Stewart (1916, 1945, 1951), Mukerjee (1937) and others. None of these authors have, however, focussed any special attention on the ecological aspects. Sher Singh (1929) was one of the first to take up ecological studies in the valley which was followed by spasmodic attempts by Pathania (1954) and Wali (1961).

Cedrus deodara is found throughout the Western Himalayas from Afghanistan to Garhwal in the east upto 79°48′ longitude. Out of a total forest area of about 19,545 sq. kilometres in the Jammu and Kashmir State, deodar forests occupy more than 1,120 sq. kilometres. Lolab is by far the most compact deodar bearing area in Kashmir valley comprising about 260 sq. kilometres out of a total deodar area of about 500 sq. kilometres in the valley. Other compact areas in the valley where deodar occurs in any quantities are in the adjacent Langet forests, Buniyar to the west of the valley proper and Kuthar valley in eastern extremity of the valley. There is no deodar of any significance on the Pir Panjal slopes forming the southern watershed of the valley except a restricted patch at Yarwan block on a sloping "Karewa".

In Kashmir, the chief zone of deodar is between 2,000 and 2,460 metres, often forming pure forests within this range. Altitude and aspect play a major role in its distribution. On cool aspects, it descends to 1,530 m and occasionally to 1,370 metres (on Buniyar side and Kishenganga valley), while on hotter slopes it may ascend to 3,075 metres or even more where it tends to be scattered and stunted. The deodar forests grow naturally on mountainous country with moderate to precipitous slopes. Though found on all aspects, it grows best on cool northerly aspects where shade required for the establishment of regeneration is naturally available. While it has been seen to occur on all important geological formations in the area under study, it does not occur well on the "Karewa" formations of Kashmir valley, where owing to the tendency to impeded drainage it cannot establish. Best growth has been noticed on deep, fairly porous fertile soils in cool situations.

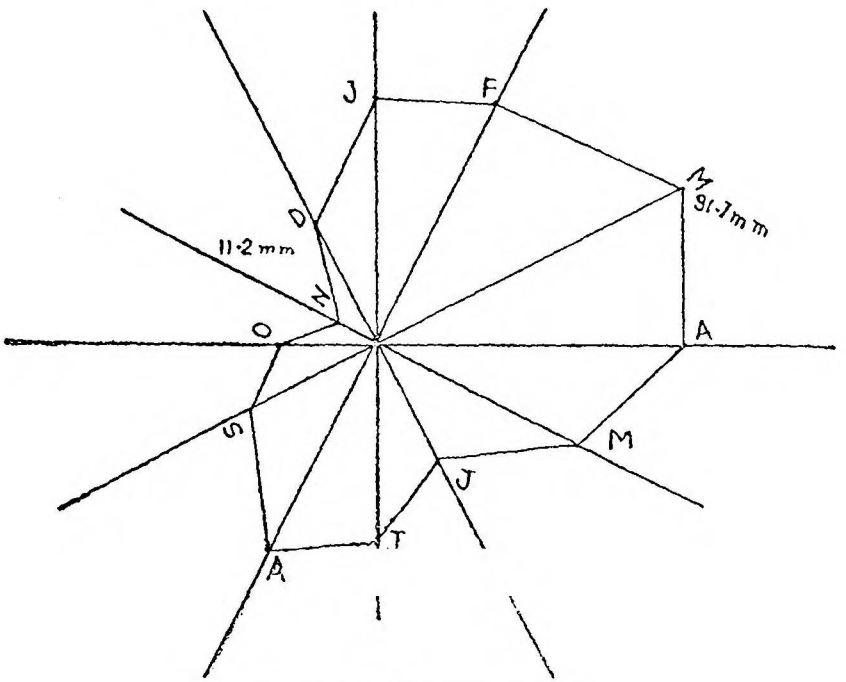
The deodar forests in the Kashmir valley are very interesting from the point of view of their composition. There are no associates of the dry type such as *Quercus ilex* and/or *Pinus gerardiana* on dry escarpments as in the inner Chenab valley in Paddar (Kishtwar) or in Chitral or in the dry parts of the Kishenganga valley and the Kagan valley in Hazara. There are primary associates of the humid type eithe i. e. *Quercus incana* and *Q. dilatata* the laurels as in the Chenab valley proper (Bhaderwah) or Kulu. No *Rhododendron* of *Ilex*, *Corylus* and *Taxus baccata* of *Desmodium tiliaefolium* are to be found as against the and dry types of deodar forests met with in the western Himalayas. In most of the the western Himalayas, *Pinus excelsa* and *Pinus wallichiana* are the most important

associates. This does not hold absolutely true in the valley, where *Picea* occurs only as a small sprinkling here and there. *Cupressus torulosa*, which is not uncommonly associated with deodar, was not to be observed as such during the study in the valley. On the other hand, the deodar belt in the valley abounds in *pohu*, (*Parrotia jacquemontiana*) which may be found outside the valley only in stray and rare patches. These peculiar and salient features of the vegetation of the area prompted the authors to take up a scientific study of the ecology of deodar in Kashmir valley. Taking into consideration the terrain and the occurrence of deodar in the area, the study has been carried out in three widely separated localities, viz., Lolab valley in the northwest, Buniyar in the west and Kuthar valley in the east.

Kashmir valley is an oval cup-shaped basin, about 128 kilometres in length from east down to west and about 40 kilometres in width on an average. Flanked by high mountain ranges all around, it ranges in elevation from about 1,538 metres to about 5,384 metres at Sunset peak or Romesh Thong of the Pir Panjal. Main drainage is south-westerly. The valley is drained by river Jhelum or Vitasta as referred in the G.T. Sheets. The river runs through the entire length of the valley, its chief tributaries from east to west being Arapat, Lidder, Bringhi, Vishau, Rambiara, Ferozpur, Ningli, Sindh and Pohru. Pohru and Arapat watersheds are the main deodar bearing areas comprising the Lolab, Langet, and the Kuthar forests respectively. The Buniyar forests drain directly into the Jhelum which passes through its foothills just after leaving the valley proper at Khadanyar.

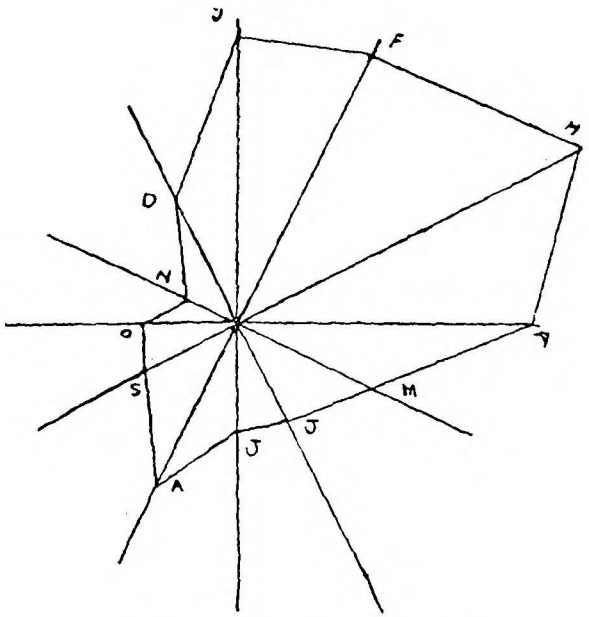
The shade temperature in the deodar belt varies from a minimum of −12.2°C to −3.8°C to a maximum of 26.6°C to 37.7°C, the precipitation pattern extends over a comparatively wider range as can be seen from figs. 1-3 and the table overleaf.

Fig. 1



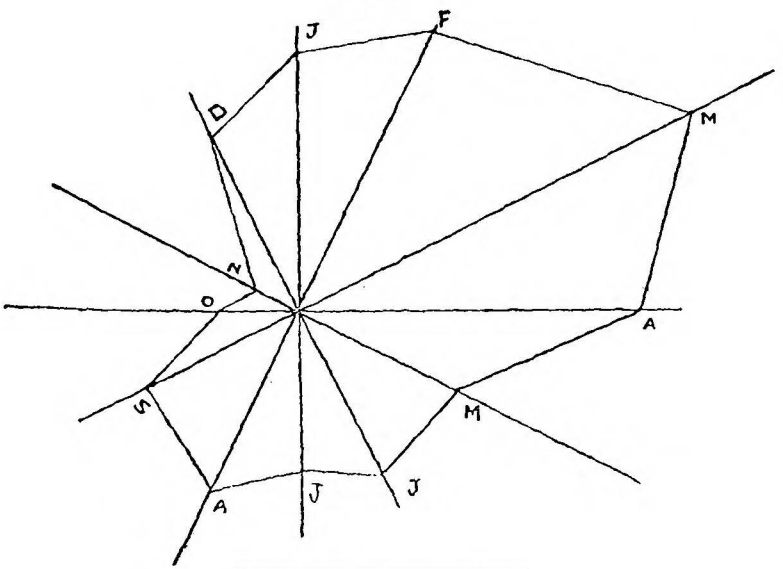
Precipitation Pattern at Srinagar

Fig. 2



Precipitation Pattern at Handwara

Fig. 3



Precipitation Pattern at Uri

Photo No. 1.



Photo No. 2.



Deodar Forests of Lolab—A general picture.

Photo No. 3.



Natural Regeneration of Deodar.

Photo No. 4.



Silvicultural fellings under uniform system with recruitment in background.

Photo No. 5.



Undergrowth of *Parrotia jacquemontiana* in open canopy.

Photo No. 6.



Advance growth of Deodar in foreground

Photo No. 7.



Broadleaved association in a moist ravine in the Deodar belt.

The Precipitation Pattern

Station	During Summer June-September	Rest of the year October-May	Av. Annual Total
Srinagar (Centre of the Kashmir Valley)	174.93 mm	449.5 mm	574.8 mm
Handwara (Applicable to Lolab deodar forests)	234.2 mm	905.2 mm	1139.4 mm
Uri (Applicable to Buniyar deodar forests)	357.2 mm	962.2 mm	1319.4 mm
Anantnag (Applicable to Kuthar deodar forests)	154.2 mm	450.1 mm	572.3 mm

From the above statement it is also evident that most of the precipitation is received during October to May. This is in the form of winter snow and spring rains. Summers are warm and pleasant with little rainfall as the monsoons are spent before reaching the Kashmir valley which is shut off from the plains by the mighty Pir Panjal and Kafir Khan range of mountains. Uri as also Karnah record higher summer rainfall because the tail end of the monsoons penetrate there. Obviously therefore, Kulu and Chakrata receive comparatively much higher rainfall (due to the benefit of south westerly monsoon) recording 646.3 mm and 1311.7 mm during the summer months respectively. The winter precipitation in the latter areas is comparatively much less than the deodar area under study. A deduction from the climatic study of deodar growing areas as also of the drier areas further northwest in the Swat valley, etc. is that winter snow is of great importance for flourishing of the species in areas like Lolab and Kuthar valleys.

The phytogeography of the Kashmir valley is interesting and explains some of the anomalies referred 5 earlier. The changes that took place during the glaciation period of the Pleistocene caused the devastation of the then existing flora and vegetation and a pronounced change in the climate of the valley. There is geological evidence to suggest that the glaciation was coupled with the uplifting of the Pir Panjal by about 1,692 m and the formation of a vast lake all over the area which perhaps bore water as high as 2,461 m above sea level. Siltation of the lake took place which on getting drained by the formation of a bottleneck outlet at Khadanyar after the retreat of the glaciers (remnants of which are the Thajwas and Kolahai in the valley) and an upheaval, left behind the deep karewa formations of alternating layers of silt, clay and loam, to be found prolifically throughout the basin and sometimes covering the parent rock as high as 2,307-2,461 m above sea level as along Ferozpur in the Gulmarg area. Prior to these changes, fossil evidence suggests that, the valley bore a tropical climate, occurrence of species like *Mallotus philpipensis* and *Woodfordia fruticosa* confirming that (Puri 1948). Elevations above the present karewa beds could have had oaks and laurels as undergrowth, this being testified by the occurrence of *Quercus* and *Litsea lanuginosa* fossils (Puri 1948). Along with the wiping out of the vegetation, the glaciation must have caused the devastation of the soils giving rise to truncated profiles and freshly exposed surfaces on the slopes, and lacustrine deposits in the basin (viz, karewas). Such substratum and the subsequent climate, having been favourable to coniferous growth, have resulted in present vegetational complex which bears very [illegible]

the broadleaved associates as already mentioned. The only remnants of the broadleaved species are *Aesculus indica*, *Juglans regia*, *Fraxinus floribunda*, *Pyrus* sp., etc. in moist depressions, pockets and valley bottoms with *Parrotia Jacquemontiana* as an understorey in the coniferous forests, mainly deodar. Birch, however, continues to occupy the alpine timber limit. It is to correlate these salient features of vegetation in the Kashmir valley with particular reference to deodar and its ecology that the present study has been taken up as the first step towards the evaluation of the ecological status of conifers in Kashmir. This hitherto unattended subject besides its academic importance, is of great practical value to those engaged in watershed management and forestry practice especially in behalf of the contribution that this study may make towards the methods of natural regeneration and perpetuation of the precious forest wealth of Kashmir on an ideal basis of silviculture and management. This paper deals with studies made in the Lolab valley and will be continued as a series on similar studies made at Buniyar and in the Kuthar valley deodar forests followed by a discussion and conclusion.

Lolab valley, about 22.4 km long is an offshoot of the Kashmir valley in its northwest located between 34°25′ and 34°42′N latitude and 74°15′ and 74°32′E longitude. The geomorphology of this valley which could be no different from the Kashmir valley proper already described, can be linked with the latter by the similarities in topography and physical features, though the karewas are in comparatively much less abundance, restricted to a narrower depth in the middle of basin. Surrounded all round by mountains, the valley drains out through a narrow gorge at Kupwara which marks the entry to the valley proper and the beginning of the Pohru river in its downward flow to meet the river Jhelum at Doabgah. The valley has comparatively low hills on its eastern and southern sides. On its northern side it is separated from the Kishenganga valley by the uplands of Gurez and Matsil which form the watersheds of the Kishenganga river. On its northwestern side, it is separated from the watershed of Kahmil nullah by the Haihama ridge. Its main drainage, Manchar or Lolab nullah joins the Kahmil at Kupwara. The Lolab valley, representing all aspects of the compass, varies in elevation from about 1,661 m to 3,846 m in its north.

The Lolab valley excels in deodar forests which are renowned throughout the country. The picturesque valley bears about 330 sq. kilometres of forests, which occupy all the slopes and foothills of the surrounding watersheds leaving the small basin area for cultivation. The deodar forests of Lolab are one of the best in Kashmir because of their compactness and exceptional suitability to a concentrated form of working. The landscape they offer is very akin to the Central European forests because of their dense even aged crops and the nature of low hills. These have been worked under scientific forestry since 1911, firstly under the Indian Selection system for the "better stocked compartments" and the Improvement system for the "poorer stocked compartments". Subsequently, under Sher Singh's plan (1924) these stands were assigned to concentrated regeneration fellings and by now conversion to uniformity in these forests is the mainstay of silvicultural practice and management. Despite the regulated fellings and management in these forests for the last about four decades, these have been subjected to undesirable biotic interference particularly a heavy incidence of grazing as the forests unlike the rest of the country are unreserved. It is thus that some of the transects laid in the present study have passed through areas both closed to grazing subsequent to regeneration fellings and open as in table overleaf (viz., Co. 23 S. Lolab). The existing stands of deodar thus represent an old virgin forest which has been gradually opened through the biotic factor of fellings and natural calamities such as snow breaks, etc. The existing crop can be categorized under three heads, viz. :—

(i) mature and over-mature deodar trees standing over established regeneration upto pole stage,

(ii) mature trees with very little regeneration under them,

(iii) dense saplings and pole crops with scattered mature deodar or Pine trees. This category represents chiefly the post conservancy crops of an age of 60-80 years or even more which have come up naturally after the organisation of a well established forest department and

the protection that was afforded to thereto maltreated areas. The present study has been spread over all these areas by taking representative samples under each condition of the constitution of the crop.

Deodar forests in the Lolab valley occur generally between 1,661 m to 2,615 m. Within the altitudinal limits it is found almost pure with a sprinkling of *Pinus wallichiana* and some broadleaved trees found in moist depressions and in nullah banks. On the lower easier or even undulating slopes and on karewa beds, it fizzles out and at places is entirely replaced by *Pinus* as at Cherkut in North Lolab. It reaches best growth in Lolab particularly at Shumbrial in the north and Dardpura in the south, where top quality I according to Kulu tables has been reached. In other places, it is mostly of I/II quality with poor stunted crops found locally on the southern and southwestern aspects. On the whole, the regeneration is fairly good in its habitat. It is, however, alarmingly defecient on heavy clayey and waterlogged sites and where the incidence of grazing is high. It was noticed to be particularly widespread under a fairly close canopy in diffused light on steeply sloping ground, as in Table 4, in Co. 1 Kandi.

The forests of the area under study have generally coniferous species of *Cedrus deodara*, *Pinus wallichiana*, *Picea morinda*, *Abies pindrow* and *Taxus baccata*, associated with broadleaved species like *Juglans regia*, *Aesculus indica*, *Prunus cornuta*. Bushes of *Parrotia jacquemontiana*, *Indigofera gerardiana*, *Cotoneaster bacillaris*, *Viburnum foetens*, *V. nervosum* are quite common. In the undergrowth *Artemisia*, *Salvia*, *Fragaria*, show a fair preponderance.

The study was conducted by the transect method (Puri 1953, Misra and Puri 1954). Quadrats of 13.2 × 13.2 m were laid along line transects running from 1.6 km to 6.4 km. Size of each quadrat was arrived at by species-area curve after Oosting (1956). In each the following quantitative values were determined:

Abundance—number of plants of a species per quadrat

and frequency—which is the percentage number of times a given species occurs in a unit area (quadrat) out of the total number of samples examined.

A plant community was distinguished and named after the most dominant and co-dominant species. The dominance was judged from frequency of occurrence and abundance.

CEDRUS DEODARA COMMUNITY

This community is interspersed with very few conifers, the only one present being *Pinus wallichiana*. Among the broadleaved species *Parrotia jacquemontiana* shows a prolific growth and is "supposed" to be a deadly inhibitor of deodar regeneration. No oaks, laurels, *Pieris* or *Ilex* which are an accompaniment of deodar communities in Bashahr, Garhwal and other western Himalayas are found here. *Aesculus indica* in the upper storey and *Stipa sibirica* in the ground cover are common.

Table 1

Forest ... Lolab Co.—23
Aspect ... Northerly
No. of quadrats studied ... 54

Species	Abundance	% frequency
Trees and shrubs		
Aesculus indica	0.29	29
Cedrus deodara	1.07	100
Juglans regia	0.03	4

(Cont'd)

Species	Abundance	% frequency
Parrotia jacquemontiana	0.70	70
Pinus wallichiana	0.22	22
Prunus cornuta	0.10	11
Viburnum foetens	0.03	4
Rhus succedanea	0.07	7
Ground flora and tree seedlings		
Adiantum sp.	0.05	6
Cedrus deodara	0.7	70
Fragaria vesca	0.4	40
Hedera helix	0.25	25
Stipa sibirica	0.56	56
Oxalis acetosella	0.17	17
Pinus wallichiana	0.09	9
Podophyllum hexandrum	0.08	8
Taraxacum officinale	0.33	33

CEDRUS DEODARA COMMUNITY

This community is again a pure deodar community, the difference with the first only being that it occupies the southerly slopes. Besides *Pinus wallichiana* in the upper storey, *Prunus spinosa* also makes its appearance. Among the shrubs *Celtis australis*, *Indigofera gerardiana*, *Rosa macrophylla* are fairly common. However, the recruitment of deodar is much less pronounced as compared to Table 1.

Forest ... Lolab Co.—25
Aspect ... Southerly
No. of quadrats studied ... 33

Species	Abundance	% frequency
Trees and shrubs		
Cedrus deodara	1.01	100
Celtis australis	0.27	28
Cotoneaster bacillaris	0.08	8
Desmodium tiliaefolium	0.07	8
Indigofera gerardiana	0.20	21
Parrotia jacquemontiana	0.16	16
Pinus wallichiana	0.29	30
Prunus spinosa	0.04	4
Rhus succedanea	0.03	4
Rosa macrophylla	0.12	12
Rubus sp.	0.11	12
Ground flora and tree seedlings		
Agrostis tenuis	0.07	7

(Contd

Species	Abundance	% frequency
Arenaria sp.	0.08	9
Artemisia maritima	0.15	15
Cedrus deodara	0.12	12
Cirsium sp.	0.05	6
Cynodon dactylon	0.22	22
Cannabis sp.	0.20	20
Geranium nepalense	0.03	4
Hypericum perforatum	0.04	4
Lespedeza gerardiana	0.08	8
Fragaria vesca	0.11	11
Lychnis coronaria	0.03	3
Myosotis sp.	0.06	6
Origanum sp.	0.08	8
Oryzopsis munroi	0.20	20
Stipa sibirica	0.25	26
Oxalis corniculata	0.03	3
Viola serpens	0.07	7

JUGLANS REGIA—AESCULUS INDICA COMMUNITY

17. This community found in a moist depression is a pure broadleaved community with very fair abundance of the shrubby and ground flora. The regeneration rate of coniferous species is very low. The occurrence of this broadleaved community is significant and will be discussed later.

Table 2

Forest ... Lolab Co.—15
Aspect ... Northerly
No. of quadrats studied ... 25

Species	Abundance	% frequency
Trees and shrubs		
Acer pictum	0.08	8
A. caesium	0.02	3
A. oblongum	0.01	1
Aesculus indica	0.40	40
Berberis lycium	0.01	1
Cedrus deodora	0.02	20
Celtis australis	0.10	10
Cotoneaster bacillaris	0.07	8
Euonymus hamiltonianus	0.04	4
Juglans regia	0.73	75
Morus alba	0.06	6
Parrotia jacquemontiana	0.20	21
Pinus wallichiana	0.01	1

(Contd.)

Species	Abundance	% frequency
Prunus cornuta	0.02	2
Rosa baccata	0.02	2
Taxus wallichiana	0.05	5
Viburnum foetens	0.06	6
Ground flora and tree seedlings		
Acer pictum	0.12	12
Adiantum venustum	0.26	26
Aquilegia vulgaris	0.03	4
Asperula odorata	0.12	12
Asplenium trichomanes	0.32	32
Artemisia maritima	0.60	60
Aralia sp.	0.01	1
Brunella grandiflora	0.02	2
Cannabis sativa	0.6	6
Cedrus deodara	0.12	12
Clinopodium vulgare	0.04	4
Dryopteris spinulosa	0.03	3
Elsholtzia fruticosa	0.01	1
Fragaria vesca	0.5	50
Geranium nepalense	0.2	2
Geum urbanum	0.10	10
Hedera nepalensis	0.40	40
Impatiens balfourii	0.01	1
Oxalis corniculata	0.37	37
Stipa sibirica	0.4	40
Plectranthus rugosus	0.36	36
Polygonum amplexicaule	0.42	42
Scutellaria linearis	0.13	13
Salvia moorcroftiana	0.45	45
Viola serpens	0.22	22

"DEGENERATE" *CEDRUS* COMMUNITY

Here the deodar forest is non closed and hence very much degraded. There is, however, hundred per cent regeneration of deodar and recruitment was recorded in all quadrats. In the shrub layer, *Indigofera gerardiana* and *Cotoneaster bacillaris* show fair preponderance.

Table 4

Forest ... Lolab Co.—1
Aspect ... South westerly
No. of quadrats studied ... 15

Species	Abundance	% frequency
Trees and shrubs		
Berberis lycium	0.23	23

(Contd.)

Species	Abundance	% frequency
Cedrus deodara	0.10	10
Cotoneaster bacillaris	0.42	42
Indigofera gerardiana	0.37	37
Parrotia jacquemontiana	0.11	11
Rosa spinosissima	0.10	10
Ground flora and tree seedlings		
Bothriochloa ischaemum	0.07	7
Cedrus deodara	1.01	100
Clinopodium vulgare	0.14	14
Fragaria vesca	0.22	22
Lespedeza gerardiana	0.11	11
Stipa sibirica	0.17	18
Pennisetum flaccidum	0.05	5
Thymus serpyllum	0.04	4
Verbascum thapsus	0.06	6

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To be continued

NEWS AND NOTES

THE FIRST WORLD NUTRITION CONGRESS

The First World Nutrition Congress, in which more than a thousand delegates from a hundred countries participated, was opened on the 4th June, 1963 in Washington in the presence of President Kennedy, India's President, Radhakrishnan, and the UN Secretary-General, U Thant. The aim of the congress, convened by the Director-General of the Food and Agriculture Organisation of the United Nations—FAO—, Dr. B. R. Sen, and concluded on the 18th June, was to direct public attention especially in developed countries to the disquieting fact that in the world today 300-400 million are still hungry or to a high degree underfed. The greatest want should be removed in coming years within the framework of a world food programme. Foodstuffs to the value of 100 million dollars will be given for the rectification of special conditions of need within three years. The Federal Republic of Germany contributes on a lage scale to this FAO—programme.

At the Congress noted experts in the field of agriculture and food economy exposed the world food problem and made suggestions for its solution. Four committees discussed ways and means for raising production of foodstuffs in developing countries and relief actions of aiding countries in progress and under consideration. All branches of agricultural production, social problems as well as such ones of education and research were dealt with.

(International Fertilizer Correspondent, August, 1963)

Appendix 5(Contd.)

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DEODAR BELT OF KASHMIR, ITS OCCURRENCE AND ECOLOGY

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RESUME

In Part A, results of the quantitative studies of deodar communities of Kuthar in Kashmir valley and those of Buniyar in the adjacent Jhelum valley are given. A qualitative analysis of Chenab valley moist deodar forests is also recorded. Environmental factors in the areas of studies are described briefly to enable a comparative evaluation of the results.

Part B deals with the occurrence, distribution and composition of *Cedrus deodara* forests of Kashmir. Based on field studies in all the principal deodar areas of Kashmir and the adjoining Jhelum and Chenab valleys for comparison as reported in Part A and in an earlier paper (12), certain new facts have been brought to light with regard to its present status in the valley vis-a-vis the various ecological factors.

There is reason to believe that the altitudinal zone from about 1,525 m to about 2,135 m a.s.l in the Kashmir valley is a potential deodar belt. It also appears that the deodar belt of Kashmir has its own character shaped largely by the geological history and glaciation that had swept the valley resulting into the destruction of erstwhile vegetation, devastation of soils, rise of Pir Panjal mountain range and formation of extensive lacustrine deposits and deep alluvia on the floor of the valley where the physiography and bad drainage are inhibiting factors for the growth of deodar.

PART A—KUTHAR, BUNIYAR AND CHENAB VALLEYS

Introductory

The method adopted for the quantitative studies has been the same as for the study of Lolab forests (12). However, the full lists of plants encountered during the sampling have not been given. Instead, only species of importance from ecological point of view with higher values of frequency and abundance or which indicate a contrasting situation in comparison to other communities have been referred to in the paper.

I—Kuthar Valley

The valley lies between 33°37′ and 33°51′ N latitude and 75°13′ and 75°28′ E longitude. It is about 24 km long with an average width of 9.5 km. The tract is bounded by the Panjal range on its north-east separating it from Kishtwar area of upper Chenab valley and the waterpartings separating it from Lidder valley on the west and Naubug valley on the east. On

the south-west, the valley descends to run into the broader main valley of Kashmir of which it is an offshoot. The mountains bounding the greater stretch of the valley are not very high and generally range upto 2,700 m. The altitude of the valley varies from 1,565 m to 4,380 m a.s.l. near Khaiburu in the north-east. It is drained mainly by Arapat Kol from north-east down to south-west and small ravines and *nars* direct into Bringi river at south-eastern extremity; both these are tributaries of the river Jhelum.

The most abundant rocks in the area are limestone, sandstone, schist and quartz. Interbedded shales and slates are also found. Panjal trap forms core of the Panjal range. Alluvium and gravel deposits are met with in streams and *nallas*. *Karewas*, which consist of alternating layers of sand, clay, loam and conglomerate, are found in a conspicuous manner in the massive plateau towards the south-west presenting in the foreground of mountains a characteristic terrace effect of a glaciated valley.

The climate of Kuthar valley, in general, is similar to that of Kashmir valley (12). The area, however, records a lower summer rainfall as well as the total annual precipitation as compared to north-western parts of Kashmir.

The deodar forests of Kuthar valley extend from about 1,650 m to about 2,400 m a.s.l.; on southerly slopes with little soil, the lower limit is higher at about 1,950 m or so. The species is not found on the massive *karewa* to the south-west which bears the ruins of Martand Sun temple except a detached patch of deodar just above the temple near a shrine which is significantly interesting. Within the altitudinal zone, its occurrence is mostly pure especially on northerly aspect. Variations in aspect, however, result in an admixture with blue pine, which may replace it completely on exposed and unfavourable slopes. In cool, protected narrow sub-valleys, fir descends in the deodar zone as an associate towards its upper limit or may even replace it for some distance. The chief broadleaved associates are *Juglans regia*, *Fraxinus excelsior*, *Prunus cornuta*, *Corylus colurna* and *Parrotia jacquemontiana* in the understorey. Unlike the Buniyar forests, no *Cornus macrophylla* or *Punica granatum* are met with. No *Fraxinus xanthoxyloides* or *Desmodium tiliaefolium* are recorded either. On southern slopes where degradation has taken place due to biotic maltreatment, most of the broadleaved tree associates are absent while *Parrotia jacquemontiana* may continue to exist; thorny species like *Crataegus monogyna*, *Zizyphus vulgaris* and *Berberis lycium* are found instead.

Cedrus deodara Community (a)

This community having a dense deodar crop occurs in Comptt. 76 of Kuthar Range. Located on a north-westerly aspect, it is a pure deodar community ranging in elevation from about 1,860 m to about 2,260 m a.s.l. on a moderately steep to very steep ground. There is no understorey. *Parrotia jacquemontiana* is not so abundant and does not attain its usual dimensions. Blue-pine is only sparingly present. The most frequent species of the ground flora are *Viola serpens*, *Stipa sibirica*, *Polygonum amplexicaule* and *Fragaria vesca*.

Cedrus deodara Community (b)

This community occurs in Comptt. 110 of Kuthar Range. It is in progression on a moderate to steep southerly slope that has been subject to maltreatment and overgrazing. It is, therefore, quite different from the preceding one. It presents a disturbed condition; bare ground was hit in the quadrats towards the lower reaches where erosion has advanced. *Parrotia jacquemontiana* is locally abundant, its frequency being the same as that of *Cedrus deodara*. Young seedlings of deodar are locally abundant under the shade and protection of *Parrotia* clumps. Seedlings of the species, especially on eroding slopes with exposed mineral soil, are quite common but are subject to browsing and have, in many cases, become bushy. Being a colonizer, blue-pine is also present. Other frequent species are *Berberis lycium*, *Crataegus monogyna*, *Indigofera gerardiana*, *Rosa* spp., *Artemisia vulgaris*, *Bothriochloa ischaemum*, *Cannabis sativa*, *Cotoneaster macrophylla*, *Daphne oliioides*, *Fragaria vesca*, *Oryzopsis munroi*, *Pennisetum flaccidum*, *Plectranthus rugosus* and *Stipa sibirica*.

Parrotia Scrub Community

It was found in Comptt. 109 of Ekingam forest on an altitude of 1,650 m to 2,100 m a.s.l., within the optimal altitudinal range of deodar in the valley. The cofiguration of the ground is sloping and the aspect is southerly. In the past the area has been subject to severe biotic interference and overgrazing that resulted in erosion of most of the top soil. It has been effectively closed for about last 5 years since arresting the process retrogression. With the availability of seed from adjacent protected areas, deodar seedlings have started appearing under the shade of the bushes of *Parrotia jacquemontiana*, *Indigofera gerardiana*, *Crataegus monogyna*, *Cotoneaster* spp., *Ribes nigrum* and others which form the major components of the present seral scrub community. *Pinus wallichiana* has also come up on this dry slope in more open patches as a colonizer and is found quite abundantly as the new recruitment.

II—Buniyar Valley

Buniyar forest area lies between 33°59' and 34°15' N latitude, and 74°3' and 74°17' E longitude. It comprises an area of about 330 sq km. The tract is bounded by Pir Panjal ridge on the south and Kazinag ridge on the north. It is situated contiguous with the Kashmir valley towards the west. On the south is the Poonch area of Chenab valley watershed and on the north is Hamal range of Pohru catchment.

Unlike the Lolab valley, the narrow strip of the gorge like tract of Buniyar has steeply ascending ridges on either side, altitude varying from about 1,240 m to about 4,135 m. The tract drains directly into river Jhelum which flows through it from east down to west.

The area has many geological formations, namely, slate, quartz-schist, phyllite and Panjal trap series. Northern slopes have mica schists with massive granite. Limestone is not uncommon. Unlike the Kashmir valley, lacustrine *karewas* are conspicuous by their absence.

The climate of the tract, on the whole, is cold; it is warmer on southerly slopes. July to September is the hottest period of the year. During this period, it receives about one third of total annual precipitation. The rainfall is higher in proportion during the summer months as also in total due to benefit of south-west Monsoons which decrease in intensity from west to east. Autumn is pleasant and dry.

The deodar forest of Buniyar ranks among best in Kashmir occupying about 44% of the entire stocked area. The other major species are *Abies pindrow* and *Pinus wallichiana*. The deodar forests occur between about 1,230 and 2,440 m a.s.l. On southern slopes, however, the forest growth does not descend as low as the river level but often starts higher up from about 1,660 m a.s.l. or more. The area abounds in compact patches of pure deodar, which is also often met as mixture with blue-pine or fir or with both on higher reaches on northern aspect. The other associates of deodar here include *Aesculus indica* and *Juglans regia*, lopped clumps of former often found as pure. These forests also include a sparse sprinkling of *Fraxinus xanthoxyloides*, *Prunus cornuta*, *Populus ciliata*, *Corylus colurna* and *Rhus succedanea*, the last named occurring in a comparatively greater abundance. Along beds of *nallas* and banks of the river, strips of pure *Alnus nitida* are often found. This species is not seen in the Kashmir valley. *Parrotia jacquemontiana* often comprises a pure undergrowth. *Punica granatum*, not reported from Lolab, is also to be seen in increasingly greater abundance as we descend. *Cornus macrophylla*, also not seen in Kashmir valley, makes frequent appearance in the tract.

Cedrus deodara Community

This is a pure deodar community on a cool northerly slope with very steep to precipitous configuration starting from as low as 1,265 m a.s.l or so. It was found to occur in Comptt. 67 of Buniyar Range. In addition to *Parrotia jacquemontiana*, which is not so much abundant and occurs as an understorey, *Punica granatum* is found in a fair preponderance concentrated along fringes and in open patches. Few broadleaved tree associates were encountered during the

course of the transect line through a ravine or moist depression. Noteworthy among these are *Alnus nitida* on the bank of river down below, *Cornus macrophylla*, *Pistacia integerrima* and *Fraxinus xanthoxyloides*, all of which are absent from Kashmir valley. Other species with higher frequencies are *Clematis gouriana*, *Hedera nepalense*, *Lonicera quinqueloculatis*, *Populus ciliata*, *Rhus succedanea*, *Rosa macrophylla*, *Spiraea canescens*, *Vibernum foetens*, *Vitis vinifera*, *Arisaema tortuosum*, *Echinops niveus*, *Pteridium aquilinum*, *Salvia moorcroftiana*, *Sedum adenotrichum*, and *Urtica dioica*.

Cedrus deodara-Pinus wallichiana Community

This community was found in Comptt. 5b of Buniyar Range. It is different from the preceding one in so far as it is located on hotter southerly aspect, and, therefore, the floristic composition is also different. The forest growth starts comparatively higher up from about 1,700 m a.s.l. and more. *Pinus wallichiana* constitutes a fair proportion of the upper storey. Species such as *Berberis lycium*, *Cotoneaster bacillaris* and *Artemisia maritima* make their appearance in fair abundance. *Punica granatum* is abundantly present. *Cornus macrophylla* is also represented.

Aesculus indica Community

This is broadleaved tree community dominated by *Aesculus indica* in cool and moist location. It has been studied in Comptt. 27 on a northerly aspect. Conifers are present only sparingly; among these deodar has the highest representation while *Picea morinda* is also present. The broadleaved species, especially *Alnus nitida*, occur in moist depressions. 'Dry' flora such as *Berberis lycium*, *Cotoneaster bacillaris*, and *Artemisia maritima*, etc., is found in open patches and on ridges and fringes. Among other species represented in the community are *Clematis gouriana*, *Deutzia corymbosa*, *Fraxinus floribunda*, *Indigofera gerardiana*, *Juglans regia*, *Parrotia jacquemontiana*, *Pinus wallichiana*, *Punica granatum*, *Rhus succedanea*, *Vibernum foetens*, *Asperula odorata*, *Asplenium trichomanes*, *Brunella grandiflora*, *Cannabis sativa*, *Dryopteris spinulosa*, *Oryzopsis acquiglumis*, *Plectranthus rugosus*, *Stipa sibirica* and *Viola serpens*.

III—Chenab Valley

Known for the luxuriance of the growth of vegetation, the valley lies to the south of Kashmir valley from which it is separated by the Pir Panjal mountain range. The valley is situated between 32°15′ and 34°5′N latitude and 74°15′ and 76°20′E longitude. It is drained by Chenab river from east down to west, of which the major tributaries are Marwa and Anji. The terrain is mountainous and rugged with steep to precipitous slopes. The tract ranges from 1,200 m to 3,600 m in elevation. Unlike the Kashmir valley there is no flat expanse of land save a few locally occurring plateaux.

Like the Kashmir valley, the uppermost part of the Chenab valley, which includes Nagseni, Padar and Marwa *illaqas* of the Kishtwar Division, is bereft of the benefit of south-west Monsoons due to its leeward location. Whatever precipitation this part receives is either of local origin or occasionally from some stray winds under profuse stress which find their way to the interior. In this part the floristic composition is ideally of the dry type represented by *Pinus gerardiana* and *Quercus ilex* both of which are absent from the Kashmir valley. The rest of the valley receives the full benefit of the south-west Monsoons resulting into considerably higher precipitation in the form of summer rainfall. The precipitation pattern of three representative stations of the valley is tabluated as follows.

(*For the Table, see Page 447*)

Table

Precipitation in mm

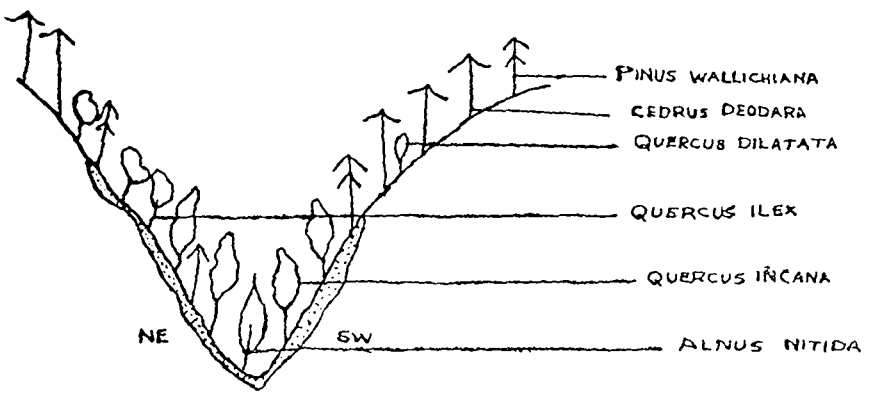
Station	During Monsoons (June-Sept.)	During Winter (Dec.-Mar.)	During Spring & Autumn (Apr., May) (Oct. & Nov.)	Total (For 12 months)
Kishtwar ...	230	475	200	905
Bhadarwah ...	360	575	170	1,105
Ramban ...	700	245	198	1,143

The temperature regime of the Chenab valley deodar forests is similar to that of the Kashmir valley (12).

The deodar forests of Chenab valley which occupy the lower reaches of the temperate conifer belt of the zone excel in growth and regeneration. The other major species of the tract are *Abies pindrow*, *Pinus wallichiana*. *Picea morinda* occurs more abundantly than in Kashmir valley forests. The subtropical pine *Pinus roxburghii* is found in the tract at lower elevations in the form of a strip along the river banks where forests of *Olea cuspidata* and *Punica granatum* are met with still lower down. In addition to some other evergreen species, oaks are the characteristic associates whence *Quercus incana*, *Q. dilatata* and *Q. semecarpifolia* mark the altitudinal zones occurring one above the other respectively. In order to compare the floristic of Kashmir valley deodar belt, four typical localities of the moist deodar type found in the Chenab valley were subjected to quantitative sampling.

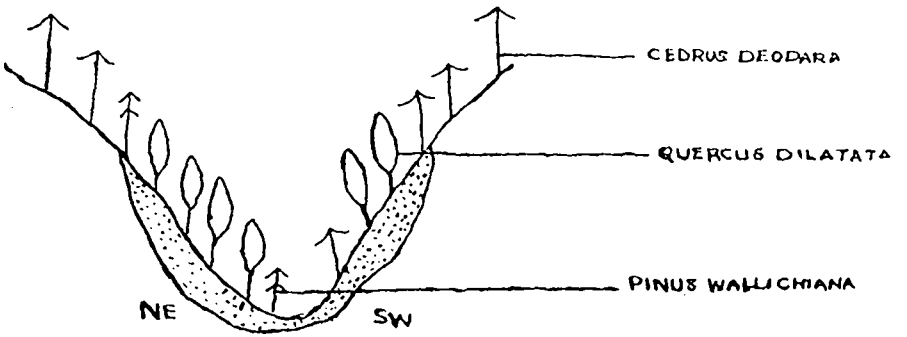
At Pranu near Doda on north-east to south-westerly aspects with a fairly open overwood canopy, species other than deodar include *Alnus nitida*, *Clematis gouriana*, *Cornus macrophylla*, *Daphne cannabina*, *Ficus palmata*, *F. scandens*, *Myrisine africana*, *Pieris ovalifolia*, *Pinus wallichiana*, *Punica granatum*, *Quercus incana* and *Q. ilex*.

Fig. 1



Profile of the forest at Pranu near Doda in moist Chenab valley deodar.

Fig. 2



Profile of the forest at Bhaderwah in Neru block in the Chenab valley moist deodar 'type'.

At Bhaderwah in Neru block on north-easterly to south-westerly aspect carrying a fairly dense overwood canopy mostly of deodar and less so of blue-pine, the species recorded include *Berberis aristata, B. lycium, Crataegus monogyna, Elaegnus umbellata, Quercus dilatata, Sagaretia oppositifolia* and *Viburnum foetens.*

At Batote on a northerly aspect including a moist depression, the important species are *Abies pindrow, Cedrus deodara, Fraxinus excelsior, Parrotia jacquemontiana, Picea morinda, Pinus wallichiana, Populus ciliata, Prunus cornuta, Rosa macrophylla, Sarcoccoca pruniformis, Viburnum foetens* and *V. nervosum.* The species of the ground flora are *Ainselia aptera, Galium aparine, Geranium nepalense, Hedera nepalense, Impatiens* spp., *Polystichum lobatus, Pteris cretica, Quercus dilatata* (seedlings), *Urtica dioica,* and *Valeriana wallichi.*

Nearby the locality at Batote described in the foregoing but with an easterly aspect and less moist, the species met with include *Berberis aristata, B. lycium, Cedrus deodara, Clematis gouriana, Cotoneaster bacillaris, Daphne olioides, D. cannabina, Desmodium tiliaefolium, Myrisine africana, Pinus wallichiana, Quercus dilatata* and *Viburnum foetens.* Of the ground flora, the species represented are *Dipsacus inermis, Dryopteris spinulosa, Fragaria vesca, Galium aparine, Girardinia heterophylla, Hedera nepalense, Lespedeza gerardiana, Quercus dilatata* (seedlings), *Salvia glutinosa, Stipa sibirica* and *Schizandra grandiflora.*

PART B—DISCUSSIONS AND CONCLUSION

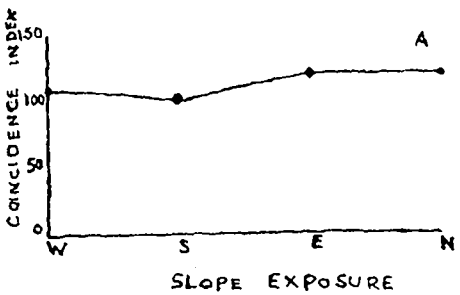
I—Discussions

(a)—*Typology*

The genus *Cedrus* Link, has three main forms classed as species which come true from seed. These are distributed in the Mediterranean and western Himalayan regions almost in a contiguous belt. *Cedrus libani* Barrilier, the Lebanon cedar is indigenous to Lebanon range and Asia Minor ranging in elevation from 1,220 to 1,950 m; var. *brevifolia* Hook, the Cypress cedar is a native of Cyprus. *C. atlantica* Manetti, the Atlas cedar is indigenous to Algeria and Morocco, inhabiting elevations from 1,220 to 2,135 m. *Cedrus deodara* (Roxburgh) Loudon is the Himalayan cedar or deodar. It seems, the genus is broken into three ecological groups showing separate morphological adaptations in each ecotype and hence the three different specific names. Similarly, separate ecotypes in the range of west Himalayan cedar, deodar, can be discernible on account of climatic, physiographic and other features such as glaciation and the floristics of deodar formations.

In the west Himalayas, the chief deodar forests are found in Chenab, Kashmir, Jhelum and Kishenganga valleys, Jaunsar, Tehri Garhwal, Kulu, Bashahr, Chamba, Hazara, Chitral,

Fig. III



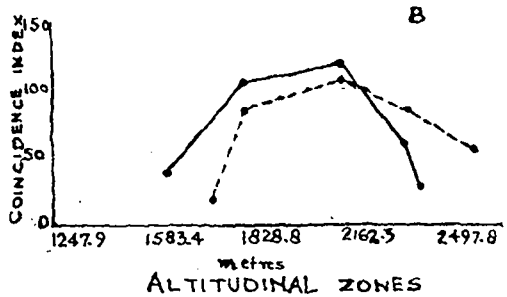
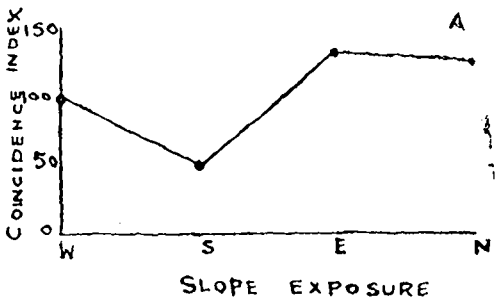
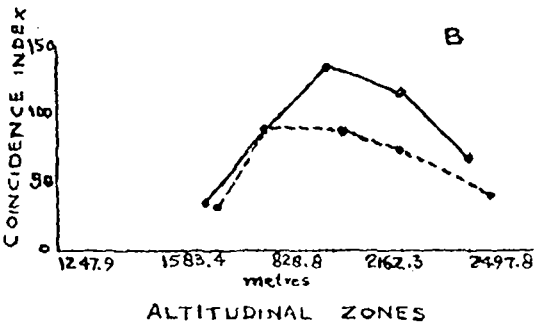


Fig. V





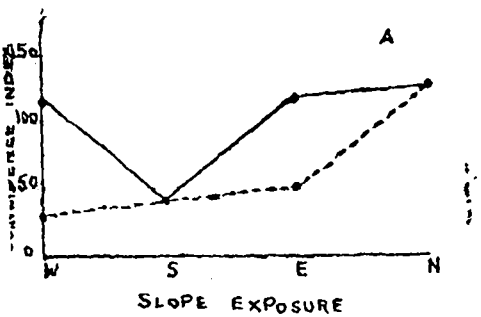
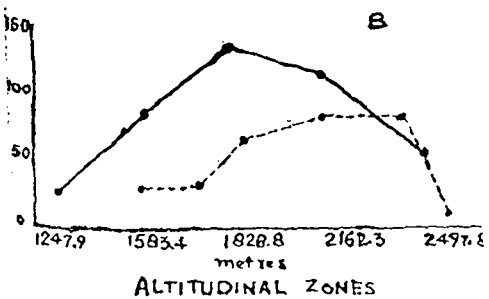


Fig. IV



Figs. 3 to 5—Relation of the deodar community type as indicated by coincidence index, to: A, slope exposure; B, altitude, in Lolab (Fig. 3), Buniyar (Fig. 4) and Kuthar (Fig. 5).



1



4



2



5



3



6

Photo No. 1 to 6—1 Kuthar valley deodar towards upper limit with alpine pasturage under snow in background. 2 Kuthar deodar at the mouth of the valley with willows and poplars bordering the paddy fields. 3 Ekingam deodar forest under progression on eroded hillside. 4 Buniyar deodar on a vertical cliff in association with *Cornus macrophylla*. 5 The low limit of Buniyar deodar on the left bank of river Jhelum. 6 A 'bare' southern slope of Buniyar with deodar above it.

Dir, Swat and other places. The occurrence of deodar in the region may be categorized into two broad climatic ecotypes, moist type and the dry type with annual precipitation ranging above and below 1,000 mm respectively. In the former type which includes tracts in the outer Himalayas, such as Lower Bashahr, Chakrata, Bhaderwah, Ramban, Batote, Lander, Sarthal, full benefit of sout-west Monsoons is received. The latter type is represented by dry inner valleys and leeward plateaux where no or feeble impact of the Monsoons is received and the precipitation is largely in the form of winter snow. Examples of this type are the deodar forests of Chamba, Padar and Dacchan in Kishtwar, Chitral, Kagan, Hazara and Astore, etc. A third 'type' may also be recognized in areas where glaciation has taken place. Here deodar seems to be in equilibrium on truncated soils devastated during the Pleistocene and does not, unlike the two other 'types', abound in oaks which may be completely wanting as in Kashmir valley.

(b)—*Physiography*

In its native range in the western Himalayas, deodar grows from about 1,220 to over 2,740 m a.s.l. but is most common between 1,825 and 2,430 m. Kashmir deodar forests lie principally between about 1,680 to about 2,285 m a.s.l. It appears that the lower altitude is nowhere a limiting factor in the Kashmir valley. The occurrence of deodar forests at a distance from the lowest points is due either to adverse edaphic conditions of bad drainage and low lying heavier soils or to biotic maltreatment. The Buniyar deodar forests may descend even as low as 1,250 m right down to the bank of river Jhelum. In its upper limit the forests may extend further beyond to 2,438 m but normally it can not hold its own above this range.

Aspect plays an important role in its altitudinal distribution. On hot southerly aspects, the lower limit starts higher up due to inability of deodar regeneration to establish under conditions of insolation and want of shade on exposed slopes where axe and grazing have a greater harmful effect. The upper limit on such aspects is higher as compared to cooler and shady northerly aspect and may vary by about 300 m or so. Thus while on the northerly slopes of Kandi range, deodar grows upto about 2,160 m on the Lolab side, it extends almost upto the waterparting ridge on southerly aspect upto about even 2,500 m or slightly more elsewhere.

(c)—*Climate*

The temperature extremes in the deodar zone vary from a minimum of -12.22 to -3.89°C to a maximum of 26.67 to 37.78°C. The annual precipitation ranges from about 760 mm to about 1,780 mm. In areas with low precipitation, winter snow in bulk is a very favourable factor. Thus in Kashmir valley at Srinagar, for example, out of the average annual precipitation of about 600 mm, 60% falls as Spring rain and winter precipitation largely in the form of snow which ensures and equitable moisture regime in the ensuing dry summer months. In the still drier valleys, where such a favourable complex is not possible, its growth is not so good and tends to be stunted, scattered and rare as in Gilgit whereas in areas with scanty precipitation it is not found at all as in the arid and wind swept Ladakh plateau. Similarly in areas with high rainfall, deodar does not flourish and disappears from west to east in the Himalayan range and does not occur in the eastern Himalayan region. So is the case in Murree hills and Dhaula-dar region near Dharamsala where the total annual rainfall is heavy.

(d)—*Phytogeography*

In going over the Kashmir valley watershed in a clockwise manner, deodar is found most gregariously in the north-west where it occupies its zone of elevation throughout the 1,900 sq km of Pohru catchment. Further east, it occurs sporadically in Madmati drainage near Chatternar, in Arahom forest of Watlar block, in Barnubug beat of Wangat drainage, in Gutlibagh beat of Mansbal block and in Akhal block of Sindh drainage. It is found scattered

in Tral Rakh in Arapat drainage and over larger stretches in Lidder drainage from its lower reaches on both its eastern and western watersheds interspersed with blue-pine upto Pahalgam. In this drainage it is found in concentrated patches in Kotsu, Hutmura, Lidru and Mamal *illaqas*. Still east, the more compact area of the Arapat drainage in the Kuthar valley is seen where deodar grows under optimum conditions at Panchalthan. Right in the east, it is found in Bringi drainage in its lower basin which includes the Ekingam forest. In the south-eastern loop of the valley, deodar occurs in Verinag area near the source of river Jhelum.

Turning west in the south, the species is seen naturally occurring in Brinyal Lamar area of Vyeth-vatur drainage. Thereafter the region of almost continuous absence of deodar is hit, whence it is not found in Vishau, Rembiara, Sasra, Romushi, Dudhganga, Shaliganga, and Sukhnag drainages over a linear stretch of about 65 km from east to west between 33°30′ and and 34°0′ N latitude. Exceptions, however, are 655 ha in Yar area at Yarwan *karewa*, which is a detached pendant between Sasra and Romushi drainages, and localised patches along the toes of this stretch from east to west in Rembiara Comptt. 29, near Kaindajan in Romushi drainage, in Nilnag block in Dudhganga drainage and at Drang and Khag in Sukhnag drainage. Further west the species occurs in Shuplian and Gogaldara forest of Ferozpura drainage. Thereafter, it is found in increasingly great proportion in a more or less continuous tier across Babareshi, Shranz, Alapathar and Chandusa in Ningal and Baramulla gap drainages till the western extremity of the Kashmir valley which leads to the rich Buniyar deodar forests.

The 65 km wide stretch of absence in the south is on the northern aspect of Pir Panjal mountain range which represents its dip slope. This is more moist and the soils have a higher clay content. The optimal altitudinal range of the species in this region is, in fact, comprised predominantly of *karewa* formations which consist of clayey loam and are deep on these mostly easier slopes. Such conditions, owing to the preference of the species for a well drained substrate, could be a major factor in the absence of deodar over this stretch and the occurrence of fir which descends quite low into the altitudinal zonation of deodar on this cool and moist aspect.

The presence, on the foot of the Pir Panjal mountain range, of a sizeable area under deodar at Yar on a *karewa* is ensured by the interstratification of the clays with soft sandstone and by its sloping sides which must lead to good gravitational as well as lateral drainage. The species is present on other *karewas* as well at the foot of Pir Panjal as at Chandusa and Alapathar in Ningal drainage due to local edaphic conditions leading to better drainage. At Babareshi, also at the foot of Pir Panjal, deodar is colonizing eroding *karewa* slopes and freshly exposed clips. At Rajwar Comptt. 4 in Talri catchment, deodar occurs luxuriantly on eroded *karewa* occupying the ridges and spurs of the rills and gullys. Kralpura *karewa* in Kahmil drainage is a good example where deodar regeneration is coming up abundantly even on its flat top due to bouldery and light soil strata in the *karewa*.

The absence of deodar from similarly well drained *karewas*, which, however, is not rare, appears to be greatly due to biotic factor. Due to population pressure for culturable land, the *karewas* have been stripped off of their permanent vegetal cover and brought under plough. Yet, it is interesting to note the re-invasion of these lands by groups of deodar seedlings as in the adjacent field near Yarwan bringing out an example of struggle between Nature and man.

There is a further reason to believe about the occurrence of a deodar belt in the afore-said tract, of which the few remnants are the tounges of deodar patches at Brinyal Lamar, Rembiara, Yar, Kaindajan, Nilnag, Gogaldara, Drang and Khag with lateral extensions broken by fir and/or blue-pine. Deodar timber is the best available for construction and other purposes. The species must have been subjected to a ruthless creaming in the past before the advent of organized forestry more so in the tract due to its proximity to Srinagar where oldest of the houses have deodar structures known to have been brought from Pir Panjal area. The lavish use of deodar timber displayed in big shrines as at Chrar-i-Shariff and elsewhere in this tract and the existence of old deodar trees in protected mosques and hamlets in the zone bear additional testimony to the possible occurrence of deodar stands carrying trees

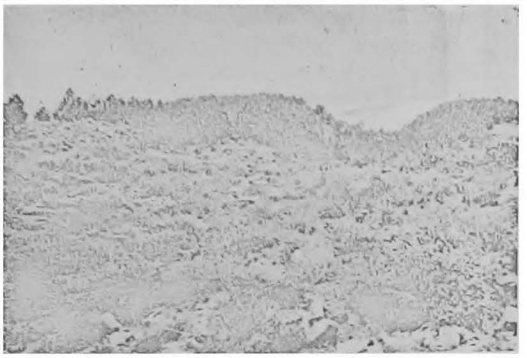
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hoto No. 7 to 12—7 Deodar in Buniyar on northern aspect on shale formation. 8 Deodar coming up under the shade of *Parrotia* scrub under progression (in foreground) in Kandi Range. 9 Post-conservancy deodar unable to extend on to the exposed southerly aspect in the absence of shrub growth or shade near Salar. 10 Receding tounges of isolated deodar patches standing in between encroachments for cultivation made near Kalantra in Ningal drainage. 11 Lopping of deodar and the wedges of cultivation in the deodar belt near Babareshi. 12 Shrubby growth of deodar due to browsing and lacking near a habitation at Chandusa.











Photo No. 13 to 17—13 A relic of 'ancient' deodar belt on Pir Panjal range. 14 Isolated groove of old deodar protected due to the shrine near Kotsu. 15 Mixture of deodar and *blue-pine* with the former in preponderance, on an eroding *Karewa* with lateral drainage at Alapathar. 16 The uppermost limit of deodar on a precipice near Pahalgam in Lidder drainage. 17 An isolated patch of deodar near Chatternar in Madhumati drainage.

of larger sizes. This can be inferred also from the fact that the few restricted crops of the species in the tract are of smaller sizes but of a natural origin.

When of late, fir forests, in which the zone abounds, have been commercialized, the silvicultural treatment and management has been geared on the lines to perpetuate this very species under its own cover admitting no chance for creation of conditions that would favour the establishment of deodar. These factors aggravated by the disability of deodar seed to disseminate over any long distance provide no scope for the 'recurrence' of deodar belt in the locality.

The disjointing of deodar belt on well drained slopes particularly in north and north-east, though over shorter stretches, appears to be due to biotic interference and geological history; the latter factor having contributed to a change in the climate of the valley due to rise of Pir Panjal mountain range and the wiping of vegetation due to glaciation. These 'barchill' slopes with a hot and exposed southerly aspect bear a scrub vegetation of *Parrotia jacquemontiana*, *Crataegus monogyna*, *Cotoneaster bacillaris*, *Berberis lycium*, *Lonicera angustifolia*, *Rosa macrophylla*, *Rubus* spp., *Ribes* spp , *Punica granatum*, *Indigofera gerardiana*, *Plectranthus rugosus*, *Rumex hastatus*, etc. This predominates in shrubby growth after protection. With continued protection against lopping and indiscriminate destruction of the vegetation, this is followed by establishment of blue-pine stands or directly by deodar growth, if seed is available. Examples of the progression are available at all such places where soil conservation closures have been effectively protected for a decade now or where the areas have come to receive the required protection as in sanctuaries and *Rakhs*. Thus these well drained slopes popularly known as 'Kashmir Bare Hills' from east to west on the right bank of river Jhelum are potential deodar areas and can give rise to an unbroken continuity of the belt if the necessary shade for establishment, seed for regeneration and protection against grazing and browsing is provided. Typical examples of deodar coming up naturally in this manner are Ekingam forest near Achabal, Hutmura forest near Anantanag, Vodhpora closure near Kulangam, Moond unit at Baramulla and Wudur forest near Aishmuqam. Deodar established artificially in this 'potential deodar zone' on the then bare Shankaracharya hill at Srinagar has now started regenerating naturally.

(e)—*Floristics*

In the 'deodar belt' of Kashmir, while a great proportion of the forests occur in pure form, others exhibit association with *Pinus wallichiana*. Sometimes a spruce belt of varying width is noticed to occupy the borderline between the 'deodar belt' and fir forest belt above it. In addition to dominant *Picea morinda* it includes *Abies pindrow* and *Cedrus deodara*, the former often in a comparatively greater proportion than the latter. The other conifer in the deodar forests is *Taxus baccata*, but, again, with a low frequency. *Ephedra gerardiana* is noticed in localised patches in only a few areas under progression to deodar though in a greater proportion in Buniyar valley.

Among the broadleaved species, most common associate in the deodar forests, both pure and mixed, is *Parrotia jacquemontiana* which forms almost a continuous understorey. This was supposed to be a 'deadly inhibitor of deodar'. This is not true. The understorey provides the shade necessary for the establishment of deodar seedlings which on subsequent freeing by cutting the shrub growth thrive unhampered. This in Kashmir can be done advantageously by providing the much needed firewood from the *Parrotia* clumps which get perpetuated by coppicing. This associate, therefore, serves as a good nurse. Often groups of deodar regeneration are noticed under its clumps which, however, must be removed after the establishment of the regeneration for its further growth and hence the importance of cultural operations of shrub cutting in the silviculture of deodar after regeneration fellings. Other important broadleaved species in the deodar forests are *Aesculus indica*, *Juglans regia*, *Fraxinus excelsior*, *Prunus cornuta*, *Celtis australis* and *Pyrus lanata*. These occur only as a sparse sprinkling. However, broadleaved associations comprising horsechestnut and walnut in main and including ash, maple and birdcherry in comparatively higher frequency along with the other species

occur in sheltered sites as strips, grooves and small patches in moist pockets, ravines and depressions in the 'deodar belt'; the frequency of deodar in such associations is very low, occurring as single stems on dry outcrops or ridges. These broadleaved species seem to form the climax vegetation in such situations on account of the edaphic and local microclimatic conditions.

Among the salient features of the floristics of Kashmir deodar forests is the absence of oaks except for the localised *Quercus dilatata* observed in Achabal Rakh area. *Alnus nitida*, *Pieris ovalifolia* and *Sarcoccoca* spp. are also completely absent. *Picea morinda* is represented very lowly in these forests as compared to the moist temperate type. Thus the Kashmir valley deodar forests, obviously, do not reflect the flora of moist deodar. Species in common, other than a large number of the ground flora, are blue-pine and broadleaved tree associates mentioned above *Parrotia jacquemontiana*, which forms a ubiquitous understorey in the 'deodar belt' and is the commonest and tallest shrub of areas under progression to deodar, is present only in localised patches in deodar forests of the other regions. With climate as denominator, the valley deodar would go to the dry type but, again, there are anomalies in the floristics. The characteristic associates, *Pinus gerardiana* and *Quercus ilex* are completely wanting. *Daphne olioides*, *Artemisia vestita* and *Ephedra gerardiana* are found in abundance only in the scrub forest, which on progression loses this element of the dry type especially the last named species which is nonetheless rare. *Fraxinus xanthoxyloides* is also not to be found to the east of Khadanyar gorge that leads to Kashmir valley from that of Buniyar where *Ephedra gerardiana* is also met with in greater localised abundance. *Cornus macrophylla*, recorded from Chenab and Buniyar valleys, is also absent here.

II—Conclusions

The overall occurrence of *Cedrus deodara* gives a clear cut impression of a deodar belt in Kashmir where the climatic conditions are ideal for its growth; disjointing in the belt is on account of unfavourable edaphic conditions of bad drainage and a combination of other factors as discussed. At other places it is under progression in this belt in scrub and blue-pine communities especially on southerly slopes where colonization by tree and shrub growth is taking place after the destruction of vegetation by glaciation or past biotic maltreatment.

The character and the floristics of the Kashmir valley deodar belt does not fit in with either the moist or the dry type deodar forests. Notwithstanding the climatic pattern, the belt exhibits greater affinities with the moist type in its overall character and has much less resemblance with the deodar forests of the inner dry valleys of the west Himalayas. Trials with *Pinus roxburghii*, the subtropical pine, at Shankaracharya, Srinagar in the potential deodar belt have so far given encouraging results and its growth falls within quality class I. On the other hand, similar trials with *Pinus gerardiana*, the dry type pine, at the same locality have yielded poor results. Pollen studies have also revealed that the region in the early Pleistocene bore a flora of the moist type when oaks and laurels were abundant and when *Cedrus* contributed to the conifer element of the vegetation (17-19). *Quercus dilatata* in Achabal Rakh may perhaps be a relic of that ancient vegetation. This may be corraborated further by the sudies of Puri (14) which have brought out the paucity of oaks in the glaciated region of Kulu Himalayas as against the non-glaciated areas in the main and tributary valleys where these are a dominant feature of the vegetation. This appears to be attributable, in great probability, to the disturbance of stabilized soils during the glaciation. The abundance of oaks in the Chenab valley and the paucity of conifers in the Mussoorie Himalayas and further east where the effects of glaciation have been remote should show that the forest succession in Kashmir valley is typical for glaciated regions. With these facts in view, it is plausible to think that deodar forms a stable edaphic climax in its altitudinal range in the glaciated valley of Kashmir as against *Quercus dilatata* (and/or *Q. incana* and *Q. semecarpifolia*) in the Monsoonic Chenab valley and outer Himalayas, and *Q. ilex* in the non-Monsoonic dry regions of Padar and Dacchan in Kishtwar and elsewhere.

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APPENDIX 6

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Review Article No. 13

INVESTMENT ANALYSIS TECHNIQUES WITH EMPHASIS ON COST-BENEFIT ANALYSIS AND RENEWABLE RESOURCE PLANNING

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I. INTRODUCTION

Renewable natural resource planning involves decisions about alternative courses of action. The arbitrary selection of options can result in a misallocation of resources. An important aspect of the planning process, therefore, is the evaluation of investment options.

II. PHYSICAL APPRAISALS

i. General

It is often argued that since the consequences of alternative courses of action necessarily depend on physical effects, technical criteria serve as valid measures. For this reason and owing to the difficulties associated with economic criteria, 'physical measures of success are the obvious choice' (81, p. 110).

ii. Product Maximisation and Input Minimisation

Product maximisation is a frequently used criterion in the renewable resource sector (60, p. 26; 133, pp. ii–iii). It gauges the desirability of options by the anticipated physical achievement, such as tons of grain produced. The obverse of product maximisation is input minimisation, whereby options are ranked according to the quantities of one or few inputs that are considered to be scarce, such as land or fertilisers.

The above maximisation or minimisation is fruitless if it involves greater costs or lesser benefits than options producing less quantity or using more inputs respectively. Such appraisals cannot facilitate comparison among options with different inputs or products, because the various commodities are expressed in non-commensurate physical units. The results would be ambiguous even if the various factors and products were of identical kind and the differences were only in proportions, because of the different relative prices or scarcities of resources. Sometimes, 'perhaps fortuitously, the physical and monetary benefits coincide, but, where they are in conflict the economy may suffer' (60).

iii. Materials Balancing

The materials balancing method is aimed at producing quantities of required goods without shortages or waste. Developed for socialist economies, it has been tried in India too (141, pp. 39–80). The practice of the Soviet Gosplan is to make a preliminary plan and revise it in the light of detailed plans from below, drawing material balances for about 1,500 products* to ensure consistency and to spot glaring disproportions (53). Accordingly, projects would be desirable if they yield outputs consistent with the needs of intermediate goods for other projects and vice versa.

The technique may not ensure the object of consistency (27). Among other reasons, this is because of the very large number of compilations and cross-checks required for balancing, which is difficult in practice (5). The consequence is that ' the plans for production, labour, finance and supply are often inconsistent ' (131). Since the balance cannot be worked for *all* commodities and does not cover the entire product of the goods in question (48), shortages or surplus may arise in balanced as well as non-balanced goods. A suggestion, not yet adopted, has however been made for an iterative method by which it may be possible to arrive at a consistent plan for products for which material balances are compiled (40, 41).

An alteration in the output of one product necessitates realignment in the chain of commodity outputs directly or indirectly used in its production process. Such widespread and concurrent adjustments are possible only for those balances in which changes are conspicuous and none for those which are not considered in materials balancing. Nevertheless, the method is useful in centrally planned economies in gearing investment to a given strategy. As such, project selection acquires a *fait accompli* status in the sense that options ranking is conditioned by the need to match a balance of resources. The difficulty, however, is that ' physical measures (weight, volume or area) often cannot reflect the consumers' value of goods. The establishment of conventional units of measurement of output, which convert physical measures to volumes of consumers' value has a progressive significance ' (65).

iv. Physical Input-output Analysis

In the Soviet Union, input-output analysis is regarded ' as an organic part of the balance of the national economy, as its further development, and above all as the development and disaggregation of the balance of production, consumption and accumulation of the social product and the national income ' (9). The materials balances show the gross production and consumption of commodities, focusing on bottlenecks. But ' the production and consumption of coal and steel are significant not in themselves, but only to the extent that they provide for the production of products intended for final consumption ' (93, p. 9). As against the balancing method, the input-output analysis focuses on net output available for final consumption. Its other advantages are that it shows clear relationship between macro-economic summary indicators and the physical structure of production, and it is relatively less laborious than the balancing procedure (1). For the latter reason, it is advocated that since the Gosplan must calculate the volume of production of more than a thousand products ' balancing can most effectively be carried out with the help of an input-output table ' (157). However, such very large tables would be difficult to compile and invert and may leave open the relationship between Gosplan's table and the thousands of materials balances compiled at lower levels of the hierarchy.

A review of the use of input-output in investment planning has been made by Shatalin (156). All Soviet input-output tables are commodity-to-commodity rather than industry-to-industry tables (92, pp. 52–7; 49, pp. 185–7). This is to reflect the technological relationships of processes, so that the tables are not necessarily a guide to inter-enterprise investment allocation and trade. The input-output models assume that all inputs are proportional to outputs, but in many industries this is not so (93, p. 38). To meet the change from the central allocation of commodities to inter-enterprise trade, both the materials

* Recently, the number of centrally planned commodities has been reduced.

balances and the physical input-output tables continue to be used (1). But these may be incompatible because input-output tables are compiled on a commodity basis and the plans on an industry basis.

The preparation of *ex-ante* value input-output tables has also been taken up. The ' most complicated and labour intensive part of the work on the compilation of an *ex-post* input-output table is to obtain and process the necessary statistical information ' (49, p. 85). This is a bigger problem for *ex-ante* input-output analyses, which can only be used as part of the comprehensive planning system, being unreliable indicators of choice of investment (180). Particularly ' the existing data on the production and consumption of agricultural products produced on the private plots by collective farmers and others is not very reliable ' (50). The other problem for the value input-output tables is that different prices are used; e.g., some use actual consumer prices and others producer prices (49, pp. 220–9; 48, pp. 159–170; 92, pp. 65–69). The ' use of value input-output tables will only result in the compilation of consistent plans if prices in which the tables are compiled reflected relative consumer valuation ' (51).

III. FINANCIAL APPRAISALS

i. General

To avoid misallocation of their resources, entrepreneurs appraise ventures according to what they expend on factors of production and receive from the sale of products.

ii Inspection method

Two options may be ranked by inspection if they have identical cash flows except that one of the two continues to earn after the other's retirement. Inspection could be useful also if the only difference between otherwise two identical options is that at the end of every year the total net proceeds of one are at least as large as, and for at least one year larger than, that of the other.

Clear-cut choices as indicated above are rare. The problem of choice is complex in renewable-resource planning because of the numerous alternative possibilities of use. The vast heterogeneity of options, many of which are mutually exclusive, call for evaluation standards in order to minimise the decision-maker's perplexity owing to the diversity of choice.

iii. Rate of return

The entrepreneur's commonest criterion is the return on capital. This is defined as the expected profit after allowing for depreciation, but before tax, as a percentage of the investment. The options are ranked according to either the direct or the average rate of return. The former results from dividing the total proceeds over the economic life by the amount of outlay, the latter from dividing the average proceeds per year, i.e., the total proceeds divided by the number of years, by the outlay (16, pp. 18–25).

These methods ignore the timing of expenditure and returns; options with same *total* proceeds, initial outlays and economic lives are identically ranked even if the proceeds in one of them accrue earlier, which are worth more because of the greater reinvestment possibility. Since these methods measure the proceeds per unit of outlay, the difficulty arises about the definition of capital, more so in view of the recovery of capital expenditure through negative taxation on investment, and initial and depreciation allowances. This creates a special problem with standing crops, which are both stock and flow resources (179). The other difficulties are of putting one figure to the expected profit because it fluctuates over years, and of the misleading nature of actual depreciation for it differs from the depreciation defined for tax purposes.

iv. Net Annual Income

This method appraises projects on the basis of the annual surplus of receipts over expenses. The practice is to relate the annual revenue to annual expenditure (182, pp. 13-15) and the aim is to maximise the difference or, less critically but more often, the revenue. This implicitly assumes that an enterprise is

a going concern and that the cost of capital can be ignored. But comparison of forestry and agricultural options on these assumptions is invalid. This is because, while agriculture may yield the surplus every year in perpetuity, forestry will involve a long waiting period with no, or sporadic, intermediate revenue. A comparison between the two may, however, be made by reducing the yield of a large forest on an acre basis. But such comparison ignores the problem of the opportunity cost of the growing stock capital and its valuation (55).

This method gives a backward looking annual profit and loss account. It does not indicate choice among future options. Nor can it rank options which, unlike orchards or normal forests (136), involve intensification of operations or the use of an hitherto unexploited resource area (127). This method does not allow either for the timing of expenditure incurred to gain revenue at a later date from land development and other investments, or for depreciation or appreciation.

v. Payback Period

The Payback period is the length of time required to recover the outlay of a project, ignoring depreciation. A project with the shortest period is judged superior to others.

Options with the same payback period will be identically ranked by this method, even if an option yields additional proceeds after the period or more in an earlier year during the period, i.e., has extra reinvestment possibility. As such, this method ignores both the earning capacity of an option after the payoff period as well as the variations in the proceeds before the payback date. The question of the earning life is sometimes met by adding to the considerations the number of years over which profitability is expected to be maintained (4, p. 11). Apart from the difficulty of defining this when profitability is not constant, it means that the assessment of options would involve at least three parameters; viz., return on capital, payback period, and period of full profitability, with there being no precise method for balancing one against the other. Nevertheless, the method is of value for a preliminary appraisal of large capital projects with high risk component, such as in many overseas investments.

vi. Value-added

Value-added is the difference between the total value of the output of processes and the value of their inputs or materials (22, p. 34). For an enterprise, it is the revenue from sales minus expenditure on materials plus the value of any increase (or minus any decrease) in stocks during the period. Though used more for sectoral or large programme evaluations, this method is applicable to project appraisal too, e.g. the development of a region's renewable resources.

However, the value-added contribution may not appropriately rank options. It may be large merely because a project is immense in terms of total resources employed. Also, this method is inapplicable to peasant agriculture. This is because of non-monetization and the little exchange of goods with other industries, so that there is little ' value-added ' in the subsistence systems (32).

The recommended practice for value-added analysis is to ' exclude increases in natural resources due to growth, as in the case of forests and standing crops ' (177, p. 24). This is in spite of the advice to include ' changes in farm stocks such as grain and livestock ' (ibid. p. 29). Apart from such inconsistency, value-added is beset with the problem of unreliability of depreciation estimates (192, pp. 31-32). As such, it is used to measure the contribution to gross—and not the net—national-product, thereby masking the actual consequences of a project, i.e., of capital consumption. Likewise, while wages are a component of the value-added, allowance is not made for costs to other enterprises of the withdrawal of labour from alternative employment avenues. For these reasons, the benefits of a project may be overcounted. Further, this method too does not count the effect of the timing of consequences.

vii. Discounted Cash Flow

The discounted cash flow (DCF) technique reckons with the time dimension effect by weighting future costs and receipts, so as to render them equivalent to their present values and, therefore, directly additive.

DFC reduces to a single figure the considerations of return on capital, payback period, annual cash proceeds, economic life and the period of profitability of an option; with that figure being comparable with similar figures for other options. Ranking can thus be made commensurably from the magnitude of the present worth, which is the net present value (NPV) of the cash in- and out-flow streams during the course of an action.

The 'earliest known application of the principle of discounted cash flow' is Faustmann's (56) attempt at the valuation of land (103, pp. 5-16). Some advocate a development over DCF, i.e. to find a rate by which the discounted value of income is made equal to the accumulated cost values for the present year (28, pp. 232-40). This is the DCF rate, commonly termed as the internal rate of return (IRR) (75). Some (74, pp. 48-65) call the IRR as financial yield, arrived at by repetitive calculations with Faustmann's formula at different discount rates till it yields a zero 'land expectation value'. This is the same as Keynes' 'marginal efficiency of capital' (86, pp. 140 ff.).

DCF gets round the difficulty of interpreting what is meant by capital and profits. This is because it yields an unambiguous definition based on all the costs, present and future, and on all the expected earnings over the entire length of a project. The gross cash flow of a project is the sum of the return *of* capital, which includes allowances for depreciation and depletion, and of the return *on* capital, which includes interest on capital, rental payments, income taxes and profits.

Besides the internal rate of return, there are three main discounting methods, viz. DCF, NPV and the sinking fund return (123, pp. 115–122). If correctly used, all the three methods are numerically correct and would lead to the same investment decisions, but DCF is a preferable choice on 'operational and technical grounds' (ibid.). Discounting of the cash flow streams can be done by the discount factor formula which is $\frac{1}{(1{\cdot}0 + r)^n}$, where r stands for the interest rate and n the year of occurrence of the consequence from the beginning of the project.

It is clear from the above formula that the further off in the future a value lies, the less weight it carries in present decisions. This explains why projects with long payouts, such as slow tree crops as against quick yielding farming options, must show larger benefits, if their present worth is to count in decisions. The 'failure to grasp this point is one of the most persistent causes of misdirected investment' (8). Likewise, the higher the interest rate, the higher the premium on having cash in hand, today, so that one can take advantage of the high earning opportunity for capital.

IV. PARTIAL ANALYSES

i. General

Financial appraisals rank options according to money values of gains and losses. Such evaluation is not inappropriate if the investment objective is financial profitability, as is usually so for private enterprises. But private profitability is divorced from many effects of options which may hinder or help development. Agricultural 'production and the competitive exploitation of forest land offer dramatic illustrations of the fact that private productive activities may give rise to substantial social losses that are not reflected in entrepreneurial outlays' (85, p. 126). To counter such divergences, the following appraisal methods are advocated, which are oriented to social goals such as economic development.

ii. Incremental Output—Capital Ratio

Incremental output-capital ratio (IOCR) ranks options by the extra output produced from an additional unit of investment. It is synonymous with the capital-turnover criterion (142), advocated on the ground that if investment funds are limited, the wise policy is 'to undertake first those investments having a high value of annual product relative to the investment' (24).

This method ignores the time element, so that quick-maturing projects with a high IOCR in the short run may have a lower ratio than other options in the long run. Thus the ranking would crucially depend on the planning horizon, the selection of which is usually arbitrary (30).

IOCR considers no inputs other than capital, though they may significantly affect the mutual ranking of options. But the aim should not be to maximise output divided by a single kind of input. The special input must then be combined with such large quantities of other and supposedly free inputs that their marginal productivities fall to zero. If these other factors are in reality scarce 'there is certain to be economic waste' (54, p. 290). This criticism applies also to other partial criteria discussed below and to the variants of IOCR, such as the value added: capital and the employment: capital ratios (176, pp. 219–24), or the 'NDR per £100 capital' criterion employed for land use comparisons (130, p. 31).

iii. National Product Test and Social Marginal Productivity

The national product or consumption test (174, pp. 29–45) selects options of which the consequences on national income, valued at accounting prices, are the highest. The accounting prices are aimed to reflect the so-called 'intrinsic' values of factors and products (144). The social marginal productivity (SMP) (83) is the total contribution of the marginal unit of resources to national product. Since the rule is to 'equate SMP of capital in its various uses' (29), it chooses options with low capital: labour ratio.

Being expressed in terms of once-for-all effect on the national income, the national product or the SMP does not include the specific multiplier effect of investment on future income levels. Neither is concerned with the 'disposal' of final products upon which the future investment rate and, in turn, incomes are partly dependent. The maximisation of the national product or the SMP may not help development if consumption exceeds the GNP, because of the dilemma that 'more consumption today means less consumption tomorrow' (16, p. 107).

Further, the methodology for accounting prices is open to question (128) and the mere maximisation of the national product 'or even of output per head is not an adequate definition' (147, p. 174).

iv. Marginal per caput Reinvestment Quotient

The short-run increase in *per caput* consumption is antithetical to *per caput* output increase. This is because the rate of capital accumulation depends on the extent to which increases in output are not followed by increases in consumption. The 'marginal *per caput* reinvestment quotient' criterion (62) focuses on the goal of maximising output *per caput*. It chooses investment options with the highest productivity.

The quotient aims at the maximisation of the rate of savings and reinvestment. Taken to its logical conclusion, this is absurd, for 'a society which has a fantastically high rate of growth of income because it reinvests all resources above the subsistence minimum cannot be said to behave very sensibly' (170, p. 30). This is not a practical criterion for most developing countries like India, even if the growth rate is not high; it favours long-maturing and capital-intensive options while the country is deficient in capital. Such a strategy clashes with the real-world institutional and political constraints, which may be better met by appropriate fiscal and monetary measures to yield savings and more desirable income distribution. The quotient disfavours employment while unemployment is an urgent problem in countries like India.

In countries with a majority subsisting at low levels of consumption—further diluted by population growth—current consumption *per se* is of immediate concern. Moreover, at low consumption levels, especially of food, increased 'productive consumption' is a pre-requisite for increased output from human capital (127). This is because food and even 'play' indirectly contribute to output (13) and 'any increase in consumption that is strictly necessary to efficiency pays its own way and adds to, as much as it draws from, the national dividend.' (116, p. 530). The discrimination against options producing such 'consumption' goods as food or fuelwood, which the quotient does, is, therefore,

unwarranted in developing economies; there the supply of the so-called consumption goods is so deficient that it impairs productivity.

v. Employment and Balance-of-payments Effects

Employment effects are germane to policy considerations. But mere maximisation of employment may thwart the policy to provide gainful employment and desirable income distribution without jeopardising development. The ranking of options by labour absorption capacity even in labour surplus economies does not necessarily lead to maximisation of the addition to total output per unit of inputs. While labour use can be given its due weight in evaluation (101), employment is not the sole criterion. If two projects use similar doses of labour, their ranking involves other considerations too, i.e. other factor inputs and the product outputs. The criterion of extra number of men employed is not commensurate with the measurement units of other factors and products. This raises the difficulty of trading-off the employment effects with others.

It has been suggested to accord priority to projects which minimise a balance-of-payments deficit (142). But, equilibrium in the balance of payments ' is better regarded as a constraint than an objective ' (170, p. 40); this should apply to the employment-effects criterion too, both being beset with similar objections.

The policy of self-sufficiency in a commodity for the sake of conserving foreign exchange, while disregarding the comparative costs, may preclude investment from more gainful options. For this reason, the emphasis on some investments at the cost of agriculture in earlier Indian plans was misplaced (171). An efficient allocation of resources would eventually lead to a better balance than with projects chosen only for a short run balance-of-payments effect. An option which does not seem to affect directly the balance ultimately does so, such as through shortfall in exports of dependent or substitute products. The crux is to rank options for efficiency as components of the entire economic activity, and not in isolation—as is implicit in the maximisation of a particular single effect.

vi. Cost-effectiveness

Cost-effectiveness comparison is applicable, or the only possible method, when choice is restricted to close substitutes for performance of some goal which is considered essential, or when benefits defy quantification, e.g. in defence, research and development programmes.

Since the criterion is to minimize the cost of achieving a specified objective, it is useless for determining whether an objective is worth achieving and ' says nothing about whether the effort is in fact worthwhile. Similarly, the approach is of little assistance for analyzing changes in objectives ' (152). This is a serious defect, because of the joint-production of renewable resources and the multiplicity of goals in land use.

The renewable resource uses cannot be compared on a cost minimisation basis. This is because the various product units, such as a cubit foot of timber, a ton of grain and a 100 user-day recreation site, are incommensurate with each other and have different effects on economic development; one cost-effectiveness analysis is not comparable with another, unless some further calibration criterion is imposed. The technique fails to relate the cost of producing a commodity with the benefits from the production process. As such, it cannot rank options for their economic effects.

vii. Recoupment Period

The recoupment period, advocated by the Soviet Planning Commission, is the number of years over which the additional investment for a project with respect to the immediately less investment-intensive project is recouped by means of lower operating costs, including amortization (167). A project is selected for which period is closest to but lower than the prescribed ' standard ' recoupment period. The latter varies from 4 years for food and consumer goods to 10 years for power and steel sectors (58, 89, 90).

The Soviet investment rules (2, 64) have been used in other socialist countries too, with some modification in Poland (91) and Hungary (135). The modifications in Poland allow for the comparison of projects with different gestation periods, lifetime, and time pattern of costs and outputs (84).

The recoupment period criterion allows for a straight line amortization of a project's operating costs, by using normative coefficients of investment effectiveness fixed for the industry (167, p. 18). Additionally, a coefficient is used with which investment expenditures during the construction period are compounded at a rate equal to the average of the normative coefficients of different industries, i.e. 0.15. This makes comparable the investment expenditures at different dates during the construction period and allows for investment outlays not incurred at the beginning of a year. This is an improvement over criteria which ignore the analysis of project durability versus construction period. For instance, one may expect a combination of shorter durability and shorter construction period to be preferable in a fast growing economy (15).

Both the above coefficients are meant to induce firms to economize investments funds although granted free of charge from the state budget. This may not be fully realized because only the investment outlays during the gestation period are compounded, thereby leaving project ranking incommensurate with respect to later costs of yields, i.e. but for the determination of the shadow capital charge, the normative coefficient plus straight line depreciation, no compounding is taken into account. Also the different shadow rates in the various industries do not seem useful in so far as these rates are used to select the production technique of a given commodity, the output target for which is set from a deliberate strategy of sectoral priorities (c.f. I. iii and I. iv).

viii. Reformulated Recoupment Period

The recoupment period criterion has been reformulated in Czechoslovakia (163, 165), requiring synthetic indices for investment analyses. These are: (i) the ratio of the values of the yearly output of a project at world prices and converted into crowns at a shadow exchange rate, and at domestic wholesale prices, (ii) the ratio between the former value and the total investment outlay at domestic prices, (iii) productivity of the outlay expressed as a fraction of the discounted sum of gross profits after project completion divided by the number of years of operation,* (iv) the pay-off period over which the sum of undiscounted profits covers the total investment cost. These indices and two more for some projects, e.g. those requiring over 5 million crowns, are each designed to evaluate a particular aspect of an investment and ' the final judgment rests on the appraisal of all analytical indexes ' (166, p. 11). Their synthesis in practice may, however, involve subjectivity in decision-making because of the possible incompatibility among them.

There are other variants of the indices and recommendations on project evaluation from the viewpoint of international trade (164). Also recommended is ' a method for the evaluation of the economic effectiveness of investment on the basis of assessing the global development of the economy of the enterprise by calculating the internal rate of return ' (163, Sec. III). Besides the institution of competitions (*Konkurs*) ' to stimulate the interest of investors to projects and realize investments especially needed and efficient ' (165, p. 8), this is the first instance in the actual practice of socialist countries where the internal rate of return is used as a criterion. Another main difference between this and the original recoupment period criterion is that the pay-off period of the total instead of only the additional investment is considered. As such, while the original criterion discriminates among alternative techniques of achieving a given target, the reformulated criterion may discriminate among alternative targets.

The original criterion confines discounting to the additional investment outlays; the reformulated criterion introduces discounted cash flow methods to the whole process of investment choice. Such discounting through the project length reckons with the timing effects of options. Nevertheless, since the

* The discount rate used in 1967 was 12 per cent.

reformulated criterion chooses both the sector and the technique of production, the use of a unique discount rate may not reflect the sectoral priorities in the national plan. This difficulty is the obverse of that for the original criterion which chooses only the technical form of investment. In either case, inconsistency between the national priorities and options ranking is likely. The reformulated criterion may conflict with the maintenance of central control over resource allocation. This is because the criterion leads to the decentralization of investment decisions, which is considered unsuitable for a socialistic economy (23).

V. COST-BENEFIT ANALYSIS

i. General

The techniques discussed so far do not confront the problem of balancing the economic gains and losses of an investment option. The solution is to evaluate alternatives by comparing the relationships between the bundle of costs and of benefits, generated through different courses of action. Such evaluation is the aim of cost-benefit analysis.

ii. Scope and Application

Cost-benefit analysis was formally initiated in the United States. The Flood Control Act of 1936 required that benefits must exceed costs ' to whomsoever they may accrue ' for projects to be authorised. The ' green book ' issued in 1950 states the procedures for the economic analysis of river basins (172). Both the concept and the application of the cost-benefit analysis technique in developed countries has already been well reviewed (139, 143). While in the United States the emphasis continues on water resource development (7, 46, 76, 95, 118, 120, 160, 178), in the United Kingdom the technique has been used mostly for transport systems (14, 34, 52, 61, 125, 191). The other areas include public health (57, 187), urban development (102, 113), outdoor recreation (25, 33, 153), research and development (66, 67), and education (12, 19).

The use of the technique has been considered in France (42, 99, 100 pp. 130-153) where it has the longest recorded history (44), and has been associated with regional development and power projects (20, 43, 119). In the Netherlands, it has been used for appraising land reclamation projects in general and Zuider-Zee in particular (78, 181). The technique has been advocated in Canada particularly with reference to regional development and multiple land-use, including recreation (37, 155, 173). In Australia the ' benefit-cost approach to the analysis of public investment projects ' has been officially recommended (6) and used in town planning and settlement (132) and in plantations (98). Its application has been suggested for planning and evaluation in New Zealand too (185), and an attempt, though of limited scope, has been made for the analysis of land development (186). Land use comparisons by relating costs to receipts of options in a commensurable manner have been attempted also in the United Kingdom (130, 183), and in Nordic countries (169), e.g., Finland (68, 146), Sweden (140) and Norway (148). Examples of application to land use evaluation in Mediterranean countries exist, bringing out the need for considering the human factor (79, 189). In Israel, the analysis has been applied to investment in education with interesting results (87).

Cost-benefit analysis has remained restricted largely to developed countries or to international agencies operating in developing countries. One work directly addressed to the latter is for industrial project analysis (106). Among the developing countries, India is leading in the use of this technique, where it has been considered in the context of planned development (111). But, even there, apart from limited analyses of nuclear power (150), the family planning programme (26) and the television system (149), instances with renewable resources are confined to ' the " easy " case of water resources ' (38, p. 8). The Hirakud dam and the Bhakra dam projects were appraised when nearing completion; of these, the former's analysis is only partial, the dam being part of a larger project (161). An over-riding justification given for the Bhakra project, the largest investment during the first Five Year Plan, is that it gave

'hope and confidence to millions' (145, p. 125). Even assuming a predetermined choice of location and overall design, wide choice existed in the use of the product of investment, i.e., water, particularly its distribution among competing demands. This 'required some judgment as to their relative economic value, which did not occur' (114).

Another analysis is of the Sarda canal system done 30 years after project completion (159). The project effects are evaluated by comparing with the socio-economy of six villages outside the canal command, ignoring the initial differences. The results are overshadowed by the passage of time and events other than the project. The evaluation over the entire command is erroneous, because both the potential and the actually irrigated areas consistently fall short by 40 to 70 per cent of the irrigable potential and the command area respectively (ibid. p. 51). One more appraisal is of Tribeni canal, made 50 years after construction by comparing 'two areas similar in all respects except for the availability of irrigation in one and absence of it in the other' (80). But, other dissimilarities do exist. As against 9 per cent in the project area, in the control area only about 5 per cent of the cultivated land is irrigated by different types of irrigation (other than the canal) . . . Tube well irrigation has also been introduced in *some** parts' (ibid. 459-60). Among other deficiencies of such comparison, it ignores the spillovers of the project on the control, the two areas being adjacent.

A recent appraisal is a case study of minor irrigation, concluding that 'the input-output ratio is lower under canal than under minor sources . . . due not to higher outputs but to lower inputs' (124, p. 161). Based on 'actual irrigation charges' (ibid. p. 112) such comparison does not reflect the costs of providing irrigation. The cost is underestimated for the canal, its outlay being ignored while the 'own' human and animal labour used lavishly for minor irrigation is imputed at full wages (ibid. p. 75). The above appraisals followed the designing stage. Such *ex-post* analyses may throw light on the various aspects of the system. But little is served towards the choice of options that were not considered. The failure to make an *ex-ante* evaluation of alternative designs is likely to have led to an inefficient use of resources, including the water.

In Pakistan, the biggest project is for the water and land development of the Indus basin. An assumption made in its appraisal is that water is limiting and not land; the rationale 'for allocating irrigation supplies is . . . the quality of land' (190, p. 44). The priorities were 'assessed on the basis of technical considerations' (ibid. p. 66), e.g. 'no uncultivated land is scheduled for development' (ibid. p. 44). The problem was not considered as a whole, but only as a salinity and waterlogging problem warranting perennial irrigation and drainage. The relevance of complementary measures and sequential consequences apart, the analysis made no joint consideration of resource use, e.g. combinations of land and water development to test the premise that the economic quality of all technically inferior land was inferior in the overall context too. The analysis amounts to a comparison where the alternative is doing nothing. Besides maintaining the present use, other choices could have been intensive versus extensive irrigation, large scale, medium or minor irrigation; desalinisation for traditional agriculture or none for riparian crops such as neem. In effect, the opportunity cost of the strategy decided in advance was not appraised.

The Jengka Triangle appraisal in Malaysia 'concentrates on the return to capital' for 'the economic justification for developing the Triangle' (96, pp. 294-319). Since 'no investigation into the opportunity cost of capital . . . was done' (ibid. pp. 334-336], it is not ensured that the only primary crops of rubber and oil palm advocated are indeed justifiable. Some plead that the two are of 'proven performance.' Be that so, the lack of benefit-cost comparisons with options based on proved forest tree species is an omission. Instead, the 'logging plan' subserves the 'schedules of agricultural development' (ibid. p. 80).

In the above appraisal, there is little economic integration between land capability and land use possibility. The capability for various crops is ruled out *ab initio* 'on the grounds of steep terrain'

* Present author's italics.

and similar natural features (ibid. p. 98). Thus, many options on various land classes possible in conjunction with conservation techniques are not considered. The choice is anticipated and the scope to use resources alternatively for different mixes of crops and techniques is not effectively explored. Despite the aim to make ' optimum contribution to national development ' (ibid. p. 58), the analysis does not necessarily optimize resource use in the face of investment opportunities.

The evaluations undertaken for water resource systems in the United States generally take some alternatives into account (7). In so far as these are specified in advance with anticipated magnitudes and technologies, such appraisals too are classifiable as *ex-post*. The analyses are restricted to procedures by which to evaluate projects ' already proposed. To select from a known and restricted set of alternatives is far from maximizing ' (112).

iii. Limitations

According to ' traditional ' cost-benefit analysis, ' projects are evaluated exclusively on the basis of their effects upon national income ' (114). But renewable resource planning is concerned with the impact on development of alternative resource use patterns, and the reliance on national income effects by themselves is not useful; that would be tantamount to a financial analysis. The income effects *per se* are a poor measure because of four main reasons: the goods or services provided may not be marketed, e.g. recreation and peasant farm output; some gains or losses may accrue to third parties, e.g. in salmon fisheries a change in the type or extent of fishing at river mouths affects rod fishing upstream; factor and product prices may not reflect national gains and losses, e.g. market value of agricultural land is affected by subsidies; a proposed project may make such a large impact on a market that the ruling prices are affected. For these reasons it would be fruitful to widen the scope of traditional analyses by valuing costs and benefits of options in social terms.

A social cost-benefit would involve the valuation of the extra-market effects of an action. There are various methods of doing so, but none is satisfactory enough (158). The wrong estimation of costs and benefits, e.g. the valuation of land at $9 per acre in contrast to the actual value of $94 (31), is held against cost-benefit analysis. Faulty estimation arises from erroneous technical data and valuation. Extra-market effects, such as erosion control and amenity, are particularly prone to such faults. Therefore, it is argued that ' the use of benefit-cost data to justify investments may best be viewed as an *ex-post* rationalization of the ranking ' involving subjective preferences (36).

The inclusion of the spillover—and linkage-effects (77) of projects is in contrast to traditional economic theory of profit or utility maximising behaviour, which assumes that each individual will take into account only such effects of his decisions that he will realise. The incorporation of the external consequences in a social analysis raises problems of distinguishing between pecuniary and technological spill-overs (120). Rigorous analysis of data is required for attempting such distinctions so that purely transfer effects resulting from income, price and demand shifts are not counted. Some argue that the ' shadow prices ' required for analysis are difficult to come by and very costly to determine (121).

An unambiguous benefit-cost ranking of options does not deal with efficiency from society's point of view, ' which is a many-sided concept ' (137). Renewable resource planning must consider the distribution of gains between the present and the future generations as well as between the different groups of people. The problem of inter-temporal allocation of resources can be handled by discounting the consequences of options to their present value. But it is extremely complex to discover the appropriate social discount rate.

Another knotty problem in benefit-cost analysis is its inability to consider adequately the institutional and social preconditions and consequences associated with the implementation of different projects. As such the results of a social benefit-cost analysis have the limitation that they cannot directly lead to decisions, though it is usually implied that they can. The analysis is only ' a tool which can avoid huge losses and make planning rational ' (188) by bringing more and organised information to bear on decisions

and hence *aid* decision-making. The latter process will involve value judgements of the policy-makers and the weighting of the results by the redistributive and other institutional constraints. This aspect has received little attention in the past and is dealt with in the following section.

The other problems of a social benefit-cost analysis are the proper delineation of the bounds of different options, identification and quantification of consequences that affect the economy, and consistency in the evaluation and computation of the benefits and the costs. One need not assume that traditionally ' profitable ' ventures do not necessarily contribute to economic development. But in a social appraisal, this contribution would be evaluated explicitly by taking account of the costs that society as a whole bears, and benefits that accrue to it. A critical difficulty in this arises because of the problematic nature of some costs and benefits attributed to a project and of their measurement (45, p. 394). However, an effort to overcome the difficulties of a rigorous analysis is worth-while, because ' basing decisions on such analysis are likely to produce consequences superior to those that would result from purely random behaviour ' (94).

The analysis defeats its purpose if it is not done rigorously because it is amenable to distortion and abuse (97). Hence the objection that cost-benefit analysis is a formalization of existing prejudices (137) or a ' window-dressing ' of favoured projects (111, p. 2). It is on record that there is ' no truly independent investigation which supports the validity of the estimates of direct benefits made . . for any project in the United States ' (116). But this need not be specific to cost-benefit analysis. Instead, it justifies set benefit-cost analytical procedures for countering wilful distortions. Then the distortions could be ultimately discouraged, for although a government can exercise only limited control over its agencies, they would not be permitted to embarrass the government consistently or frequently (35). Governments may be prepared to undertake such rationalisation because they do frequently act in society's interests since the next election is far enough away (72). Even if the governmental standard is not ideally ' conceived through economic theory, it still serves a worthwhile purpose to restrain abuse of economic arguments in the political process ' (184).

iv. Objective function and Choice

The traditional benefit-cost analysis is a desirability test for the acceptance or rejection of projects, e.g. ' let projects be justified only if the benefit-cost ratio is well in excess of 1.0 ' (46, p. 101), or ' projects be chosen which show the highest benefit-cost ratio,' (154, p. 24). But this is inadequate for evaluating choice among options from the point of view of economic policy, because the latter includes objectives other than purely economic efficiency. An important objective of national policies besides economic growth is equitable income distribution for the sake of economic stability as well as for egalitarian reasons. Indeed, the subsidiary aims of the various policies, e.g. regional development and employment, are also aimed at the redistributional objective, which is itself often stated explicitly.

The benefits and costs should be synonymous with advantages and disadvantages. The advantages would be a weighted sum of allocative benefits and favourable equity effects, and the disadvantages would likewise include the unfavourable effects. In an objective function which incorporates all the advantages and disadvantages, the equity effects would be a ' subset of the " grand-efficiency " effects ' (188). The problem in instituting a ' grand-efficiency ' function is the lack of a commensurate valuation measure for efficiency and equity, or a rationale for trade-off between the two. A ' composite-objective function ' could be based on policy-makers' statements of ' willingness to sacrifice efficiency for redistribution ' (110, pp. 78-81). But such explicit statements are too much to expect, for they require an *ex-ante* efficiency valuation of distribution.

Nevertheless, decision-makers do ' sacrifice ' allocative efficiency for distribution. The acceptance of comparatively inefficient projects is not uncommon in developing countries, such as of ' traditional modes of production ' for Ghandian reasoning (17) or of the Indian nuclear projects for prestige or so-called spin-off benefits (150). In one American case, if the budget committed to 29 projects was allocated

efficiently, no project with a benefit-cost ratio less than 1.8 would have been chosen. Actually, 11 projects with lower ratios were selected to distribute expenditure among favoured regions (69). Maass (117) inserts an explicit redistribution value in project evaluation and Weisbrod (188) attempts the use of the trade-offs implicit in past decisions to infer the distributional weights actually applied.

The above weighting presumes that the projects undertaken are neither more nor less beneficial than the most profitable project not undertaken. Such deductions are inapplicable to normative analyses, also because the standards of distributional equity are changeable over time and variable among people at a given time. The weights are residually determined. But all deviations from efficiency may not have been for equity, because decisions are often motivated by considerations other than equity and efficiency. The past trade-off values are a bad guide, unless all the sacrifices of efficiency over ' a ' period of time are evaluated. The expenditure decisions should be considered *in toto*. This is operationally difficult because non-expenditure decisions which affect distribution, such as taxation, legislation and regional tariffs, should also be included.

Some advocate that only the preferences of ' decision-makers ' of the time are relevant and be used for successive elimination of options (82). But this may rule out options which, when considered jointly, would maximise an objective because of the interrelatedness of the components of a renewable resource system (10). This process involves ' decision-makers ' prior to the systems designing stage; hence the danger of using the analysis to justify pet projects.

While it is asserted that decision-makers can be made to reveal their preferences during the analysis (82), the practicality of repeatedly consulting *the* decision-makers is questionable. The elimination process would, in effect, involve the judgments of low-level decision-makers. Even if the goals of decision-makers at different hierarchical levels were identical, the quality of information received and of instructions provided at higher level deteriorates as the size of organisation increases. This implies an increased divergence between the decisions taken at lower levels and those sought at higher levels (175). Reliance on the preferences of low level decision-makers is likely to cause inconsistency in project analysis vis-a-vis developmental objectives.

The utility comparisons of project effects from the community's standpoint could avoid the subjectivity of present ' decision-makers.' But the utility maximisation approach is beset with the inability to map social preferences from individual preferences and because social utility is not represented by consumption or profits alone (151). Indeed, the need to discover trade-off values would not arise if social indifference maps could incorporate the social marginal rates of substitution between different objectives. Some say that ' one method of specifying the relative importance of objectives lies in explicitly weighting the contribution of projects to each ' (111, p. 23). This supposes the validity of the multipliers that may be used for different project effects. But the choice of the multiplier for, say, increase in income in one region as against another can only be subjective. Policymakers do not reveal their preferences quantitatively in these matters, and plan less ably in advance of information about the implications of alternative project designs and locations.

An impasse exists in defining an aggregate benefit-cost objective function from either the past or the present decisions. Nonetheless, the distributional aim may be catered for by combining benefit-cost analysis with an income-distribution constraint. The constraint can be imposed on the maximand such that the analysis becomes two-dimensional, without having to impute distributional weights. This approach is useful on the ground that welfare is not a sum of utilities and that, assuming the existing distribution as non-optimal, it is not the *necessary* conditions of Paretian optima but the '*sufficient* conditions for improvement that we really want ' (105, p. 138). Since the present renewable resource use-options are mutually exclusive with the rest, the initial choice is between status-quo and change. A change may be opted for if the associated conditions are sufficient to improve welfare, i.e., if the previous distribution remains unaltered except for ' proportionate ' increases in the incomes. However, despite satisfying the sufficient conditions, it may not be necessarily welfare maximizing. In that context

the theoretical optimum may not be attained, i.e. when none can reach a higher point without causing someone to drop to a lower one.* But since maximum welfare and 'ideal' distribution are ethical concepts, the trade-off of efficiency for these purposes can be effected through policy makers' value judgments.

Nonetheless, a value judgment is still required. This can be defended; making no value judgment is tantamount to making it 'not only in the sense that one is saying that one ought to abstain from making value judgments, but also in the sense that the results obtained are those that would result from glorifying the present distribution' (59). The crux is at what stage to apply the judgment and whose preferences are to count. The above procedure defers the judgments till after options appraisal is made. Further, it is the policy-maker whose preferences count, because society authorizes him to express himself on its behalf. It is practically possible to draw on the policy-maker's judgment by presenting him with a final set of alternative designs. Such trade-off does not involve subjectivity in benefit-cost analysis in so far as the alternative designs with dissimilar equity effects are arrived at objectively. Decision-making becomes explicit when confronted with different effects of alternatives quantitatively.

It is difficult to make assumptions about the relative importance of a marginal unit of benefit or cost to different people in advance of appraising the range of effects of an investment and their individual magnitudes. It is, therefore, unhelpful to sacrifice objectivity in appraisal or to distort results prior to overviewing them. As such, the above approach is useful, especially if it is possible to compensate losers such that production following an action would be 'welfare-creating' (138). It enables the separation of the production aspects of economic policy from their redistributional by-products, and the desired alterations in distribution can be effected independently of a 'resource-using project' (71). A desired distribution could be effected through fiscal and institutional measures.

By taking the *ex-ante* distribution as the datum and appraising the significance of marginal changes, the analysis acquires the intended normative status. It is no longer crucial that there will be no conditions which 'are sufficient for an increase in welfare without also being necessary for a welfare maximum' (104). This is because one need not claim to have necessarily struck the theoretical optimum; instead one ensures planners' practical choice of improvement over the present production pattern, with 'improvement' as defined by a concensus of the electorate. Nor does the non-existence of a second-best solution 'mean that if an additional constraint is imposed on the welfare function there is no actual relative maximum' (94). The plea for the redistributive measures is tenable also because 'it does not follow that abstention from intervention would permit the economy to remain closer to the constrained maximum' (ibid).

The conflict between efficiency and welfare, through the distribution of total income among individuals of different preferences and the resultant effects on the constellation of prices, is minimal in renewable resource systems. Some (95 pp. 49-51) observe that its 'practical significance will be negligible' for water resource systems, which they therefore deal with on an efficiency basis. Water resource systems involve heavier and more concentrated outlays than the other extensive renewable resource systems covering fairly homogeneously an entire economic region. The cumulative effects of developmental expenditure for these systems are more unlikely, because incremental expenditures are incurred in new areas and do not equally benefit those favoured elsewhere or earlier. Additionally, the pattern and intensity of an optimum resource use in each neighbourhood is somewhat similar, being conditioned by climatic and physiographic features, so that the impact on the members of a community would be generally in the same direction.

* Maximisation of welfare and its implication of an ideal distribution, could at best be defined only in a state where economists, or other subjects, never question the value judgments of their rulers (105, p.120). In application, the Paretian optimum, 'rests on an extremely shaky foundation of ethical propositions' (21). That distribution A is superior to B, if none feels worse off in it than in B and if at least one person feels better off, can be restated in terms that distribution A is superior to B if one or more persons prefer it and none prefers B, because 'better off' or 'worse off' 'are measured of course by preferences' (ibid.). The succeeding statement then indicates the real-world welfare-increasing schema. This is valid on the assumption that the electorate convey their preferences to the government that they vote for.

v. Decision-making

Politics influence resource allocation. Social investment decisions, in practice, have to consider the multifarious issues facing a society, so that economic objectivity alone is not the basis. Social choices are group choices for which there is ultimately no correct preference function, i.e., ' choices whose preferredness cannot be subject to any ultimate test ' (121).

Decisions may diverge from the results of cost-benefit analysis for reasons which are valid from the politician's viewpoint. For instance, in developing countries, food ' has not only economic but also political implications ' (109). If a land-use project yields a high benefit-cost ratio but may lead to immediate starvation in an area, it will be unacceptable—more so in a democracy, in which, it is argued, that the government has a single motive—i.e., ' to maximise the length of its tenure in office ' (39). The divergence could be greater in large federal states. In Australia, ' development investment decisions are made on an *ad hoc* basis largely from the political utility of the decision ' (122). The position is similar in India, where highly redistributional transfers are effected through grants and centrally sponsored schemes (73).

Practical decision-making has to cater for the opinion of pressure groups, and some argue that the attitude of the ' soft states ' of South Asia is a bottleneck to development (128). But ' rational behaviour is made of actions consistent with objectives, whatever they are ' (11). Cost-benefit analysis can assist in reaching rational decisions by making explicit the economic gains and losses associated with an investment. It is, however, unable to bring out the full implications of a decision. For this it needs to be developed further. The ' work of extending the methods of benefit-cost analysis and of criticising and appraising these extensions has only just begun ' (38). Though the avenues for improvement exist, it seems unlikely that cost-benefit analysis may replace the role of the policy-maker.

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APPENDIX 7

FOOD INVESTMENT IN INDIA'S HUMAN CAPITAL WITH SPECIAL REFERENCE TO KASHMIR

By

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APPENDIX 8

PRICES FOR SOCIO-ECONOMIC EVALUATION WITH SPECIAL REFERENCE TO KASHMIR'S RENEWABLE RESOURCES.

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Prices which reflect gains and losses in the economy are required for socio-economic evaluations. They are distinct from prices for appraisals from the viewpoint of an enterprise, or for an ad hoc pricing policy. The prices should be applicable to ex-ante systems designing so as to facilitate investment planning, i.e., the prices should be identifiable prior to the formulation of a plan for an area of the economy, on the basis of the economy's overall structure. This paper attempts a social pricing schema, using Kashmir's renewable resource sector** as an illustration.

1. Exchange Ratio.

No particular price is sacrosanct. For options appraisal, it need not be the market or the so-called intrinsic value price. What is important is that the ratio of prices of various goods and services should not be distorted. The marginal exchange ratios or rates of substitution among items - inputs to either production or consumption - may be regarded as ratios of prices. Once these ratios are 'correct', resource allocation will follow the pattern of relative values in the economy of the various commodities, no matter what the absolute magnitude of prices be. Since it is important that prices of different commodities should not be

*J.J. MacGregor, Fellow, St. Cross College and University Forest Economist went through portions of the draft paper. Discussions with other Oxford economists, I.M.D.Little, M.F.G.Scott and B.G.Jackson were useful. The author is grateful to them but he alone is responsible for the views in the paper derived from his research at Oxford during 1967-1969.

**This includes those natural resources which are renewable through use over time, viz., forests, soil, biotic and water resources.(Muthoo, 1970).

out of step with each other, the crux is to have prices which reflect the probable exchange ratios from social view-point, i.e., social opportunity costs. For this we need a common societal reference point, say foreign exchange, from which the exchange ratios of different commodities are calibrated commensurately.

2. Market Prices.

Prices used to exchange commodities freely are the market prices. These prices arise from the competition for limited resources and indicate the markets' response to difference between supply and demand.* Ideally, market exists as the clearing house such that supply and demand stay in a continuous balance through instantaneous price changes. This is possible when the cost of changing prices is negligible, transactions are numerous for buyers and sellers to remain in communication, and losses from failing to effect a transaction are high. Such assumptions rarely hold in practice; suffice it to quote that because Northern Railways' price offer was considered unsatisfactory, sales of Kashmir timber were withheld in 1966 with no apparent loss as timber stocks standing in the forests continued to grow and appreciate till 'better' prices were negotiated. A continual adjustment is highly inefficient and difficult in multiproduct organisations like renewable resource systems or when inventory costs are high such

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*If a resource is so abundant that 'demand' is satisfied without giving rise to competition, no market prices exist; it is not an economic resource because it has no market demand, such as air or water in cycle. This logic, however, does not apply to unskilled labour in developing countries; it has a price in spite of its abundance. A reason is the institutional framework governing the use of labour - slavery and forced labour having been abolished. The wage formation process in markets characterised by surplus labour is explicable also because, through better diet and improved attitude at higher wage, each man-hour will contain more work hour units and over a certain range this increase in productivity is greater than the wage itself (Moes and Bottomley,1968). Therefore, employers hire labour not at the lowest (or zero) wage at which a quantitatively sufficient supply should be available but at wages which minimize the cost of the work unit.

as for the timber cruising. Frequent price changes exceed managerial capacity so that relatively easier action is taken as a substitute. Instead of increasing prices or production, excess demand may be met by reducing inventories, e.g., overfelling a forest instead of extending the management. Other responses may include rationing, planned delays in meeting orders or in fulfilling targets of consuming sectors, and the cancelling of some orders, so that, in effect, the demand is contained rather than equilibrated.

Price changes may not result from shifts in demand and supply in the economy, but for reasons specific to an industry. Firms may reduce prices to boost sales so as to utilize excess capacity, which may have been built for reasons unrelated with market demand. Conversely, prices may be increased to keep production at optimal level instead of resorting to less profitable higher operating capacity or to capacity expansion. Market pricing is influenced by uncertainty. Even in a 'competitive' case, a producer does not know whether others will adopt the same price changes. Since one is not fully conversant with the demand curve, one cannot be certain of the response of sales to the price change. Customers may pay higher prices because of the inability to establish new supply connections. Adjustments through supply and demand changes are impossible if producers and customers are bound by agreements and contracts, i.e., the market prices reflect the conditions prevailing previously. This is common in the renewable resource sector. Fruit orchards and timber are auctioned for periods ranging up to ten years or more. Agricultural crops are tied in advance to intermediaries or sold before harvest without knowledge of market at harvest time. Indeed

> 'the continuous-clearing case, where production equals supply and supply equals demand, is probably an exception. Disequilibrium is the more common situation.' (Eckstein and Fromm, 1968).

Besides the intrinsic unreliability of the laissez faire and the imperfections, market prices are unreliable because of the rampant under employment of some resources, such as labour and the excess demand for others such as capital, in most of the developing countries. Divergence between prevalent prices and the relative social value or scarcity of factors and products is highly likely in mixed economies like Kashmir's. This is so in the largely private agricultural sub-section because of ignorance of investment opportunities, poor marketing, relative immobility of resources, usurious credit, and material input and commodity trade monopsony. The problem is accentuated by state monopolies, e.g., in forestry subsector, and by state trading, commodity and input rationing, e.g., of food grains and fertilizers. Distortions arise from interference with demand and prices, which function artificially in a regulatory framework ranging from price and exchange controls, investment licensing, subsidies, selective import quotas, trade zones and preferential protection to prohibition and land holding legislation. Chronic shortage of savings, deficit financing, inflation, recurrent recession, over valuation and devaluation are too common a spectacle to enthuse confidence in ruling prices.

McKean (1968) argues for market prices because 'markets provide an enormous amount of information at relatively low cost.' His statement that 'the system of markets is a fantastic information generating device' is not untrue. But there is little merit to market prices if they are inaccurate. It may not be possible to institute prices which embody perfection without considerable expense that the market system obviates. But that does not imply that market prices are reliable. They bear no explicit consideration of externalities, linkage-effects and the future configuration of prices contingent upon the effect of an investment upon demand and supply. Brownlee (1961) estimates that 95 per cent of public expenditure in the United States has public goods effects for which no market prices exist. If the

costs of providing such goods - recreation, pollution control, relief from congestion - are not evaluated, allocation of large sums may be misdirected. Imputation of prices is particularly essential in developing countries where, besides the non-marketable public goods, market prices are non-existent in the sizeable non-monetized sector. Even in the monetized sector, market prices fail to reflect the relative scarcity value of resources, being subject to institutional constraints, e.g., minimum wages instituted in the face of involuntarily unemployed labourers willing to offer themselves for work at lower wages. The distorted signalling by the market mechanism and the lack of market prices for many commodities go against relying on them for social opportunity cost pricing.

3. Shadow Prices.

The frequently advocated method to circumvent the difficulties of free market prices is to impute shadow or accounting prices. These prices are implicit in exchanges that 'ought' to be made to maximise one's objective function or to minimize a cost function. They comprise 'a set of equilibrium prices associated with an efficient allocation. In equilibrium, the price of a factor is equal to the value of its marginal productivity' (Qayum, 1960, p.15). The total value of the commodities produced equals the total value of the factors at the equilibrium price. The so-called efficiency pricing assumes equilibrium and perfect competition, a closed economy in which foreign markets and prices have no relevance, optimal technology yielding the maximum output, correspondence between physical quantities and relative prices, absence of linkages and externalities. The accounting prices are not amenable to practical use by systems designers, being both the solution and the reference point in the matrix of the problem.

The assumptions of the equilibrium and perfect competition are unrealistic because of the structural disequilibrium and chronic maladjustment in factor use in developing economics.

Planning is not a panacea for the current imperfections and disequilibria, as is implicit in the logic of accounting prices. Macroplans, let alone sectoral plans, like the one for Kashmir's renewable resources, cannot be formulated reliably on the basis of equilibrium prices because they are not a constant and definite magnitude; they are dependent on the choice of techniques, levels of outputs of different sectors, final demand and availability of resources over time.

Accounting prices do not reflect the opportunities of trade because final products are priced from the value of factors in a certain 'efficient' allocation. The latter is one which leads to an output of final commodities such that no other allocation can result in an increase in any one commodity without causing reduction in any other commodity's quantity.* This is contingent upon a technology which produces the maximum volume of output in relation to the pattern of final demand and resource availability in a region, which is thus treated as an independent unit.

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* A feasible allocation is efficient if

$$\sum_{j=1}^{n} a_{ij} X_j \leq V_i \quad \ldots\ldots\ldots\

Valued at accounting practices, the net revenue of each activity or commodity will be imputed back completely to factors absorbed. (c.f. footnote on Page 6). The assumption is that prices of final commodities are given. In ex-ante systems designing, this is an unhelpful assumption; the merit of producing different commodities depends upon the relative proportion and price of factors absorbed in the different production processes. Further, a 'feasible efficient allocation' in a system may lead to imputation of factor prices that diverge from their relative exchange values in the economy as a whole. This is because there can be a number of efficient allocations corresponding a given set of amounts of resources and technological possibilities of production. Thus accounting prices will only be relevant to the extent the alternative commodity flows and technologies have been considered.

All alternative possibilities in the economy are difficult to consider and impossible for the system-designer to discover. The difficulty also exists that the prices derived are no more appropriate than the assumed preference functions and technological relationships that underlie them. For entire economies it is almost impossible to conceive of complete and appropriate preference and production functions. The role that is assigned to shadow prices can hardly be fulfilled by them; one need only to consider that the 'efficient' allocation to marginal productivity is not the sole preoccupation in resource allocation from social view point (Peacock and Wiseman, 1968). McKean (1968) concludes that the

> 'shadow prices from a pretend-economy have a good chance of being no more relevant than shadow prices from the economy on Mars'.

As G. Myrdal (1968, p.2038) says, the accounting prices, particularly in countries like India, are utterly unreal in concept and 'cannot be definitely ascertained.' The practical problem is that they are based on 'circular reasoning',

i.e., they depend on preference functions and policy measures rather than being guides to policy. They are inapplicable in practice, because they hypothesize equilibrium which does not exist. From footnote on page 6, it is obvious that the accounting prices for factors which cannot be fully utilized are zero.* Thus it is theoretically possible to have the accounting price of unskilled labour 'as equal to zero in a good number of cases' (Tinbergen, 1958, p.86). But making wages equal to such so-called intrinsic value is practically impossible.

4. SOCIAL PRICING OF TRADED COMMODITIES.

One way out of the dilemma posed in the foregoing, i.e., of relying either on the market or the shadow prices, would be to banish the prices. Price system could be replaced by physical planning like the material balancing approach, whereby producers aim at producing the quantities of goods required by consumers. This may involve shortages or waste, giving rise to inconsistency of plans (Ellman, 1969). That apart, how in the absence of prices can one determine what the consumers require, for demand depends on prices? Nor can the production targets be fixed to the society's best advantage for making the most beneficial use of national resources when one does not know what the various commodities cost.

Prices are useful for rationing society's output and necessary for ensuring a resource allocation by which the social sacrifice involved in alternative investment possibilities is related with the benefits to society. Resource allocation should consider the comparative advantage of a country so that investments are made according to a country's effective factor proportions vis-a-vis its trading partners. Prices for options appraisal should ensure the exploitation of the potential advantages of trade open to a country. Besides other reasons discussed below, since prices should reflect whether a country ought to domestically produce or import a commodity, we propose marginal export revenue and

*If 'there is surplus labour even under optimal allocation, the marginal return to an additional unit of labour must be zero .. (and) the shadow price .. must .. be zero' (Sen, 1968, xxi).

marginal import cost per unit of a traded commodity as the appropriate prices.

The above price may be referred to as the 'world price.'* The word 'marginal' signifies that we ought to consider the effect of additional exports or imports on prices. If that is negligible, the average c.i.f. and f.o.b. prices recorded in national trade statistics are respectively applicable to imported and exported goods. The export subsidies or import duties and purchase taxes are not to be incorporated in these prices. That would defeat the purpose of using world prices, i.e., to overcome the domestic distortions in the price system. By excluding tariffs and taxes, we will be able to rank investments for their actual foreign exchange effects. Such ranking will not substantiate the perpetuation of policies that may be wrong, e.g. no longer will the benefits be exaggerated or costs underestimated because of a low domestic tariff. The latter may encourage the importation of a commodity with high foreign exchange cost to society. The high cost is masked because the consuming industry apparently pays less than for a high tariff substitute commodity, the foreign exchange cost of which may in fact be less.

Measured in foreign exchange, the world prices provide a common reference point for such valuation of goods that represents the actual terms on which a country is able to import or export, i.e., the terms at which society foregoes the services of goods exported or procures the services of goods imported. It directly

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*An earliest recorded attempt to use world prices is the valuation of wheat by the International Institute for Land Reclamation (1960). However, it entailed a faulty use of the concept because the logic was only confined to the valuation of the output. One similar view for using world prices was put forward at the International Economic Conference in Bulgaria in 1964 (Kaser,1968). Nevertheless, it was not rationalised. Recently, Little and Mirrlees (1969) advocate world prices for traded goods in the evaluation of industrial projects in developing countries.

measures the actual sacrifice involved in either case. World prices circumvent the choice between the devil and the deep sea (c.f. sections 2 and 3). Unlike the shadow prices, they are real prices at which society imports or exports. Their use does not assume equilibrium and allows for the realistic consideration of an economy as open. Unlike the market prices, they are not influenced by the distortions in the country's economic system. They are prices that society would pay or receive, no matter what the governmental regulatory framework, the distribution of economic power or the criteria for resource allocation in different sectors and regions,

The choice of world prices is appropriate when the use of resources anywhere in the country is to be considered from the viewpoint of society as a whole. The use or production of a commodity in which the nation is deficient and is imported, will be evaluated at c.i.f. or import (foreign exchange) cost. The reverse is true for a nationally exported commodity, for which the f.o.b. price is applicable. Such rationale applies even if the region which uses or produces the commodity has a local surplus or deficit respectively. The logic is that the use or production of a nationally imported commodity in any region involves increased (foreign exchange) cost or saving, for the country as a whole. This is equivalent to the import value of the commodity used or produced. Conversely the use or production of a nationally exported commodity involves a proportionate loss or addition of foreign exchange resource to the country at a price at which the commodity is exported.

The use of world prices to reflect the social desirability of using or producing a commodity can be made to allow for the comparative advantage or disadvantage of doing so in the different regions of a country. This is achieved by adding to the c.i.f. costs of nationally imported commodities the costs (measured in foreign exchange) of transport and handling from the port to the

region using or producing the commodity. Similarly, the transport costs would be subtracted from the f.o.b. value of a nationally exported commodity. Consider wheat, which is a commodity imported into India. The gain to the nation from its production in Kashmir is equal to the foreign exchange that would have been spent on its import and the cost that society would incur in transporting it from Bombay port to Kashmir. On the other hand, society only saves the import cost for the wheat produced in Bombay. If Bombay produces an export commodity, the nation saves all the foreign exchange equal to its f.o.b. value. But proeucing the same commodity in Kashmir would earn the nation the f.o.b. value less the foreign exchange equivalent of factors used for handling the transporting from Kashmir to Bombay. Such use of the world pricing mechanism links the investment activities in any region with national economy as well as gives credit for the comparative advantage of location of different regions in the national context.

In ex-ante systems designing, one does not know in advance whether the optimal quantity produced would be insufficient, more than or equal to the demand in a region. Is it the f.o.b. or the c.i.f. prices that are appropriate especially if the anticipated demand is likely to be just about balanced? A region is a part of the country and the world prices are based on the trading opportunities of the country as a whole. The position of the country as an importer or an exporter of a particular commodity is usually known. Sometimes the level of output may be precariously balanced so that adjustment in production in a region may shift the country from an importer to exporter or vice versa. No such difficulty arises for commodities possible of production from the renewable resource base of Kashmir, treated as a region of India; no shift in the national deficiency, surplus or self-sufficiency of the different commodities is likely from adjustments in Kashmir's renewable resource sector.

World prices need to be adjusted for option's evaluation if the increased or decreased production is likely to influence these prices. The marginal changes in the levels of outputs have to be evaluated by correspondingly different foreign exchange values per unit of a commodity. This would apply to commodities, like tea, jute, cocoa, coffee, sugar and rubber, whose world demand is relatively inelastic or may become saturated through increased production. It also applies if the country has monopoly in a commodity's world trade, so that reduced production and supply may force up the prices. None of the commodities that can be produced in Kashmir fall within such categories. Further, the quantities that can be produced from Kashmir's renewable resource base, even if production is pushed to extreme specialisation, are an insignificant proportion of both India's and, especially, the world demand and supply. As such, the various options of using Kashmir's renewable resources are unlikely to alter the world prices.

Should the world price of a commodity produced or imported in a region be adjusted by the transport cost* to or from the port even if it is not actually exported to or imported from a foreign country? A commodity, if surplus may be supplied to another region to meet the latter's deficit. Conversely, it may be procured from a neighbouring surplus region to fulfil the local demand. In most cases the social cost of transport from or to the nearest port has to be added to or subtracted from the relevant world price to appropriately reflect the opportunity cost of the import or the social benefit of export or import substitution.

Consider a commodity say fertilizers, of which the country is a net importer but Kashmir region receives its supplies from

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*Implies the domestic transport cost including handling expenditure expressed in foreign exchange equivalent.

the neighbouring Punjab. The cost of transport to Kashmir is only that for the haulage from Punjab. But, since the consequent deficit in Punjab may have to be met by import from abroad, the transport cost to society for the tonnage supplied to Kashmir is a total of the costs from Punjab to Kashmir and from the port, say Bombay, to Punjab. Cost-wise, every ton consumed in Kashmir is transported from Bombay. Suppose there is no deficit in Punjab as a result of the supply to Kashmir, yet the deficit may exist in another region, say Rajasthan, as long as India remains a net importer. Punjab could supply to Rajasthan instead of Kashmir. Then the latter would have to transport direct from Bombay. Alternatively, Punjab may continue supplying to Kashmir and Rajasthan would have to import from abroad. In effect, import involves society to expend social costs of domestic transport about equal to those from the nearest port to the deficit region.* The same logic applies when the country is a net exporter and a surplus commodity from the region is transported to another region. It is only when the country is self sufficient that the transport cost should be taken equal to actual social cost from the surplus to the deficit region, because routing via the port may be unnecessary.

A straightforward substraction of world prices by the cost of transport to port does not reflect the social value of a commodity produced in a surplus region while the country is a net importer. Take the above example of Punjab. To ensure consistent valuation, the social price of fertilizers produced in

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*This assumes that inter-regional flows operate in an optimal manner. That may not always be true owing to middirected roundabout or backward and forward flows. Then costs based on the shortest route from the nearest port to the region may be an underestimate and necessary increase in the cost to society may have to be reflected.

Punjab is that in Kashmir, which receives the supply, less the cost of transport from Punjab to Kashmir. The same would hold good if Punjab supplied to Rajasthan and Kashmir received the imports from abroad. The value in the producing region is the c.i.f. price plus transport cost to the furthest region from the port to which imports penetrate less the cost between that and the producing region. The reverse would be true for a deficit region if the country as a whole is a net exporter.

The above example illustrates the need to reformulate for the actual circumstances the general principle of adding cost of transport to and subtracting it from the world prices. Such like complications are few for Kashmir, being the furthest region of India; there the prices of imported and locally produced commodities, including the transport costs, should be identical. Nevertheless, the timber produced in Kashmir and supplied to Punjab is one of the exceptions. It has to be treated unlike the reformulation cited above, though fertilizers and timber are analogous in being nationally deficient commodities. Here the world price has to be added to by the transport cost from port to Punjab, which is not the furthest point of import, and then subtracted by the transport cost from Kashmir to Punjab. This reflects the value of timber in Kashmir used in Punjab, which is the nearest outlet for Kashmir's surplus. This is because an alternative to meet Punjab's demand is direct imports; society benefits in value equivalent to the c.i.f. cost plus the social cost of transport from port to Punjab, both of which are saved, less the social cost incurred on transporting from Kashmir to Punjab. The valuation of apples and other items supplied from Kashmir to Punjab and other regions need to be dealt with similarly, in each case taking account of alternatives foregone or opportunities created.

5. SOCIAL PRICING OF LABOUR.

Labour is not a homogeneous resource. The main kinds are the skilled, semiskilled and unskilled. The last name includes wage and non-wage labour. The latter are the self employed,

subsistence agriculture workers, livestock herdsmen and communal plantation workers. They are the peasants of Kashmir, i.e., family producers working the land and livestock for producing food crops laregly for internal use. The peasant community is not exposed to intensive commerce. Its labour arrangements are the use of household work force and exchange of working days among families.

The peasant labour use may appear to cause no gain or loss to society and a zero shadow wage may appear appropriate, because peasant households consume what they produce. Such reasoning assumes a static situation with peasant system left to itself.* Ceteris paribus, the zero valuation of the peasant labour will disproportionately disfavour commercial production; labour for the latter would be valued at non-zero price because society would sacrifice something by paying wages to draw labour into exchange economy. Such outcome conflicts with the course of development, which includes the transformation of traditional agriculture (Schultz, 1964). The static state concept defeats the object of planning, i.e., an improvement in resource use both in the peasant system and the rest of the renewable resource sector. Subsistence agriculture must 'be taken into account, planned for and rationalised...since it will continue as a necessar part of the economy for decades' (Pearse, 1969). Transition to higher subsistence level and commercial agriculture needs consideration. Apart from various non-traditional inputs, changes in labour use pattern are required for the transition. These considerations warrant a comparative evaluation of options in the peasant sector among themselves and with those in the rest of the rural economy. For that, the costs of the traditional and

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*A corollary is that the peasant system is outside the mainstream of the economy. But one could argue that this system is the mainstream and rest of the sectors are the periphery.

other inputs and the benefits to society of the process of transformation need to be imputed.

In the evaluation of a land development project in Malaysia,

> 'the opportunity cost of settler's labour has been assumed to be zero in that production in the rural areas is unlikely to be affected by their transfer.' (Lembaga, 1967, pp.294-319).

The zero opportunity cost in labour surplus economies results from the efficiency allocation concept (c.f. footnote on Page 6), because the accounting prices are zero for factors which can not be fully utilized. Such mathematics, resting on the assumptions of equilibrium and zero marginal productivity of the surplus labour, is often rationalised by the argument of the saving potential of disguised unemployment or underemployment pool.* But, to effect the use of the surplus labour, those left behind in the rural sector have to work harder and/or longer to maintain the previous output level (Sen, 1968 p. 5). For that, among other things, they need increased food input. Leakages in the potential occur through the ties of the departed worker with his family and through his higher (urban) consumption. These and other conceptual problems, discussed by Muthoo (1969, pp. 432-434), make it difficult to realise the theoretical potential.

The practice to impute to peasant workers the wages paid in the monetized sector is no less implausible than the zero shadow wage valuation. For instance, Misra (1968, p.178) works out labour wages for those employed on exchange or on kind 'on the basis of current daily rate of wages for labour hired on cash payment.' Such imputation ignores the existence of economic and

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*This is apart from the difficulty in empirically testing the degree of underemployment or the non-positive marginal productivity of labour in farm sector. While Pepelasis and Yotopoulous (1962) for Greece and Schultz (1964, p.67) for India conclude that it is a false doctrine that some farm labour has a zero marginal product, Sen (1967) argues that Schultz's results cannot be authenticated.

technological dualism (Higgins, 1959, p. 325-333) and the distinction between the subsistence and organised sectors. The output per head in the former sector, with possibly 'zero or even negative' marginal product (Nurkse, 1957), is lower than in the market-oriented sector, where the marginal product is higher though not necessarily equal to or greater than the wage (Lewis, 1954). Apart from the psychological and displacement costs, the real cost of living is usually higher in the organised sector than in peasant holdings. Importantly, wages are institutionally determined and are not a reliable benchmark for valuing labour.

Unskilled labour includes workers who contribute to the economy mainly through the use of their physical energy. Some 'specialisation' in the use of the physical labour may take place; some are more adept than others on particular jobs, such as women in Kashmir who weed the paddy fields while men harness the bullock-power. Such 'specialisation' exists largely because of custom rather than from any special training. Semiskilled workers combine physical force with experience which involves a small degree of specialisation in the application of labour. Unskilled workers, on the other hand, are available for diverse jobs. They switch from one kind of work to another according to seasonal demand, e.g., logging in winter; sowing and planting in spring; earth movement, range use and silk cocoon rearing in summer; and crop harvesting in autumn. They are in abundant supply in slack winter and summer seasons though the possibility to move from one job to another in the renewable resource sector considerably harmonizes the demand fluctuations in Kashmir.

The work of semi-skilled labourers involves limited apprenticeship and their crafts are generally handed down in lineage, so that there is an absolute addition to their numbers even if all the offspring do not stay in family occupations. There is a net expansion in the supply of these workers also because

of the inducement of higher income and more secure job opportunities. Such incentives draw labour for these occupations from the unskilled categories. Though construction and other development works have resulted in increased demand for them, no shortage in the supply of semiskilled workers has arisen as testified by their migration, especially seasonal, to the neighbouring Jammu, Punjab, Maryana and Delhi regions. Considered separately as well as jointly, the unskilled and semiskilled potential work-force is increasing faster than demand because of net population growth. The trend in the labour supply is projected to continue (Mehra 1967), so that non-skilled labour resource is unlikely to take on scarcity value, both the relative and absolute levels of unemployment being on the increase (Tilak, 1965).

Instead of the zero shadow wage rate of the accounting price schema, we attribute positive cost of using labour to reflect approximately the import content value of the goods and services given up by society for its effective employment.* Nevertheless, the cost of a labour unit is different for options according to whether wage or non-wage labour is used. For the latter class, only the extra consumption represents the social cost, because the consumption at current subsistence level occurs even if the peasant or his dependants are not engaged in work that could contribute to the economy. There is no practicable alternative to the subsistence consumption; the opportunity cost of this part of a potential non-wage worker's consumption is nil.

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*Seton (1969) has also adopted a similar pricing system for wages to labour in Chile. He values the 'shadow wage rate' at so called 'frontier prices' of the import content. The underlying principle though similar to ours, his approach, in actual valuation is different. Further, his procedure does not distinguish between the different kinds of labour.

The alternative to the consumption by wage workers is conceptually no consumption when they are unemployed, so that their entire consumption is reflected in the value of a wage labour unit.* When wage workers are unemployed, they may consume but the workers pay for it either from past or anticipated income (by sharing another worker's current income), so that the social cost remains equivalent to the consumption basket available for a wage labourer's actual income. If a wage worker is drawn from the subsistence sector, his share in the peasant household is ultimately consumed by those remaining behind and the increased numbers through population growth in the subsistence sector. The distinction is that while the peasant workers consume the produce of crops raised by the household, whether or not they are gainfully employed, the wage workers have little scope for doing so unless they render services in exchange. Society does not sacrifice resources required for meeting wage workers' demand for goods and services if they do not offer themselves for work in contrast to the peasants. This happens through the regular migration of workers out of Kashmir, who, therefore, do not cost society unless they stay within the region; in the latter case they earn their livelihood by working and contributing to the region's economy. A clear distinction between unskilled wage ahd semiskilled workers is not crucial, because

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*It may seem questionable to impute the social value of all the wage worker's consumption as cost of an unskilled wage labour unit. Part of consumption, say eating, contributes to utility and hence the social welfare of the region of which the worker is a part. To ascribe all the consumption cost is to ignore the utility value. But this does not affect the relative social pricing because the unskilled non-wage workers as well as the semiskilled wage workers also derive some utility from eating, besides becoming productive. All that our procedure amounts to is an assumption that the utility to the non-wage workers from their little food consumption, to the unskilled wage workers from their increased consumption and to the semiskilled workers from still increased consumption both in quality and quantity, is more or less equal. Perhaps, this is not off the mark and it avoids the measurement of relative utilities.

their social costs are proportionate to money wages. Our rationale remains unaffected even if there is a revision in the money wage, because revisions are aimed to counteract increases in the market prices of goods and services.

The value of peasant labour could be derived from the social value of goods and services used by the subsistence households. But the latter value would refer to the total consumption irrespective of the degree of unemployment. The labour cost would be averaged out without regard to actual quantity of labour involved in different activities. Further, the total consumption includes a subsistence portion to which society is committed whether or not the peasants are employed, i.e. the social opportunity cost of this portion is nil. Since all the consumption cannot be treated as the cost of using the peasant labour, the difficulty of apportionment arises. An appropriate approach is one which reflects the social value of a labour unit on the basis of the extra sacrifice that society makes to secure its use, so that options employing labour, in full or part, are ranked commensurably.*

We will adopt a 'reference man-day' as the unit of unskilled labour, i.e., 8 hours 'moderate' work per day (Masefield, 1967, p.64). For conditions in Kashmir, the daily input requirement for the labour unit equals 2400 calories as against 1400 calories available per person from the domestic produce (Muthoo, 1969a, pp. 426-427). It may be assumed that imports are required to supply the extra calories**, i.e., goods and services equivalent

*When part of the labour requirement is met by employing non-peasant workers, the value of the latter must also be measured in commensurate manner. This can be defined by consistent [illegible] valuation of wage paid unskilled labour.

**This is the case in Kashmir which is a deficit area. Even if imports were unnecessary to supply the demand of wage workers and others outside the subsistence-oriented peasant sector, their consumption of locally produced goods would be tantamount to reduced exports by the economy, i.e. society sacrifices resources of an equivalent value. Alternatively, if no imports are made, the gap in calorie supply of a non-wage worker or the requirement of a wage worker may be met by reduced consumption by others. This will render the latter unproductive (Muthoo, 169a, pp.434-435). Then society will suffer a loss equivalent to the unproductive consumption by potential work force. The cost of an accessible

(Contd.)

in value to the extra 1000 calories are required to convert a potential subsistence worker into a reference man-day unit. Assuming that tastes remain unchanged, the extra consumption will be met by providing 128 gms. of rice, 110 gms. of maize and 43 gms. of wheat. Valuing these commodities in appropriate social prices and adding for the little psychological displacement and other input costs, the social opportunity cost for a non-wage labour unit is foreign exchange Rupees 0,26.

One may argue that the cost of a labour unit does not equal the social value of the extra inputs because of the unit's (extra) contribution to production. The marginal product may be higher than the value so that the net social cost of an extra labour unit is negative; if the product is less, the cost is the difference between the two and not the total extra cost. This problem does not arise if we separately count the labour and other costs of an option and the benefits of using labour and other resources. The marginal product of labour will be represented among the benefits and its relationship with the marginal cost in the benefit cost data. A benefit-cost analysis circumvents the marginal productivity measurement of a resource in isolation, which is especially difficult for labour in the rural sector. Such marginal productivity valuation is not meaningful because of scale effects and indivisibility, i.e., the margins for individual resources are not comparable among options. In our search for the level to which the use of the bundle of resources can be pushed for maximum social profitability, application of this concept would involve prior choice of technology. That amounts to a post-facto evaluation contrary to the object of planning which is to establish the most suitable design of the renewable resource system

labour unit may again be reflected in terms of the extra-consumptio requirement of those who have been made to give up part of their consumption. In practice, however, it is difficult to force a lower consumption level than the existing one, being already very low, so that direct imports in Kashmir are resorted to in all the years.

Unskilled wage labour is hired or employed for wages casually or regularly by the various renewable resource agencies. Society may be assumed to import the goods and services demanded by the wage labour (c.f. Footnote on Page 20). On the analogy of the imports for non-wage reference-man unit, the social cost of a wage labour unit is foreign exchange rupees (F.E.Rs.) 0.62, i.e., the social value of 2400 calories and complementary inputs. But the purchasing power of wage labour is more than the non-wage subsistence requirements. It uses additional social resources either through reduced exports or increased imports. The prevailing wage of unskilled labour is about domestic rupees (D.Rs.) 3.00. The consumption basket equivalent to F.E.Rs. 0.62 at market prices is obtainable for about D.Rs. 2.40. Scope thus exists to consume extra goods and services worth D.Rs. 0.60. Assuming unchanged taste and proportionally increased demand for different commodities, this would cause society to sacrifice additional resources worth F.E.Rs. 0.15. Hence the social opportunity cost could be F.E.Rs. 0.77, i.e. 0.62 plus 0.15.

The above assumption of similar consumption patterns of non-wage and wage workers is questionable, because of the latter's higher real income and the effect of the income elasticity of demand. Assuming the samples of Maheshwarpura (Mughal and Kamili, 1967) in Kashmir to be typical, a landless wage worker's household consumption basket revalued at world prices ranges between F.E.Rs. 0.72 to Rs. 0.86. Allowing for the higher overhead costs of wage workers including the displacement cost, of moving to work or of prolonged absence from home, the social price may be assumed at F.E.Rs. 0.80. This is F.E.Rs. 0.03 higher than F.E.Rs. 0.77, arrived at above, and does not involve the accumption of unchanged relative proportion of commodities in the consumption basket.

The assumption for the social valuation of unskilled labour is that the inputs required for securing its use largely consist

of what are termed as consumption goods.* A similar assumption may be made for semiskilled workers who are generally either wage paid or produce market goods.** Their higher earnings may reflect the value of skills acquired through on-the-job training. For the unsophisticated skills, the training is not required in an organized manner. It does not cost society significantly as against formal training and education of skilled personnel. Therefore, the social cost of semiskilled workers may be derived from their effective demand for resources on the same principle as for unskilled wage labour. The relationship between social price and money wages of unskilled wage labour is F.E.Rs. 0.80 : D.Rs. 3.00, i.e., the social price is 26 per cent of the money wage. Given the money wages of the categories of semi-skilled labour in Kashmir, a consistent valuation of their social costs emerges by using this relationship, e.g., the social price of a carpenter's labour unit is F.E.Rs. 2.60, because the money wage is D.Rs. 10.00.

The consistent valuation assumes that social resources used are in the same proportion as by unskilled wage workers, who earn only about D.Rs. 90 per month. In practice it is different, e.g., 68 per cent of total expenditure by the group with income of over Rs. 101 per month in Maheshwarpura is on food as against 80 per cent by the D.Rs. 76 to 100 income group (Farooqi et al, 1967, p. 82-87). According to the over D.Rs. 101 income group

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*Muthoo (1969a) argues that extra food consumption in malfed societies like Kashmir's is of the nature of investment in human capital. Since undernutrition afflicts the entire workforce, change in the numeraire does not affect our argument here.

**Semiskilled labour includes the artisan class of carpenters, blacksmiths, turnery workers and masons, and the road, canal, transport and office maintenance staff including diverse and menial cadres, for which recruitment qualifications are not prescribed.

expenditure data, the consumption basket of a carpenter revalued at social prices equals F.E.Rs. 2.80. However, we may adopt F.E.Rs. 2.60 per carpenter labour unit in the construction of fence posts, and, likewise, 26 per cent of domestic wage for the mason's labour component in soil conservation retaining wall construction, and so on. The apparent reduction of 7 per cent, from F.E.Rs. 2.80 to Rs. 2.60 the latter being consistent with unskilled wage valuation, allows for contribution to savings by semi-skilled workers, which is unrecorded as such in the published data. Though they, like the unskilled workers, contribute no direct taxes, they may be assumed to make indirect savings especially through better care of offspring. The latter results in lower social overhead costs and formation of improved human capital. For instance, the expediture on education is 100 per cent more by the over D.Rs. 101 income group than the D.Rs. 76-100 group; doubling of the expenditure accompanies only one and a half times increase in total expenditure. (Ibid).

The social valuation of skilled labour is difficult because of the different educational training and other costs incurred by society for imparting diverse skills. However, in the renewable resource sector, the skilled labour component in the bundle of costs is relatively small and a sophisticated evaluation is not crucial. The main skilled labour categories are the clerical and ministerial and the professional and technical. The latter personnel 'are' an international resource. Judging by comparable salaries abroad, they are underpaid even after allowing for differences in quality and costs of living. The earnings of clerical and white collar workers, most of whom need not have university or specialised training, are disproportionately higher than unskilled and semi-skilled workers. This is evidenced

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* Because of the greater prestige and satisfaction of being an office hand rather than a factory worker or farmer, they are considerably better-off from the view-point of utility too.

by the greater supply than demand and the commonplace overstaffing of offices with ministerial workers, often of low proficiency. It may be assumed that this class is relatively overpaid and the professional class is underpaid. These imperfections in the market pricing of skilled labour may be approximately neutralised by relying on existing wages (Muthoo, 1969b). One may, therefore, adopt the actual annual expenditures on the salaries and allowances of the skilled staff of the agencies concerned with Kashmir's renewable resource sector as the guide for assessing this cost component.

Skilled labour is employed for supervision and management. Its costs would be computed among the overhead costs together with research and development. In new options, the costs should be adjusted for scale-effects and the marginal nature of a new project, existing capacity for expansion, special requirements of skills, extension services, research and development. The adjustments are guided by the proposed expansion of activities and corresponding expenditure on staff in the fourth and the perspective plans of different departments. The precision of the adjustments is not crucial in view of the small proportion of skilled labour costs to the total costs.

6. Social Pricing of Non-traded Commodities.

The social prices of non-traded commodities are the cost or benefit to society in terms of foreign exchange lost or saved. The same reasons apply here as to the traded goods. But unlike the latter and like labour, which too is a non-traded commodity, world prices are not directly applicable, for they do not exist. This involves imputation, which is possible by relating the use of a non-traded good with the best opportunity that society forgoes of using the services of the bundle of traded goods, i.e. we trace that alternative whose effect is the most on the direct flow of foreign exchange in the economy.

To illustrate, consider cattle dung in India. On the basis of the wet dung yield and the livestock census, over 1200 million tonnes are produced annually (Planning Commission, 1961). It is estimated that, of the currently used quantities, over 66 per cent is burnt as fuel and that the fresh dung outturn in Kashmir is 11.66 million tons (Ministry of Food and Agriculture, 1967). Such quantities, affecting the economy in one way or the other, cannot be ignored in social evaluations, though the commodity does not enter the market. The commodity's social price in Kashmir may be deduced from the opportunity that society forgoes by using it as fuel.

0.3 tons nitrogen (N) and 0.15 tons phosphorus pentaoxide (P_2O_5) are respectively equivalent to 1.5 tons ammonium sulphate and 0.75 tons phosphatic fertiliser (NCAER, 1959, p.18), i.e., ammonium sulphate and superphosphate contain 20 per cent N and 15 per cent P_2O_5 respectively (Ignatieff and Page, 1958, pp. 63-64). One ton wet dung has 0.30 to 0.60 per cent N and 0.15 to 0.35 per cent P_2O_5 (op.cit., p.30). 0.67 tons dry dung are equivalent to 3.35 tons wet dung (NCAER, 1959, p.13) and dry dung contains 1.5 to 2 per cent N and 0.75 to 1.5 per cent P_2O_5 (Ignatieff and Page, 1958, p.68). One wet dung ton may, therefore, be assumed to have a manurial content equivalent to 0.015 tons of ammonium sulphate and 0.010 tons of superphosphate.

At social prices in Kashmir per ton of F.E.Rs. 600 for ammonium sulphate and of F.E.Rs. 750 for superphosphate, the manurial value of a wet dung ton is F.E.Rs. 16.50. This is the social opportunity cost of burning a ton of wet dung. Rs. 16.50 in foreign exchange could be released by using a wet dung ton as manure, because this would substitute fertilizers imports of equal value.

With the above price of wet dung the profitability of fuelwood plantations too can be assessed. A firewood ton, approximately 50 c.ft. of wood, has half ton coal equivalent

energy (Von Monroy, 1961, pp. 81-91). So has a dry dung ton which is equal to 5 wet tons (NCAER, 1959, pp.3-4). Therefore, the social price of a ton of firewood is F.E.Rs. 82.50. It would be socially justifiable to produce additional firewood supplies to substitute dung if the discounted social cost of raising a cubic foot of wood is less than F.E.Rs. 1.65. Similar imputation of social prices to other non-traded commodities is advocated for socio-economic appraisals.

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APPENDIX 9

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WHICH DISCOUNT RATE FOR SOCIAL INVESTMENT ANALYSIS? – especially in a developing country.

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A discount factor or rate is required for making additive, or reducing to present value, the benefits and costs occurring at different points in time through the course of an action. Market does not offer a guide-post because of the constellation of interest rates operating at any particular time, especially in developing countries. The difficulty may be avoided by using a range of empirical rates. For instance, the profitability of primary crops in Malaysia has been evaluated 'at 5, 10 and 15 per cent to reflect a possible range of interest rates that would be applicable' (Lembaga, 1967, p.118). King (1966) uses 1 to 10 per cent rates of interest for plantation evaluation in Nigeria. Fenton (1969) suggests a range of 4 to 7 per cent for forestry in New Zealand as 'an empirical choice based on current internal rates in agriculture.' Foster and Beesley (1963) evaluate British public expenditure for 4 to 8 per cent range. Weisbrod (1960, 57, 90) uses 10 and 4 per cent to represent the cost of private capital and government borrowing respectively. The idea seems to be that the ranking of options is 'little affected by moderately large changes in the rate of discount' (Johnston, 1966). This may be so for a chosen range. But it may not include all possible variations. An inconsistent ranking is likely over a wider band, sometimes even within a narrow range. The Natural Resources (Tech.) Committee's (1966, 69-77) 'conclusions based on a range of rates' - 5 per cent on 'traditional considerations' and 3 and 7 per cent for possible variations - are problematic. Forestry is profitable at lower rates and agriculture at higher. A decision about the appropriate rate is inescapable, though a range may be used to study sensitivity to changes.

The interest rates of the world bank and like institutions do not reflect the social cost.* They lend conditionally and only limited sums. The U.S. President's Water Resources Council (1962) and Harberger (1968) advocate long-term government borrowing rate adjusted to include tax revenue foregone. Walker (1958, 289-290) argues that in the U.K. 'the ability of the forestry commission to pay 4 per cent for capital justifies its claims' for funds, because interests on treasury loans averaged thereabout. The Lower Indus project has been evaluated 'at the government lending rate of 4 per cent' (WAPDA, 1966, 66). The use of the government rate implies that public finance is raised by the issue of bonds or in a like manner. But such voluntarily raised finance particularly in developing countries is small. The bond rate does not reflect full cost; lenders to government do not allow for the riskiness of projects. Yet it carries some risk premium for market and money price variations. The bond rate is inapt also because the monetary policies, for example, of the Reserve Bank of India, and tax exemptions, including the benefit of converting black money into white, granted on bond investment influence the rate.

Krutilla and Eckstein (1961, 92-117) use weighted average rate of return on private funds, assuming that alternative to public investment is a tax cut. This ignores alternatives like another public project. Nor can it hold during depressions or inflation with rigorous monetary policy, as current in India and many other countries. An expenditure cut may only equal a tax cut under successful governmental stabilization policy. The

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*An example of the use of long-term lending rates is in the report on the Prek Thnot project in Cambodia by the Committee for Coordination of Investigation for the Lower Mekong Basin (U.N./ECAFE, 1968). A weighted average interest rate of 1.8 per cent is used for the reason that 11.53 million U.S. dollars are available as interest free grants and loans and 15.50 million from 4 countries at an average interest rate of 3.15 per cent.

average rate itself is inappropriate. It is the marginal rate of return on displaced funds which is relevant. But a marginal rate is difficult to identify. Reliance on the marginal rate of return on private investments assumes unlimited resources, i.e., investment occurs to the extent that additional gains are offset by additional costs at 'the' going interest rate. In practice, it is unlikely to undertake all projects profitable at the going rate and the rate of return is higher. This discrepancy may be reduced by selling and reselling at profit. But that is inapplicable to society as a whole.

Market rates, government or private, are inappropriate because of the capital market imperfections.* Borrowers are not free to borrow (or lend) at a unique interest rate and, not rarely, at any rate. For such reasons, it is heuristic to consider a perfect market rate. It is inapplicable unless all other assumptions of perfect competition are met (Little, 1957, p.147). The real world is far from 'perfect.' Intertemporal allocation particularly abounds in imperfections; there is no competition between present-day and future consumers. The latter's choice is restricted by the former's actions. Even if a perfect market rate were to exist, it has little significance for social decision: It would equate private demand and net supply schedules and not the social productivity and saving schedules incorporating external effects, so that 'atomistic market forces need not lead to Pareto-optimal decisions' (Marglin, 1963a).

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*The evidence indicates 'the capital market to be imperfect, to be rife with rationing, ignorance, differential tax treatments, reluctance to finance investment from external funds, slow adjustment processes, etc., which destroy the normative significance of actual rates found in the market' (Eckstein 1961, b).

The assumption that social utility depends on consumption does not necessarily hold, especially for societies aiming at 'quick' economic development or capital accumulation. Tinbergen (1960) first proposes this approach but later finds that no clue 'can be derived from the simple maximisation over time of instantaneous utility.' Eckstein's (1957) consumer sovereignty based social-welfare function adds little substance, because consumers who can presently express no preferences are also involved; if the prevailing 'bias' against future in say Kashmir' subsistence system were to rule, there would be little investment or hope for its transformation. On the other hand, the maximisation of growth by investing to the limit of productivity amounts to valuing gains at different times equally. It 'implies that the marginal disutility of saving is zero' (Horvat, 1958). A choice involving very low rate of return on investment pushed to the uppermost limit and reflecting infinite social patience, or zero marginal utility of consumption, is unrealistic, perhaps more so for developing countries where most wants are unmet.*

Bauer (1965, 113) attaches 'significance, meaning and value to individual time preferences.' This ideal is inapplicable to the concept of socio-economic planning. Individual actions are based on imperfect knowledge about others' actions. These are inconsistent with preferences that would be exhibited in perfect knowledge of others' intentions and dependent future prices. The interdependence of individuals' satisfaction on ones own as well as others' consumption militates against reliance on individual

*Dobb's (1960) extreme view to use a zero rate of interest because government should safeguard future interests is puritanic conservationist. It does not stand to reason because the alleviation of poverty of the present generation is a relevant aim of development (Muthoo, 1969a).

preferences. These are subject to the 'isolation paradox' of a person's readiness to forgo present consumption provided others do the same (Sen, 1961). The 'paradox' exists because of the different choices when confronted in isolation in contrast to a collective proposal such as national defence or taxation.* Boulding (1969) and others bring out the dichotomy between the economic man and the citizen. Individual preferences are ambiguous, giving rise to 'schizophrenic dilemma' (Marglin, 1963a), because of the divergence between personal and general preferences. Given such divergences a relevant social time preference (STP) map cannot be constructed from individual preferences.

An STP rate measuring society's marginal rate of substitution between present and future gains should reflect society's preferences as a whole. Feldstein (1964n) says that an'ex-ante estimate of the STP rate can be made' from society's final location in the consumption space in terms of indifference curves reflecting the social consumption-utility function, the rates of population growth and pure time discount. Such extension of Fisherian indifference curves from individuals to society is conceptually incompatible with the 'impossibility' theorem of constructing relevant social indifference curves.** Feldstein (1965) derives the STP rate as a function of the consumption, population growth and

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* Sen (1967) has elaborated the argument to two related causes, viz. 'isolation paradox' whereby it pays no individual to save an optimal amount, whether or not everyone else does so, and the 'assurance problem' in which the individual will save enough only if he is assured that others will also do so.

** Samuelson (1956) demonstrates that community indifference curves, defined in the above sense, are 'impossible.' He concludes that 'except where income elasticities are all unity and tastes are absolutely uniform for all, it is proved to be absolutely impossible to solve for unique market price ratios in functions of market totals; hence we must lack collective indifference curves capable of generating group demand.' Arrow (1951, 59) also argues that 'if we exclude the possibility of interpersonal comparisons of utility, then the only methods of passing from individual tastes to social preferences which will be satisfactory and which will be defined for a wide range of sets of individual orderings are either imposed or dictatorial.' That is if consumers' values can be represented by a wide range of individual orderings, the doctrine of voters' sovreignty is incompatible with that of collective rationality.

'pure' time-preference rates, the elasticity of the utility-consumption function and a population parameter. Besides the above disability, such a relationship assumes strong separability properties of the social utility and felicity functions. This is not valid because of the interdependence of individual utility, and the current, future, and even past, consumption of an individual and the other consumers. In view of the imperfections and the 'isolation paradox', the application of such a function for a social optimum is not useful. As will be seen towards the end, the search for an ex-ante STP rate is futile as well as unnecessary

In mixed economies, the private sector is likely to exploit opportunities with high marginal productivity.* An opportunity cost for public investment arises; it is the present value of the consumption stream that would have been generated at the marginal rate of social productivity of the displaced private investment. This cost need not arise 'if we assume adequate competence on the part of governments...for some artificial encouragement to...investments the return from which will begin to appear after the lapse of many years' (Pigou, 1932, 30). Hirschleifer, de Haven and Milliman (1960, p.120) suggest to overcome the divergence between true time preference and that observed through market behaviour by making the situation optimal with coincident market and social rates. This could be possible

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*Beazley (1965) argues along these lines for a low discount rate for forestry in developing countries: since private sector avoids investment in long maturing investments, of which forestry is an extreme example, government should be induced to take these up by using low interest rates. The claim is that forest products are 'indispensable' social goods. Leslie (1967) rightly says that such a claim is unjustified because wood production is similar to any other commercial activity. He suggests that 'a market-rate should be used for discounting costs and revenues in the timber production components, but that a social rate should be applied to collective or social benefits.' Accordingly, he uses a 'market rate' of 5.5 per cent for discounting direct benefits and a 'social rate', viz. 3 per cent, for indirect components of a plantation in Australia. Such use of multiple interest rates is equally unjustified, for the so-called indirect effects could be produced by an alternative investment - even in the private sector. The crux is to correctly evaluate all the effects of a project and not to change the rationale for the opportunity cost of resources for part of an investment. Full allowance in the estimation of costs and benefits can be made for the social advantages of a collective goods project by the government (or of a private sector project on which prestige expenditure is less than a counterpart public project). There is no case, after all such allowances are made, for adopting different rates of interest' (Little & Mirlees, 1969, 95).

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In mixed economies, the private sector is likely to exploit opportunities with high marginal productivity.* An opportunity cost for public investment arises; it is the present value of the consumption stream that would have been generated at the marginal rate of social productivity of the displaced private investment. This cost need not arise 'if we assume adequate competence on the part of governments...for some artificial encouragement to...investments the return from which will begin to appear after the lapse of many years' (Pigou, 1932, 30). Hirschleifer, de Haven and Milliman (1960, p.120) suggest to overcome the divergence between true time preference and that observed through market behaviour by making the situation optimal with coincident market and social rates. This could be possible

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*Beazley (1965) argues along these lines for a low discount rate for forestry in developing countries: since private sector avoids investment in long maturing investments, of which forestry is an extreme example, government should be induced to take these up by using low interest rates. The claim is that forest products are 'indispensable' social goods. Leslie (1967) rightly says that such a claim is unjustified because wood production is similar to any other commercial activity. He suggests that 'a market-rate should be used for discounting costs and revenues in the timber production components, but that a social rate should be applied to collective or social benefits.' Accordingly, he uses a 'market rate' of 5.5 per cent for discounting direct benefits and a 'social rate', viz. 3 per cent, for indirect components of a plantation in Australia. Such use of multiple interest rates is equally unjustified, for the so-called indirect effects could be produced by an alternative investment - even in the private sector. The crux is to correctly evaluate all the effects of a project and not to change the rationale for the opportunity cost of resources for part of an investment. Full allowance in the estimation of costs and benefits can be made for the social advantages of a collective goods project by the government (or of a private sector project on which prestige is expenditure) less than a counterpart public project). There is no case, after all such allowances are made, for adopting different rates of interest' (Little & Mirrlees, 1969, 95).

through monetary or subsidy policy, but is an issue beyond project designing (Musgrave, 1969). Failing that, social appraisals face the prevailing sub-optimum situation, i.e., the divergence between private and social rates of return.

Let us assume an optimal allocation with coincident rates of STP and the (risk adjusted) marginal social return. Then the STP discounting allows comparison of options with the objective function expressible as:

$$\int_0^\infty \beta(x, t)e^{-rt}dt - k(x)$$

where x is the choice variable, t the time, $\beta(x,t)$ the benefit rate, r the marginal social discount rate or (marginal) STP rate, and $k(x)$ the capital cost (as a function of scale).

If capital employed on a project precludes private investment, the costs and benefits need to be adjusted at a social opportunity cost (SOC) rate. Not only need we to consider the relative value of present social gains exchanged for future but also the value to society of the foregone best use of capital from the assumed preclusion of the private options. The above objective function changes to:-

$$\int_0^\infty \beta(x, t)e^{-rt}dt - ak(x)$$

where 'a' represents the SOC per rupee of the public investment.

Krutilla and Eckstein (op.cit.) discount consequences at an opportunity cost rate assumed to represent the cost of funds transferred from private sector. Eckstein (1961a, 99-101) proposes a compromise with the 'high' (STP) rates, advocating a 'relatively low interest rate...coupled with a minimum benefit-cost ratio.' The rate, in effect, approximates the opportunity cost of capital raised by federal taxation. Either approach rests on particularly unrealistic assumptions for developing countries, e.g., i) full employment, ii) money entirely raised by taxation, iii) unlimited resource availability as projects can, implicitly, be undertaken by increasing taxes, iv) acceptance of private

time preference and prevailing consumers' sovereignty. Such use of SOC disregards STP, while an 'SOC rate can be guide only to social productivity of private investment' (Feldstein, 1964,c). Sometimes, the STP and SOC rates may coincide, but they do not override or substitute each other.*

The costs of a public project may arise from i) transferring private funds, ii) foregoing public alternatives, and iii) displacement of alternative private investment. These respectively present SOC for the source(s) of funds, budget scarcity, and 'supramarginality' of a foregone private opportunity over its marginal alternative. Steiner's (1959) recognition of the range of the opportunity costs and another of deferred consumption, which is the STP, is an attempt to combine SOC and STP. He values the opportunity cost parameters as functions of STP, cut-off project length and internal rate of return (IRR). Besides the ambiguity associated with the latter,** this approach is no different from

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*No single interest rate can serve both to compare benefits and costs of different dates and to measure the opportunity cost of private investment displaced by public investment because the marginal social rate of time preference is unlikely to coincide with the (risk-adjusted) marginal social rate of return from investment (Prest & Turvey, 1966). The implication, as discussed below, is that investments cannot be ranked merely by using a rate of interest equal to the opportunity cost of capital. Carr (1966) puts forward a different viewpoint for a fully employed economy in which the estimated risk-adjusted marginal rate of return differs from the estimated social time preference rate. He says that 'irrespective of the rate of time preference, an optimum will be achieved if all resources not consumed are invested in such a way as to maximise the present value of investment using a discount rate equal to the marginal productivity (opportunity cost) of capital.' This seems plausible if the social opportunity cost rate is higher than the social time preference rate. But the situation in developing countries could be considered as the reverse because of the large opportunities for investment open to both the public and the private sector and the deficiency of investible resources. This is in addition to the point that in economies which are not fully employed, investment may be mobilised from resources which otherwise would not be invested. Their cost is the foregone current consumption, which can be valued according to the marginal social time preference rate (Feldstein, 1964a).

**Owing to multiplicity of rates for certain cash flows and no internal rate at all for others with consistently positive or negative net benefits over the project length (Hirschleifer, 1958; Wright, 1963). Eckstein (1961b) further argues that the general use of the internal-rate-of-return method does not give optimal results, and that normative significance in ranking is obtained only by discounting by a subjective time preference.

Krutilla and Eckstein's (op.cit.) weighted average interest rate for the funds withdrawn from private sector; it is beset with the same objections for the first of the above parameters. The second parameter depends on the extent to which budget is limiting. That can not be foreseen for the project length. For the third parameter, one must know the private alternatives displaced as well as the marginal private investment pool. It is conceptually difficult to identify a marginal private investment alternative to every displacement. An impesse exists when ranking of marginal private projects at IRR is inconsistent with that at STP rate due to either the unlike time profiles and/or different project lengths.

The opportunity cost rate, i.e., the SOC of transferred funds as a perpetuity at a yield equal to the rate, in the above model is not a true measure of the consumption component of the transferred funds. Marglin (1962) removes this defect by segregating the funds into investment and consumption segments. The social cost, Ko, of a public project then equals

$$\left[\theta_1 \frac{\delta_1}{d} + (1 - \theta_1)\right]\left[K(x)\right], \quad \text{or}$$

$$\left[\theta_1 \delta_1 + (1 - \theta_1)d\right]\left[K(x)\right]/d \ldots\ldots\ldots (1)$$

where θ_1 is the proportion of each unit of resource transferred from private investment sector, δ_1 the percent annual benefit yield of the investment outlay in perpetuity of the displaced funds, d the STP rate, and K (x) the money cost of resources used.

This model assumes full employment and that δ_1 is constant over the entire range of alternatives. The former is unrealistic for developing countries and the latter implies a marginal productivity of private sector investment, i.e., the IRR on marginal private investment, the operational difficulties of which have been cited earlier. Another implicit assumption is that private investment benefits are instantaneously consumed; otherwise the real alternative is not the perpetuity of δ_1 per cen

but the benefit stream of the nominal alternative plus reinvestment, which is ignored. The set of 5 models presented by Marglin (1936b) express opportunity costs as a function of displacement and yield rates. They differ from the above model in having an additional parameter for reinvestment benefits of a project, which reduce the cost. They involve another untenable assumption of a constant reinvestment quotient θ_2 throughout the economy and the difficulties of different distribution of benefit and reinvestment rates in private and public sectors. The replacement of one private sector by n sectors, when θ_1 and α_1 are regarded as n vectors and $(1 - \theta_1)$ becomes $(1 - \sum_1 \theta_{1_i})$, does not remove the basic deficiencies.

Marglin's (1967, 58-61) 'synthetic discount rate' is a function of STP rate, economic life and shadow price.* The latter is the cut-off benefit-cost ratio similar to model (1) above, except for the reinvestment quotient. Additional abstraction is the constancy of benefits and that the displacement and reinvestment quotients as well as the rate of return on displaced projects are the same. The'synthetic discount rate' will vary for different programmes and no single rate will permit evaluation of heterogeneous options. The other objections are of ignorning taxation and reinvestment effects by treating the SOC stream as a perpetuity and of an unchanged STP rate over time.

Baumol (1968) also advocates the use of an opportunity cost criterion. The corporate income tax is shown to create a divergence between the marginal rate of return on private investment and the subjective time preference (or government

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*Hufschmidt (1961, 23) has also indicated the necessity for a rate which synthesizes the social rate of discount and opportunity cost (investment foregone) in the private sector. Usher (1969) argues on the basis of second best analysis that 'under certain quite general assumptions, the appropriate interest rate on government projects lies between the rate of time preference and the rate of opportunity cost between present and future consumption in the private sector.'

borrowing) rate. He considers the former to constitute the opportunity cost of capital and suggests that the appropriate social discount rate is necessarily higher than that which accords with the subjective time preference; a higher rate should apply to all resources withdrawn from the corporate sector whether they would have been used by the firms to produce consumers' goods or producers' goods. The reason given is that a corporation must at the margin earn enough to cover the (marginal) corporate income tax and to allow for a risk premium. Baumol's aim is to show that in social evaluation of investment options, the appropriate social discount rate for projects in the public sector cannot be lower than for those in the private sector. For the same reason the discount rate cannot be higher either, and the problem remains of the choice of a rate applicable to investment appraisal from the public viewpoint. As Ramsey (1969) comments, the 'social discount rate is a linear combination or weighted average of observable market rates of return and hence is <u>not</u> a directly observable market rate', the weights depending upon 'private sector's reaction to transfer of resources', time preferences and risks. Such a rate would be operationally difficult to identify. Not only has one to identify the observable market rates but also those on investments which are precluded and the attendant time preferences and risks. Objectivity is likely to be lost in this process and the problem becomes insoluble when no observable rates exist, as in the non-monetized sector of developing economies.

Baumol's conclusion seems to be right in that there 'is no need to lower artificially the social rate of discount in order to increase further the prospective wealth of future

generations.'* But, apart from the difficulty in methodology pointed out above, the reasons adduced seem questionable. A rate reflecting corporate taxes is not justifiable by itself, for then the external diseconomies associated with corporate enterprise cannot be ignored (Kapp, 1969). The rate should be based on the social opportunity cost of postponement of benefits as a consequence of investment, whether in the private or the public sector. This is an issue of social time preference and not merely of the opportunity cost of withdrawal of resources from one sector of th economy for use in another. Indeed, it is not necessarily realistic that the opportunity cost of transfer would be higher than the social time preference, whereas Baumol's model rests on the assumption that subjective time preference rate is lower than the opportunity cost rate.

A high 'social discount rate' because of a risk premium is not appropriate, for investments in the economy as a whole are subject to the law of large numbers. It is for such reasons that Samuelson (1964) refutes Hirschleifer's (1964) view ** of the

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*Tinbergen (1967, 154-157) advocates for developing countries 'a higher rate of interest than prevailing on the market' for the different reason that 'developed countries such as Germany have an interest rate of 7-8 per cent and the United States had this rate a century ago, whereas personal loans are often made in developing countries at rates of 25-30 per cent.' Boiteux (1964), on the other hand, argues for low interest rates to enable low yielding French power projects to muster. He says that the government should 'offset the national behaviour of individuals on the assumption that they are doubtless adults in dealing with the immediate problems of life, but minors with respect to decisions involving their future, or their posterity.' This is an authoritarian viewpoint. The advocacy of low discount rates on grounds of social responsibility overlooks present social needs, especially in developing countries with large numbers at subsubsistence level. Suggesting that the appropriate rate for investment allocation should emerge from a macro-economic analysis of investment-savings equilibrium, Stoleru (1967) shows that, even for France, it should be higher than market rates on bonds or loans.

**Similar views have been expressed by Hirschleifer, de Haven and Milliman (1960, 139-150). The argument is that 'the market rate of interest is generated by an equilibrium between marginal time preferences of consumers and the marginal time productivity of resource...In a risky world there are many "impure" time-plus-risk interest rates rather than one pure time-rate, but the way to take this into account is to use in the public sphere the rate employed for "comparable" investments in the private sphere.' (Hirschleifer, 1966, 268-277). This is tantamount to advocating market rates, which we have argued are inapplicable (c.f. page 1-3). This advocacy refutes the possibility of pooling independent risk, by

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applicability of a risk-adjusted 'harmonized' market rate as a social discount rate. Arrow (1966) also pleads that 'the government should not act as a risk averter. That is, the optimal policy for the government is to reckon uncertain benefits and costs at their expected value and then discount the resulting stream at the same rates as used for riskless investments.' Further it can be argued that risks involved in private investment include a disutility to the investor. Such psychic costs have no counterpart in the public sector. This too reverses Baumol's argument for an opportunity cost for resources transferred to the public sector high enough to equal the private rate of return.

Feldstein's (1964a) net social benefit (NSB) algorithm incorporates the SOC of capital as the current value of all the foregone consumption. It includes the reinvestment sequential effects too. But, it involves unrealistic assumptions of i) a single marginal propensity to consume, ii) what is not consumed is invested, iii) a unique and constant marginal rate of return on all private investments with equal and constant marginal productivity and iv) constant STP rate. Theoretically, consumption functions can be disaggregated and the parameters over time varied to reformulate the first and the last and, less suitably, the other assumptions. But 'estimating many of the variables and parameters needed to calculate NSB may indeed be difficult' (*ibid.*), more so for developing countries with a sizeable unmonetized sector.

The basic assumption in the above approaches that public investment causes transfer of private investment resources may not hold. A project may be financed out of public funds, or by foregoing public expenditure, which does not have the private investment opportunity cost, e.g., untied grant-in-aid from abroad.

** ....large organisations such as a government and more so the entire economy (Vickery, 1964; Solow, 1964, 70-71). Hirschleifer (1966, 275) says that 'the pooling argument rests ultimately for support upon market imperfections... (but it) is incorrect on the level of generality at which it is usually propounded'. But the very reason of a 'risky world', hence the prevalent imperfections, make the pooling argument applicable in practice as a general phenomenon: What may be a small or no risk to A may be a big risk to B in one and the same economy.

Taxation may withdraw only current consumption and not affect private investment. It is conceptually possible in underdeveloped economies to undertake projects that take up the slack in the economy and do not curtail private investment or consumption. Measures may be used to induce private investment in areas which otherwise require public enterprise at the cost of private alternatives. In a planned mixed economy, public programmes need not displace 'superior' private opportunities.

The above models* presuppose knowledge of private investment opportunities, their individual rates of return and, more precisely, that of the displaced funds at the margin. Project planners do not know all this. The assumption that a unique marginal rate of return exists is untenable in view of the heterogeneity of private enterprises. Even the same investor or consumer often borrows and lends at different rates simultaneously to and from different sources. The individual marginal borrowing and lending rates do not coincide. No single loan can be treated as marginal and it is impossible to identify the rate which measures the return in the economy. The above models implicitly assume that there are no mutually exclusive or interdependent projects; otherwise, as in the real world, no unique marginal rate exists, being dependent on the combination considered.

Private returns, on which the models rest, ignore social consequences, e.g., they include higher wages and rents as costs.

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* The discussion here and in the ensuing paragraphs applies also to the Little-Mirrlees' (1969, 181-189) accounting rate of interest (ARI). Their model is similar to the SOC models, for the criterion for the ARI in mixed economies is that 'planners should try to see that the marginal social yield is about the same in both' the private and the public sectors (ibid., 95). The main distinction is that the ARI is applied to investment and involves the revaluation of each year's consumption in terms of savings for investment. Though they admit that 'the ultimate object and intention of the government's economic activities is to provide a high standard of living' (ibid., 39), the emphasis on investment is either a change in numeraire or to stress the greater social value of investment resources (ibid., 41) along the lines of Galenson and Leibenstein (1955). The latter advocate allocation of investment resources by equating the marginal per capita reinvestment quotient in its various alternative uses.' Not only may this be antithetical to public policy, but, as will be discussed later, the distinction between one or the other

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But the spillovers of displaced private investment need to be incorporated to reflect the true SOC. Obversely, public investment may create external economies for the private sector outweighing the cost of displacement. The extent of displacement, if any, and its social costs depend on the structure of the economy and the manner in which resources are raised. No ad-hoc treatment is possible, as in the above calculations. These attempts get invalidated if deficit financing and inflation are an accepted strategy.* Since 'low income consumers borrow at higher rates, public investment will be of shorter maturity with regressive than with progressive taxes' (Musgrave, 1969), it is questionable to extend Marglin-Feldstein criteria to developing economies. Their structure does not permit conformity with the investment and consumption parameters in the criteria, because of the conceptual difficulties in segregating consumption and investment in the conventional manner (Muthoo, 1969b).

Discounting at SOC cum STP rates results in double counting of opportunity costs. Since factors and products in a socio-economic analysis are valued so as to reflect social opportunity costs, no further opportunity cost multiplier is warranted.** Having shadow priced labour (Marglin, 1967, 56-57), the use of an SOC rate causes the adjustment of the labour content of costs twice. The approach advocating SOC rate discounting involves this

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.... investible resource, or between investment and consumption per se is not crucial to the problem of intertemporal optimization of resource use. 'Government investment may displace a combination of private investment and consumption' but the ultimate source of resources does not affect the appropriate discount rate'. (James, 1969).

*The deficit finance component of India's 1968-69 budget exceeds the outlays for Agricultural Production Programmes.

**Mishan's (1967) reformulation of Steiner's (op.cit.) analysis of investment projects - by discounting their expected future returns using the social rate of time preference as the appropriate discount rate - mainly in 'the substitution of normalised terminal values for Steiner's non-normalised present values,' also 'makes calculation of SOC unnecessary.'

defect except for 'capital,' which may not be socially valued in the computation of benefit-cost streams. Yet, none of these approaches specify what 'capital' is. In a social benefit-cost analysis there is no need to do so, the aim being to relate benefits to investment costs, whether current or outlay. One steers clear of the unnecessary distinction between costs at different dates, if adjusted for the time dimension effect. The distinction between different kinds of commodities also need not be made; the crux is a commensurate evaluation of consequences occurring at different points of time.

The models of Eckstein (1961a, 94-104), Marglin (1963b) and others which are preoccupied with the explicit consideration of reinvestment of the so-called "throw-off," fail to recognize that 'a policy-maker who is optimizing with respect to a current decision is also in a position to optimize with respect to reinvestment' (Arrow, 1966). The problem in investment decision-making is that of choosing an optimal policy and not merely of optimizing a current decision, taking as given all future behaviour of the government and the private individuals. Thus the need is for a rule for decision-making to be applied now and in future, suggesting a dynamic programming approach. This is consistent with Carr's (1966) criticism of Feldstein's (1964a) view to segregate consumption and investment resources, for it neglects 'the possibility that any resources withdrawn from consumption could be invested to yield a return equal to a (high) opportunity cost of capital instead of some lower return.' This signifies that the question of where resources come from may not be relevant to the problem of how best to use them.

While the programming approach yields shadow price duality relations which can be interpreted as discount factors or interest rates (Dorfman, Samuelson & Solow, 1958, 266-355), the difficulty is that 'the discount rate to be used for calculating present values...cannot be discovered until the solution is attained, and

so is of no assistance in reaching the solution, (Hirschleifer, 1958). Baumol and Quandt (1965) refine the approach to provide what they call 'an objective measure of the discount rate', i.e. an internal production opportunity rate. This rate can be distinguished given a specified budgetary constraint, for the opportunity rate is the ratio of the dual prices corresponding to the constraint at different points in time. But if the constraints are not optimally chosen,* the resulting discount rate cannot ensure optimal resource allocation among competing inter- and intra-sectoral investment programmes. This defeats the purpose of a rate appropriate for choice among investment options from the economy's viewpoint. Apart from the use of the subjective utility index**, which the model involves and which would be controversial in socio-economic appraisals, the applicability of the model for corporate investment decision-making faced with certain budgetary constraints seems quite useful.

The maximization principle in programming approach is similar to the 'golden rule of accumulation' which, as Horvat (1968) argues, does not correctly solve the problem of maximizing growth rate of consumption. According to the rule, the marginal efficiency of capital equals the rate of growth of capital, while in fact investment should be pushed to the point where its marginal efficiency is zero. This is so essentially because in any finite time period, zero marginal efficiency of investment is equivalent to a positive marginal efficiency in a longer period. The difficulty arises because of limited absorptive capacity in the finite time period. This creates a special kind of external

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*That is, in the context of intersectoral budgetary allocation in a planned economy like India's.

**It could be interpreted that the objective function is arrived at for a zero discount rate, so that the resulting internal production opportunity rate is specific to the indifference of the withdrawal and use of resources at different points in time. Thus we are conceptually back to the above problem posed by Hirschleifer, i.e., the shadow interest rate is contingent upon the assumptions in the objective function.

diseconomy as an essential part of the system. Therefore, the rationality of private behaviour is inapplicable to social resource allocation indicating that 'the theory of perfect competition is to be replaced by a theory of perfect planning if we are to solve the problem of economic rationality' (Horvat, 1968). The conclusion is that for socio-economic planning, besides the proper measurement of their consequences, 'the main problem in the efficiency appraisal of options...is the discounting of costs and benefits over time to weight them by society's time preference rate'* (Muthoo, 1970b).

Public investment exchanges one stream of gains for another. The desirability of the exchange in practice, hence the setting of the STP rate, is a matter for social policy considering ethical principles as well as economic opportunities. This is because investment decisions from public viewpoint are social decisions. They require a search for collective (marginal) time preference by which society values the intertemporal gains. An individual's discount of future benefits merely because of futurity is irrelevant to societal optimization problems.** In so far as it largely represents a 'pure' psychological discount of the future, it is 'polite expression for rapacity and the conquest of reason by passion' (Harrod, 1948; 40). The collective preferences depend upon society's judgment about the future configuration of the economy seen through a communal telescope adjusted to the range of public policy aims. It is not fruitful to attempt an ex ante STP rate from the behaviour of the individual members of society. The rate should reflect what society's overall objectives are, or ought to be, though systems designers are unable to comment on the latter.

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*As indicated by society's planning goals.

**Just as future gains appear smaller because everything distant appears so, present gains viewed from future too would look small. This is due to defective telescopic faculty.

Development plans outline society's objectives. None, however, carry an explicit statement of society's time preference. Some value judgments are easier to make than others, depending upon familiarity. Choice of 'correct' discount rate is difficult because of unfamiliarity with the consequences of different rates. Policy planners are not used to STP rates, but they do make judgment about growth rates. The discount rate for social appraisal ought to reflect the value judgment of the body collective. The choice of social discount rate should, therefore, follow from that of growth rate,* to which planners are used and to which society commits itself. If the growth rate for the economy is known, which need not be constant, the level of investment required for achieving it can be derived.** The social discount rate or society's preference for exchange between present and future would be represented by the rate one needs to use in

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*Following from the discussion on the lines of von Neumann's (1945) model, in which the rate of interest (or of profit) equals the rate of growth, Dobb (1969, 158 ff.) recommends that 'if g is the annual growth-rate and n the number of years previously (to the emergence of the end product) that any item of wage-cost is incurred, the weight attached to this wage-cost for costing purposes should be $(1+g)^n$ '. In effect, Dobb (ibid. 191-192) advocates the use of growth-rate as a weighting factor for wage-costs at different points of time. Kornai (1967, 271) similarly states as one of the accounting principles that 'the magnitude of the computational rental on capital should fundamentally adjust to the growth rate of the national income.' Accordingly, he uses a time-discount factor of 0.08 for the Hungarian economy (though this is 2 per cent more than the actual growth rate of 6 per cent in the past). In the model mentioned below, the discount rate would turn cut always to be higher, rarely equal, and never less than the growth rate (Muthoo, 1970a). Hirschleifer (1966, 268-69 ff.), an exponent of the 'market rate', concedes that 'a "social discount rate" excogitated from value judgments or Planners' time preferences...can be defended as a way of compensating for market bias due to private "myopia" or intertemporal "selfishness."' Even if this may not be strictly within the scope of Pareto-efficiency criterion, the further defence is that it is not the necessary conditions of Paretian optima but the 'sufficient conditions for improvement that we really want' (Little, 1960, 138). Baumol (1969) also accepts a discount rate that permits transfer of resource for investment in the public sector provided they constitute improvements, lest opportunities for a 'better' use of resources are lost in an unwillingness to compromise with ideals. Though for different reasons, Eckstein (1957) also concludes that 'the interest rate varies directly with the rate of growth of consumption output and with the rate of pure social time preference'.

**The Indian national plans specify both these parameters by mutual iteration; a feasible growth rate is set by matching with investment resources.

order to achieve the required investment and hence the chosen growth rate. The above argument would be operational if the discount rate could be derived from societal decision about growth rate in a planned economy. Muthoo (1970a) discusses a model according to which the social discount rate,

$$ds = g / \frac{s}{D},$$

where g is the growth rate, s the global saving ratio, and D the share of capital or of profit income in the total income.*

From the above model, it is apparent that the discount rate could vary through the length of a project's life, which exceeds the finite planning horizons of five years or so. This would be because of the changes in social time preference in the long run reflected through changed target growth rate and/or the value of the s/D coefficient. Margolis (1959) states that 'the discount rate appropriate to this transformation (of a dollar in year t to a dollar in year t +1) need not be the same as the one necessary for any other pair of years.' Despite the need to'be cautious about a procedure which neglects this problem' (ibid.), no investment analysis could be quoted which allows for this. In a developing country like India, it may be realistic to appraise costs and benefits for the distant years of a project at a discount rate lower than that calculated for the current 5 year or the perspective planning period (which usually extends over

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*The estimated net national savings and income in 1960-61 at 1948-49 prices in India were Rs. 141.33 million and Rs.1273 million respectively (National Council of Applied Economic Research, 1965). With the estimated income share of the corporate sector at Rs. 20.61 million, the growth rate at 4 per cent, the savings ratio s works at 0.11, s/D at 0.55 and the discount rate at 7.3 per cent. The corresponding data for 1961-62 yield the s/D coefficient at 0.50. With the target growth rate of 5 per cent for the 3rd 5 Year Plan (Planning Commission, 1963) and likewise for the 4th 5 Year Plan, though with changed individual parameters (Raj, 1967), the current appropriate discount rate may be assumed as 10 per cent.

15 years).* This would be so because once the government is able to meet some of the pressing demands of the electorate, e.g. minimum food and drinking water, resources could be channelled into more durable investments. This would be possible also becaus the quick-yielding investments, e.g. in the agricultural sector, would allow for increased savings(over the greater part of the economy) and investment for sustaining a higher future growth.

Contrariwise, the implementation of capital-intensive long-maturing projects, reflecting a low social time preference, in the earlier decades would starve resources for more immediate social needs** and gives rise to instability inimical to sustained

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*On the other hand, Eckstein (1957) advocates to 'base discount rate on the hypothesis that as income grows in the future, the marginal utility of an extra unit of income will decline. As we need less of such extra income, we should discount it more.' This is self-contradictory when looked from a dynamic point of view,i.e., between any two pairs of years considered as parts of separate planning periods. Feldstein (1964,b) also expects the social time preference rate to rise as a function of time on the supposition 'that a government that foregoes a pure time discount in early years will nevertheless wish to impose one for years that are further in the future.' This seems plausible by comparison of Stalinist era with Russia of recent years. But it is inoperational to advocate Stalinistic approach for economies like India with Gandhian means. In such economies, the reverse seems more reasonable as indicated below, i.e., a process of slowly declining social time preference rate but never equal to zero.

**This was the strategy adopted during India's second and third Five Year plans. The attempt does not seem to have paid (Streeten and Lipton, 1968). The emphasis has now been reoriented; the farm-sector's needs for inputs has been recognised, though not necessarily in the form of large capital-intensive multipurpose schemes that characterised the earlier years. Now minor and lift irrigation is also receiving attention. Intensification of agriculture and development of the rural base would also ease the unemployment problem which would pose a threat to any democratic government with the proportions that it is assuming in India. Such and other employment generating investments, which are not those indicating low social time preference, deserve priority lest the development of the economy is frustrated by violence, especially if society is not conditioned for a non-democratic revolution.

growth. In the early days of poverty, society would want to plan investment more for improving the lot of the present generation than the posterity, which they hope will be less poor because of the benefits of the improvement.

The later generations, which are hoped to be handed down improved human capital, infrastructure and a base for sustaining a higher proportion of savings and growth, will be expected to be able to make relatively greater sacrifice with lesser absolute hardship, i.e., the posterity can afford a relatively lower social time preference. Tullock (1964) also objects to a lower social discount rate for the present generation, for that implies the transfer of resources to a generation that is 'going to be wealthier than we are.' It is better to redistribute through public investment more in favour of the diseased, illiterate and underprivileged of today than for the better-off posterity through investments which start yielding after we are dead.*

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*This is not an argument against conservation, say of some plants as a 'reservoir of germ plasm', for the benefit of society (Krutilla, 1967). It is to stress that arguments for missionary outlook calling for untold sacrifice by the present generation for future's sake (Landauer, 1969) are not rational, i.e., preservation for someone's emotional reasons is contradictory to socially optimal intertemporal resource allocation. The fact that the Americans ran down their forest capital in days gone by helped their economic take-off and they are now so far advanced that they can invest in the recreation of forests (Zivnuska, 1966). As Fahnestock (1970) says: 'we seem to be getting along pretty well without the moa, the dodo and the passenger pigeon'. However, as a society becomes affluent, it can divert resources for long-term investments, even for prestige or preservation of amenity resources and improvement of future environmental quality.

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APPENDIX 10

Planned Growth and the Rate of Discount for Project Appraisal in Developing Countries with Special Reference to India

M. K. Muthoo*

Introductory

Decision-making in the interests of public involves the evaluation of alternative time streams of social benefits and costs of investment options. In choosing among different designs of individual projects and among feasible combinations of various projects, the choice of discount rate is, therefore, of crucial importance. Among notable attempts to arrive at an appropriate rate subsequent to Margolis' (1959) review of the works of Eckstein (1958), Krutilla and Eckstein (1958) and Mckean (1958), are the contributions of Baumol (1968), Baumol and Quandt (1965), Feldstein (1964 a, b, c ; 1965), Hirshleifer et. al. (1963), Horvat (1965, 1968), Little and Mirrlees (1969), Marglin (1963 a, b ; 1967 a, b), Sen (1967), Steiner (1959) and Westfield (1959). But, 'no one has yet invented a uniquely superior way of doing this' (Prest and Turvey, 1966). This paper is another attempt from a different perspective.

Our rationale will be derived from the contention that project designing and selection, from public viewpoint, should be consistent with national economic policy, one of the most explicit goals of which is the ex-ante rate of growth. Hence, our attempt will be to discover a rate of discount that reflects the time preference of a society as embodied in the economic objectives and the targets that it has set

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for a specified planning period. Such a social discount rate can be deduced only for planned economies where goal-setting takes account of both the private and the public sector. One such example is India.

This exercise is more relevent to developing economies largely because the objection to employing growth theory assuming general equilibrium under conditions of full employment, as we shall do in arriving at our model, would be difficult to meet in the case of developed economies. This is obvious from the penultimate paras of the discussion.

Background

On the assumption that, in the long run, savings are equal to investment in an economy, a steady growth rate 'g' in the Harrodian sense requires that the natural growth rate of economy, equalling the rate of growth of the labour force 'n' fixed by 'non-economic demographic forces', be equal to the warranted growth rate, this equalling the savings coefficient 's' times the output capital ratio, $1/v$. It implies that 'n' be equal to s/v, but 'n', 's' and 'v' being independently determined, the well known Harrod-Domar problem arises and full-employment steady growth becomes impossible except in a very special case.

To depart from this restrictive schema, it appears reasonable to start with a 'Bastard Golden Age' (Kahn, 1959) assumption, as distinct from a 'mythical' golden age (Robinson, 1956). Then a steady growth is not incompatible with unemployment, and the rate may even exceed the Harrodian ceiling set by 'n', because of an initial pool of unemployment as in India or, obversely, by drawing labour from outside the economy as currently in West Germany and also in Great Britain. This leads to a realistic reformulation of the Harrod-Domar model (Harrod, 1948 ; Domar, 1946) in so far as steady growth can occur with $s/v \neq n$, and more specifically with $s/v < n$, so that growth can be sustained without the necessity of generating employment equal to the level of 'n'.

Now, there is no universal need to satisfy the condition of equality between 'g' and 'n', and for equilibrium growth the effective framework, in general, emerges as :

$$g = s/v \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

During finite planning horizons such as are adopted in India, 'v' has an inflexible range while 's' is the variable whose range is adjustable corresponding to a certain growth process and vice versa.

Thus it is possible to determine rates of growth against savings-income ratios considered feasible according to saving propensities, population growth, levels of living and employment, and the policy goals of society. The rate of growth can be derived iteratively on the basis of the suitable capacity to siphon off income for investment. And, in line with what Marglin (1963a) says, with such a rate of growth $g(t)$, it is possible to determine the 'optimal' rate of investment $I[g(t)]$ for a particular society. The (marginal) social time preference $r\{I[g(t)]\}$, then, is the discount rate which just makes $I[g(t)]$ optimal in the welfare sense of equating the present value of the benefit stream generated by the marginal investment to the sacrifice in foregoing equivalent benefit now. Thus $r\{I[g(t)]\}$ also reflects the (marginal) productivity of investment at the given $I[g(t)]$ when derived on the basis of the optimal rate of growth $g(t)$ set by a society commensurate with its social and economic parameters. The task before us can thus be identified as that of discovering a relationship which could appropriately link the time preference rate with the growth rate, assuming that the latter has been chosen at an 'optimal' level. We shall discuss the optimality assumption later and point out here that $g(t)$ as 'optimal' reflects an implicit balancing of (marginal) time preference and (marginal) productivity of investment, and this reinforces the validity of the foregoing argument.

Among the earliest to formalize a relationship between rates of growth and of interest are von Neumann (1932) and Kaldor (1937). But their conclusion that the maximum rate of balanced growth equals the rate of interest rests on the assumption that there is no final demand, which holds only for a closed system that admits no autonomous consumption. This may well be true for economies on a very low level of living and 'is not entirely irrelevant from the empirical point of view' (Chakravarty, 1964), but because of its logical inconsistency this model is of little economic significance. Nevertheless for our purpose, it highlights that, assuming social discount rates in developing economies are higher than growth rates, the latter comprise the floor limits for the discount rates in these economies.

While Leontief's (1951) closed model is a special von Neumann model, the generalised von Neumann models developed by Morishima (1960) and others show that full employment equilibrium interest rates could be derived from suitable savings assumptions. But the relationship established does not specify how the rates are actually determined especially because, in equilibrium, technology and prices must have so

adapted themselves that the equilibrium interest rate also measures the equilibrium rate of return over cost. Malinvaud's (1953, 1962) reformulation of the von Neumann model and Solow's (1963b) penetreting attempt, though different in presentation from the former both, allowing for consumption, present relationships between efficiency rate of interest and marginal social rate of return on investment. They show that in systems which maximise permanent maintainable consumption, the marginal social rate of return on investment equals the rate of growth and which, in the von Neumann sense, is also the efficiency rate of interest.

The above mentioned relationship can be cast into a convenient algebraic exposition. However, despite its neatness, operational difficulties go against the practical usefulness of the model because the social returns depend upon the consumption plans and neither these nor the prices can be contemplated in advance in view of the efficiency assumptions behind them. Further, the system does not allow for un- or under-employment and the situation dealt with under 'efficiency' and 'competition' assumptions is pareto-optimal and not real world one. It, nevertheless, is an advance over the specific von Neumann growth path and its virtue for us lies in the reversal of early Kaldor and von Neumann thinking in showing the dependant relationship of profit rate with growth rate rather than the latter being a maximum when equal to the interest rate. And, this is the kind of a link that we are interested in and not vice versa.

The Model

Having appreciated that a relationship between growth and interest rates should exist, we revert to the situation of developing economies such as of India for detecting the nature of the relationship. With 'unlimited' supplies of labour, this resource, in general, is not a constraint in these economies ; there it is the savings for investment which are the key limiting factor for growth, this being particularly true for India in comparison with many other developing countries where it may be less important (Streeten, 1968). Our attempt would, therefore, be more useful in terms of saving-income ratios, again assuming the long run equality of savings and investment.

We also make the assumption in accord with Kaldor (1956), Robinson (1956), Solow (1963a) and others that savings both of profit and wage earners are a function of their incomes and that profit earners' propensity to save is higher than that of wage earners, so

that the overall saving-income ratio depends on the distribution of incomes. No doubt, the saving-income ratio may be an increasing function of the rate of income growth but 'it would be difficult to deny that the proportion of profits saved is greater than the proportion of wages saved since the propensity to save out of corporate profits is high' (Hahn and Matthews, 1964). In any case our assumption is useful in that it caters for the likely difference in saving propensities of different income earners in an economy. Any of the below mentioned three situations in this behalf may be encountered :

i. The classical saving function—when savings from profits are positive and constant, and that from wages are zero ;

ii. The extreme classical saving function—when all profits and no wages are saved and ;

iii. The real world saving function—when part of profits as well as of wages is consumed.

In the first situation, the overall propensity to save (s) equals profit earners' propensity to save (sp) multiplied by the ratio of profit (P) to national income (Y).

Thus

$$s=sp.\frac{P}{Y} \quad \ldots \quad \ldots \quad (2), \text{ and}$$

by substitution in equation (1), we have

$$g=sp.\frac{P}{Y}\times\frac{1}{v}$$

$$=sp.\frac{P}{K} \quad \ldots \quad \ldots \quad (3)$$

Since $\frac{P}{K}$ is the rate of profit (r) on capital,

$g=sp.\ r \quad \ldots \quad \ldots \quad (4)$, so that with a given rate of growth and capitalists' propensity to save, the profit rate, which in the long run equilibrium equals the interest rate, is given by the equation

$r=g/sp \quad \ldots \quad \ldots \quad (5).$

In the second situation $sp=1$, and therefore

$r=g \quad \ldots \quad \ldots \quad (6).$

This is the same as in the specific von Neumann model referred to earlier. Neither of these situations appears to be realistic as the third

situation where savings in the economy may be contributed by both profit and wage earners. In this situation equation (2) is modified to

$$s=\left[\left(\frac{P}{Y}\times sp\right)-\left(\frac{P}{Y}\times sw\right)\right] \quad +sw \quad \ldots \quad (7), \text{ and}$$

equation (1) to

$$g=r(sp-sw)+\frac{sw}{v} \quad \ldots \quad (8),$$

where sw is the wage earners' propensity to save and we no longer have the case where g equals r except in a very special circumstance.

The above model indicates that the equilibrium growth rate depends upon the distributive shares and this model is valid in all situations except when $sw>sp$, which we assume as unrealistic. In other words we are accepting a model which holds under the conditions when $sw<\frac{S}{Y}\left(\text{saving-income ratio}\right)$, $sp>\frac{S}{Y}$, or $sw<sp$, and this we regard as satisfactory.

Equation (7) implies that the national savings (S) are composed of savings by profit earners (Sp) and by wage earners (Sw) and that this distribution is important in determining the corresponding profit or interest rate, because

$$s=\frac{P}{Y}(sp-sw)+sw$$

$$\equiv\frac{S}{Y}=\frac{Psp-Psw+swY}{Y}, \text{ or}$$

$$S=P(sp-sw)+swY \quad \ldots \quad \ldots \quad \ldots \quad (9)$$

$$=Psp+Wsw,$$

$\equiv Sp+Sw$, because Psp and Wsw respectively represent the shares of profit and wage savings.

From equation (9), we have

$P(sp-sw)=S-swY$, or

$P=(S/sp-sw)-(swY/sp-sw)$

$$\equiv\frac{P}{Y}=\left(\frac{S}{sp-sw}\times\frac{1}{Y}\right)-\left(\frac{sw}{sp-sw}\right), \text{ and}$$

$$\frac{P}{K}=r=\left(\frac{S}{sp-sw}\times\frac{1}{K}\right)-\left(\frac{sw}{sp-sw}\times\frac{Y}{K}\right) \quad \ldots \quad \ldots \quad (10)$$

Substituting the value of r in equation (8),

$$g=\left[\left(\frac{S}{sp-sw}\times\frac{1}{K}\right)-\left(\frac{sw}{sp-sw}\times\frac{Y}{K}\right)\right]\left[\left(sp-sw\right)\right]+sw.\ \frac{Y}{K}$$

$$=S/K \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (11)$$

This is consistent with equilibrium growth because equation (11)

$\equiv g/Y=S/Y\times 1/K$, or

$$g=s\times Y/K,$$

which is the same as equation (1).

Only when wage earners consume what they earn, can we do away with the distribution of income between the two groups as incorporated in the foregoing model. Assuming that wage incomes are all consumed and that profit earners either consume part of their earnings so that $sw=O$ and $1>sp>O$, or that they do not consume at all so that besides $sw=O$, $sp=1$, equation (9) becomes, either

$S=Psp$ ... ... (12), or

$S=P$ ... ... (13) respectively.

Following from this and with $\frac{P}{K}=r$ we have

$$r=\frac{S}{sp\times K} \quad \ldots \quad \ldots \quad \text{(12a), or}$$

$$r=\frac{S}{K} \quad \ldots \quad \ldots \quad \text{(13a) respectively.}$$

Under the above set of assumptions, the same result is obtainable directly from equation (10) as well.

The above model is derived on Kaldorian (Kaldor, 1956 and 1957) type assumptions where, while savings are split between those of wage and profit earners, profits are earned by the investment carried out by the latter. This is what Pasinetti (1962) calls a 'logical slip' in this, because by attributing all profits to the 'capitalists' as distinct from wage earners it implies 'that workers' savings are always totally transferred as a gift to capitalists.' Notwithstanding the separate categories of income earners, profit distribution, in the long run, is proportional to ownership of capital which depends upon an individual's savings. This necesitates a reformulation of the foregoing model in order to allow for the share of profits by wage earners because, assuming that $sw>O$, wage earners also become profit earners either, directly, by owning capital or, indirectly, by lending their savings to capitalists at a profit rate. Profits (P), therefore, are divisible into capitalists'

profits (Pc) and wage earners' profits (Pw). As such, equation (10) has an additional component as indicated below.

$$\frac{P}{K}=\frac{Pc}{K}+\frac{Pw}{K}=\left[\left(\frac{S}{sp-sw}\times\frac{1}{K}\right)-\left(\frac{sw}{sp-sw}\times\frac{Y}{K}\right)\right]+r\times\frac{Kw}{K} \quad \ldots \quad (14)$$

Where Kw is the amount of capital 'controlled' by wage earners. In dynamic equilibrium where $S=I$ (investment), we have

$$\frac{Kw}{K}=\frac{Sw}{S}=\frac{sw(Y-Pc)}{S}=\left(\frac{sw.sp}{sp-sw}\times\frac{Y}{S}\right)-\left(\frac{sw}{sp-sw}\right) \quad \ldots \quad (15)$$

By substitution (15) in (14), we have

$$\frac{P}{K}=r=\left[\left(\frac{s}{sp-sw}\times\frac{1}{K}\right)-\left(\frac{sw}{sp-sw}\times\frac{Y}{K}\right)\right]$$

$$+r\left[\left(\frac{sw.sp}{sp-sw}\times\frac{Y}{S}\right)-\left(\frac{sw}{sp-sw}\right)\right], \text{ or}$$

$$r\left[1-\left(\frac{sw.sw}{sp-sw}\times\frac{Y}{S}\right)+\left(\frac{sw}{sp-sw}\right)\right]=$$

$$=\left(\frac{S}{sp-sw}\times\frac{1}{K}\right)-\left(\frac{sw}{sp-sw}\times\frac{Y}{K}\right), \text{ or}$$

$$r=\frac{S}{sp.K} \quad \ldots \quad \ldots \quad \ldots \quad (16)$$

Even *a priori* this result does not seem to be right because savings as long as they contribute to society's investment capacity must influence its economic growth. A model which can happily ignore the savings of one class of earners cannot claim to exhibit either a satisfactory or a complete relationship between growth rate and its dependent parameters, being based only on the saving propensity of the other income earners. The above model is analogus to that of equation (12a) but not the same because now we have made no restrictive assumption about income and savings distribution and have, instead, allowed for the non-negative propensities to save of both wage and profit earners. It signifies a paradox that while workers' propensity to save influences the income distribution, it does not affect the rate of profit in the economy, and, likewise, the growth rate.

The same conclusion about growth rate can be reached with equation (16) as with equation (4), because the former is

$$\equiv\frac{S}{Y}=r.sp.\frac{K}{Y} \quad \ldots \quad \ldots \quad \ldots \quad (17)$$

though the latter was based on the assumptions that $sw=0<sp$. By substituting (17) in equation (1) we again have

$$g=sp.p \quad \ldots \quad \ldots \quad \ldots \quad (18)$$

and we are back to the classical savings function which is contrary to our assumption that savings by wage earners are non-negative.

The inconsistency in the above model can be seen to arise because of the underlying assumptions due to Pasinetti. Apart from the difficulties in his approach analysed by Samuelson and Modigliani (1966 a, b) and by Meade and Hahn (1965), Pasinetti's point against Kaldor is not so much of a 'logical' matter but a difference in assumptions. Pasinetti assumes that 'workers' save the same fraction of their wage income as they do of their profit income. Kaldor can be interpreted as assuming that a fraction sw of wage income is saved and fraction sp of profit income is saved regardless of who receives the profit. This would make sense, for example, if all of the savings from profits were done by the corporation that originally received the profits. Another interpretation of Kaldor's assumption is that each person has a saving rate that is a weighted average of sw and sp, with weights equal to the proportion in which his income comes from wages and profits. On the other hand, Pasinetti's assumption requires, so to speak, that people are 'hereditary' workers, i.e., one must save a fraction sw of one's income even if 90 per cent is profits and 10 per cent wages, as long as there is any wage income at all. This does not seem to be realistic.[2]

This difficulty does not exist in the model arrived at in equation (8), which holds in von Neumann context as well. Solow (1963 a) says that if 'both wage and profit incomes...be divided—perhaps in different proportions—between consumption and savings, then the relation between interest and growth rates depends on how consumption out of profits compares with savings out of wages'. If sw and sp be fractions of wage and profit incomes saved, then under the assumption of constant prices the capital stock value grows at rate g, so that

$$_{g}V_{R}=sw.WL+sp.pV_{R},$$

where V_R is the value of the capital stock, pV_R is the profit earned on the stock and WL is the wage income. From this it follows that the relationship between the rates of profit, p, and growth g, is $p-g\gtrless 0$ according as $(1-sp)\ pV_R \gtrless sw.WL$, i.e., as capitalists' consumption exceeds, equals or falls short of workers' savings. On the

[2] These points were made clear to the author by Professor R. M. Solow.

intermediate assumption that capitalists consume but workers do not save, the interest rate always exceeds the rate of growth because $sw=0$, and in golden age when the fraction of their income that profit receivers save is an increasing function of the rate of return,

$$g=p.sp \quad \ldots \quad \ldots \quad \ldots \quad (19),$$

which is same as equation (18). For the situation where wage earners also save, Solow accordingly concludes that

$$g=p\left(sp+\frac{1-Dsw}{D}\right) \quad \ldots \quad \ldots \quad (20)$$

where 'D' is the share of capital or of profit income 'P' in total income 'Y'. This equation can be re-written as

$$g=p\frac{Dsp+(1-D)sw}{D} \quad \ldots \quad \ldots \quad (21).$$

$D.sp+(1-D).\ sw$ is the global savings ratio, this expression being the weighted average of the saving propensities of the two income earning classes. Therefore, in brief, equation (21) is

$$g=p.\frac{s}{D} \quad \ldots \quad \ldots \quad \ldots \quad (22), \text{ or}$$

$$g=p.\frac{S}{Y}.\frac{Y}{P}, \text{ or}$$

$$=\frac{P}{K}.\frac{S}{Y}.\frac{Y}{P}, \text{ or}$$

$$=\frac{S}{K} \quad \ldots \quad \ldots \quad \ldots \quad (23)'$$

which is the same as equation (11) derived from the model represented in equation (8).

We have a link between the rate of growth and the rate of interest as follows :

$$p=r=g/\frac{s}{D} \quad \ldots \quad \ldots \quad \ldots \quad (24).$$

It is a re-written form of equation (22). In having reached this conclusion through Solow's formula too shows that the procedure satisfies the generalisation of the von Neumann model because with the latter's specific assumption of $sp=1$ and $sw=0$, equation (20) results in the equality of growth and interest rates.

In the generalised von Neumann models of Solow (1956, 1963 b) and Malinvaud (1961), who relax the assumption of no consumption out of profits and conclude similarly about the relationship between

the rates of interest and growth, the former exceeds the latter rate when wage earners consume all that they earn as is reflected in Solow's intermediate assumption. Though our model indicates a theoretical possibility for 'r' to be less than 'g' it is unlikely to be so on the basis of empirical evidence. Indeed, 'r' is likely to exceed 'g' without making the Solowesque assumption provided only that the denominator on the right hand side of equation (24) is less than unity. Apart from the position that entrepreneurial incomes and savings are greater than wage incomes and savings in developing economies such as India, this is consistent with our earlier assumptions about saving propensities that $sp > sw > 0$, so that s/D is less than unity but positive. For this reason the equality of interest rates with growth rates in such economies would appear to be the limiting case.

Apropos of, and assuming that sp and sw have non-negative values of less than unity and also that the former is greater than the latter, the rate of interest, for an economy with an 'optimally' determined growth rate, is given by equation (24) and is likely to be higher than the growth. As also pointed out by Chakravarty (1964), this rate of interest is different from that 'usually understood in connection with the capital or money market' because the model does not introduce uncertainity and the corresponding distinction between various types of assets. As he says, Solow's formula 'takes into account both productivity and thrift. The influence of productivity is taken into account in the numerator, while the savings coefficient subsumes the influence of thrift. Behind thrift lies the factor of 'time preference'. And the rate of interest that we obtain thereby is the social discount rate appropriate for discounting net benefit or cost and benefit streams of projects in a planned mixed economy that includes profit as well as wage earners.

Discussion

At this stage it is essential to examine the salient features of our model's anatomy to reveal the implications that flow from it. The crucial assumption on which the relationship hinges is that the savings, investment and the growth rate chosen for an economy are 'optimal'. This we assumed right at the outset. Without the 'optimality' assumption the model cannot be relied upon for the purpose of evaluation in a social context and the micro-planner, for whose use the relationship is derived, has no means of testing it. He has nevertheless, to depend on the assumption that the marginal productivity of

investment at the planned level enables the economy to sustain growth at the planned rate. Thus the relationship is operational only under conditions of macro-planning when, besides the setting of a target growth rate, the corresponding rates of investment and savings, considered feasible of implementation during the planning horizon, are also specified. We assume that these conditions are met with in India, and the allowances and shortcomings that may exist in the national planning process are reflected in a relationship derived from our model. The micro-planner cannot assume the role of refuting or improving upon the relevant parameters as represented by macro-level decisions that are, deductively, placed as optimal for a given national economic situation. All we are saying is that by making the 'optimality' assumption, project appraisal with a discount rate derived on the basis of planned growth rate is, for better or worse, consistent with national planning objectives and our model is useful if one is not dissatisfied with that limitation.

Our social rate of discount is thus a normative rate aimed to fit in within the ramifications of the planning process at sectoral and sub-sectoral levels and may be likened to a shadow rate of interest for that purpose. This is not the same as a shadow rate that could be calculated ex-post from a programming analysis once the design of relevant projects and the optimum pattern of inter-and intra-sectoral combinations are supposed to be known. Our discount rate may diverge from the optimum social discount rate and lead to project selection that may not result in a growth rate that would be truely optimum for an economy. Notwithstanding that, it is this discount rate that is of operational usefulness for decision-making in project planning and not the optimum rate of discount, though the latter is theoretically important for micro-planning in the determination of the optimum rates of savings and growth. And since the growth paths chosen by nations are not optimal in the sense of a programming model, our social discount rate is an approximate shadow rate of interest with the added advantage of practical applicability.

Now it is clear that the 'optimality' assumption is not so restrictive as it may have appeared. The assumption simply construes that the specified rate of savings would result in the target rate of growth if the concomitantly assumed incremental output capital ratio is not violated through an inconsistent choice of techniques. A project selected on the basis of our discount rate would, therefore, fulfil this so-called optimality condition provided that its marginal productivity

is non-negative. Indeed this should be a necessary condition to ensure against the misdirection of investment resources vis-a-vis the set rate of growth so that the validity of such a project appraisal remains although the selected growth path is not truely optimum.

In so far as our model has a similarity in its genesis to the Harrod-Domar and subsequent macro-dynamic models, which assume long run general equilibrium under conditions of full employment, its application in an economic with chronic un-or under-employment may appear unrealistic and contradictory to the earlier statement to disregard the golden age assumption. But full employment, implying that the general level of output at any one time is limited by available resources. 'need not necessarily imply the full employment of labour except in a developed economy where the available capital equipment is sufficient or more than sufficient to employ the whole of working force' (Kaldor, 1957). But this is not the case with capital deficient countries like India. In their economies, despite surplus labour, 'the situation is not one of Keynesian underemployment as the supply of goods is in general inelastic in the short period and irresponsive to increases in monetary demand. Here again it certainly appears more correct to assume that output at any one time is limited by the scarcity of resources (including skilled manpower) rather than by effective demand' (Kaldor, 1957). Nurkse (1960) and, in particular, Rao (1963, 1964) have argued lucidly along these lines.

Further, since long-run full employment is not incompatible with short-run un-or under-employment as long as the economy is growing (along a planned path), the model acquires realism because the planning horizon over which it is intended to be applied and that for which its parameters have been derived, i.e. the five year and the perspective planning periods in India, constitutes the short-run phase. Also, if the growth (or employment) rate equals or is greater than the rate of population growth, as is assumed in Indian macro-plans, the case of underemployment is not inconsistent with an apparently full employment model, because the back-log of unemployment is, as it were, exogenous to the system.

The above discussion makes it obvious that the discount rate determined on the basis of our model is not a once-for-all choice and will have to be varied according to changes over time in the policy parameters of a society. This is yet another element of realism that the model incorporates because social time preference is bound to change as the structure of economy changes through growth.

The operational significance of our approach is not just to determine the social rate of discount. It is mainly to help in the evaluation of the social worthwhileness of a project and its alternatives. If the present value of the benefits of a project is not in excess of the present value of its costs at the relevant discount rate or if its internal rate of return is less that the discount rate, the project fails to be admissible because it then falls short of the society's aim of achieving a certain target rate of growth. On the other hand, a project among the admissible options is more worthwhile than the rest, if its selection maximises efficiency in resources allocation by producing a higher ratio of benefits to costs both discounted at the relevant rate or by breaking even at a higher discount rate than the one obtained through our formula. Thus the discount rate, which we can determine from the parameters of growth rate, savings coefficient and the share of profit incomes, is a useful index in discriminating between socially profitable and non-profitable projects as well as in ranking the profitable options among themselves.

With the help of our relationship, project planners are spared from the need to resort to an arbitrary choice of discount rates such as the bond or the market rates, which are beset with the complexities of market imperfections and do not reflect the social costs of resources or society's collective time preference. Also they need not search for unavailable data or make unrealistic assumptions about the choice and productivity of projects in the rest of the economy as is necessary for more elaborate but less practical methods of determining social time preference and social opportunity cost rates. Indeed, the attempts to search for an *ex-ante* social time preference rate are not only unnecessary but also unproductive, because the desirability of exchange of one stream of social gains for another is in practice a matter for social policy, which takes account of both the economic opportunities and various other considerations, and because collective social time preference maps cannot be constructed from individual preferences.

Notwithstanding that we have avoided these difficulties and made no assumptions about social policy, as, in fact, our starting point is the goals expressed by a nation, our method may not appeal to private sector. The latter aims at the maximisation of an objective such as profits from the point of view of an enterprise, so that a discount rate linked with national objectives may not seem relevant in its investment analyses. Nevertheless, it is suitable for and relatively easily applicable to a project appraisal in the public sector and in

cases where the merits of a projects are sought to be evaluated from the social point of view. Another practical advantage of our approach is that all projects can be compared in a commensurate manner, because of the uniform economic evaluation standard applicable throughout the economy and that decision makers can rank investment options directly on the basis of their economic efficiency.

Summary and Conclusion

A model has been presented which exhibits a relationship between an economy's rate of growth and rate of interest. The latter reflects society's time preference during the planning horizon of an economy for which, and if, the rate of growth has been set by policy planners. A discount rate derived from such a model can be used for project appraisal from a social point of view. This may lead to a selection of projects not necessarily according to their 'intrinsic' merit but one that satisfies most the policy regarding overall economic growth pursued by a society during a particular phase of development.

Considerably more refinement than could be indicated in this paper is required to ensure consistency with the national as well as regional objectives and to evaluate the real contribution of a project to the development process. Here the attempt has been to make a case for the relevance, in social terms, of a discount rate linked with the target rate of growth by providing a conceptual basis to show the existence of a symmetrically valid relationship between the two.

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APPENDIX 11
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Optimal Systems Designing for Efficiency in Kashmir's Renewable Resource Use

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I. Introduction

Renewable natural resources, such as soil, forests and pastures, comprise a dynamic system with two mutually dependent components, viz; resources and society (37). Among other things, production is conditioned by environmental constraints, i.e. the quantity and quality of land. This makes renewable resource planning different from production processes of which labour and capital are the primary inputs.

Since society's needs outrun means, and more so in poorer countries, an area's renewable resources should be used with highest efficiency possible. For this, a systems analysis is required (38). This is because the planning problem is comparable to so-called 'new class of managerial problems' (9, p.4) involving the interaction of the components and requiring the determination of the best solution in terms of the overall interest of the system, i.e., optimization of the systems design.

II. Interdependence and Constraints

Most 'discussions of formal decision models assume . . . that all investment alternatives are independent in the sense that the acceptance of any set of them does not affect the feasibility or profitability of accepting any different set' (57, p.194). Difficulties arise when the independence assumption does not hold (47). This assumption is strong since a use of any acre of land has an alternative. Such mutually-exclusive set of options is not the only alternative to independence. Contingent projects can arise, for instance, when 'acceptance of one proposal is dependent on acceptance of one or more other proposals' (56, p.11).

The choice of cultivating paddy on paddy-land is determined not only by the effects of the choice of foregoing poplar and/or wheat cultivation on it. It is determined also by the effects of what use is made of poplar- and wheat-land, since all the lands could be used for producing any of the three commodities. The effects include the conjoint benefits and costs of options, the consequences on demand and supply of commodities and on the use of complementary resources. Such effects underlie the interdependence of

alternatives.

The interrelatedness exists even in the production of one commodity. The choice of raising poplars on poplar-land depends on the relationship between the benefits and costs associated with it and those of the alternative courses of poplar cultivation, viz., on poplar-land with a different set of techniques and on other suitable lands. The choice is influenced also by similar relationships with other methods for producing wood. These include high- and farm-forestry, by which fir and willows of certain comparable properties are cultivable. All these options compete with each other for common scarce resources. Many of them are incompatible too, e.g., a site planted to poplars is pre-empted from other uses.

The options cannot be chosen from benefit-cost, or profitability, ranking order. For instance, it may not be feasible to allocate all or any land of a certain type L_1 to the most 'profitable' activity A_1. The overall profitability of the system may be maximised by allocating the land to a less profitable option A_2 and undertaking the activity A_1 on another land type L_2. This can happen, if lesser profit per unit of resource is reduced by A_2 activity on L_1 than by A_1 on L_2. That is, A_2L_1 and A_1L_2 is a more profitable combination than A_2L_2 and A_1L_1, when A_2 and A_1 are components of an inter-related system.

Benefit-cost or marginal analyses could handle few contingent projects if represented as sets of mutually-exclusive compound projects. One could consider the two alternative designs either A_1L_1 and A_2L_2 or A_2L_1 and A_1L_2. The gross marginal changes would indicate the better of the two. But even this may be beyond the scope of such analyses for compound-project selection. Suppose the activity A_1 can be pursued with i techniques, activity A_2 with j techniques, and the area of L_1 is m and L_2 is n. Then the number of options and the choice of combing them is vast. Instead of only two alternative compound projects, these will be any combination $\sum_i A_1 i + \sum_j A_2 j$, each $A_1 i$ and $A_2 j$ activity varying in magnitude from 1 to $m+n$ and interacting with each other so that the scale of one affects the rest.

In the real-world renewable resource systems the number of options or the alternative component projects of a system are numerous. Even a finite but large number of options poses problems. They can be combined in many ways. Each combination, or systems design, has an associated set of consequences, depending on how the benefits, costs and other effects of the component options interact with each other. The benefit-cost, or marginal, analysis techniques do not identify the possible permutations and combinations of options. Since neither a selection from such an array nor the interrelatedness of options is considered by benefit-cost analysis, it cannot directly lead to systems designs.

The mutual exclusiveness and the interplay of commodities, techniques, and scales of options, yields varied patterns of resource use on each land type and on all of them considered as a whole. A cause of the interdependence problem is the restricted availability of lands of different types. Other constraints add to the complexity.

Often the only constraint when explicitly considered, is of capital rationing (31). Benefit-cost analysis could be then applicable; projects may be selected in a descending order of their marginal efficiency, or benefit-cost ratio, till the budget is exausted. F.N. 1 But the problem is not so simple. Land and labour too may be limited. The three constraints may be inconsistent. All the available resources may not be simultaneously usable to specified extents. The problem of combining the interdependent options emerges. The combinations need to be permutated and the relative loss in benefits from the non-use of resources in each design evaluated.

Besides resource restrictions, institutional constraints may exist. Demand and price relationships of the commodities are among the other constraints. Given such an host of constraints,[F.N. 2] the object of systems designing is to maximize benefits without violating, rather than precisely fulfilling, the constraints.

III. Mathematical Programming

When confronted with the twin problems of interdependence of options and the multiplicity of constraints, marginal or benefit-cost, analyses

cannot decide optimal resource use. A 'source of the subjective non-optimality of such decisions seems to be man's demonstrable inability to take proper account, simultaneously, of the various component attributes of the alternatives' (52, p. 257). The overall evaluation by weighing and combining all the separate attributes at the same time is required for rational systems designing. This implies comprehending and evaluating all the repercussions caused by an adjustment in any one of the system's individual operations. Such a task calls for 'a formal, systematic approach - that is, mathematical programming' (46). The data already being used in informal planning methods can also be adapted to programming models 'with gain in precision of planning and a more efficient use of scarce resources' (25, p. 246).

Programming techniques apply to linear as well as non-linear problems. We have formulated our problem as a linear programming (LP), or linear optimization (30, pp.1-59), model. Since 'non-linear functions could under certain conditions be approximated by linear functions, methods of linear programming have been applied even to basically non-linear problems' (51, p.24). Non-linearity of the prices in our problem does not arise, because the world demand and supply schedules will not be affected significantly (c.f. footnote 14). Non-linear production functions are dealt with by considering a number of activities for a process. Thus the various points on a non-linear production possibility curve are represented e.g., a number of options are included in the model for paddy cultivation, inter-alia, for different fertiliser doses[P.M.3].

Although the basic principle of LP and 'the marginal analysis is essentially the same' the former's greater value is that the limiting inequalities and the maximand function are more accessible to information' (6, p.9). This is because a linear relationship is easily observable and only few parameters are needed to define a functional relationship. Yet, LP 'models are systems models' (7) and hence useful for systems analysis. Also because LP 'tends in the mutatis mutandis direction' (ibid).

LP models can function in a mutatis mutandis manner satisfactory enough for renewable resource planning. This only requires the incorporation of all relevant facts of interdependence and such flexibility in lay-out

that the model reacts to change in one variable by affecting the related ones. A high degree of absolute accuracy [F.N.4] of data is not necessary in such studies. It suffices to have the data of relatively uniform quality, accurate or inaccurate (7). Since all variables are simultaneously adjusted in the model, only the ordinal ranking of options and relative proportions of variables are important (38).

The essentials of the model are the objective function, alternatives and the constraints. Any problem 'which has these three components can always be expressed as a linear problem' (24, p.2). Ours is a choice problem, beset with land and other constraints. Alternative processes exist, competing for Kashmir's limited resources. The objective is to achieve such a combination [F.N.5] of the options that efficiency in overall resource use is achieved.

The above economic problem becomes an algebraic problem by omitting most of the explanatory text. As an LP problem it involves 'maximising a linear expression, the objective function, subject to the satisfaction of other linear relations, known as constraints'(59, p. 22). i.e.

$$\text{Max } B = \sum_{i=1}^{n} a_{oi} x_i, \qquad (1.1)$$

subject to:

$$\sum_{i=1}^{n} a_{ji}\, x_i \leq a_{jo} \qquad (j = 1,2, \ldots .m), \qquad (1.2)$$

where x_i are the unknown variables, a_{oi} their objective fuction coefficients, a_{ji} their contraint coefficients and a_{jo} the limiting level of the constraints. We seek a vector $x = (x_1, \ldots ., x_n)$ which maximises (1.1), without engaging in impossible negative production processes. The latter is a side-condition, which 'marginal analysis is, by itself, incapable of taking account of' (4, p. 73) but programming can by introducing non-negativity restrictions

$$x_i \geq 0 \qquad (i = 1,2, \ldots ., n) \qquad (1.3)$$

In contrast to the allied problem of solving simultaneous linear equations, LP problems are not solved directly. As such, 'we ~~restrict~~ resort to iterative solutions' (17, p. 67). The Simplex procedure [F.N. 6] for this involves the replacement of inequalities by a system of equations. This is

done by adding slack variables, so that (1.2) reads as:

$$\sum_{i=1}^{n} a_{ji} x_i + x_{n+j} = a_{jo} .$$

The slacks too must satisfy the non-negativity restriction,

$$x_{n+j} \geq 0 \qquad (j = 1,2, \ldots, m).$$

Now the problem represented by an m x(m+n) matrix can be expressed as a set of constraints

$$\begin{aligned} Ax &= a_o \\ x &\geq 0 \end{aligned} \qquad (2.1)$$

to the objective function

$$\text{Max } B = a_{o\cdot}^T x,$$

where x^T and a_o^T are vectors with (m+n) components,

$$x^T = (x_1, x_2, \ldots . x_n, x_{n+1} \ldots . x_{n+m}),$$

$$a_o^T = (a_{o1}, a_{o2}, \ldots . a_{on}, a_{o,n+1}, \ldots . a_{o,n+m}),$$

and $a_{o,n+1} = a_{o,n+2} = \ldots . = a_{o,n+m} = 0$

A modification of the above simplex algorithm is the revised Simplex or the inverse matrix method (IMM) (12).

If it is assumed that the nonbasis variables (c.f. footnote 7) all have zero values, there are left m basis variables whose values have to be chosen to satisfy m constraints. The solution of these constraints for the v values of the m basis variables requires the inverse of m Xm matrix of the coefficients of the basic variables in the constraints. As such, only inverse matrices have to be found, so that IMM calculates particular elements of the tableau only when required. This means fewer operations than in the Simplex, a reason why IMM is particularly suited to automatic computation (55).

The formulation (2.1) can be expressed as:

$$a_{o\cdot}^T x + x_o = 0 \qquad (2.2)$$

$$\begin{aligned} Ax &= a_o \\ x &\geq 0 \end{aligned} \qquad (2.3)$$

where x_o is a variable added for the objective function expression in the matrix form equation (2.2), $- x_o$ denoting the value of the objective function (2.1) for the basic solution.[F.N.7] Now (2.2) and the constraint system (2.3) may be combined as:

$$Bx = a_o \qquad (2.4)$$

and all the Simplex calculations done in this single system.

The IMM has two versions, the explicit inverse and the product form. We use the latter. In this, the inverse is the product of a sequence of m x m matrices, only one column of each matrix differing from a column of the unit matrix. This makes computation easy. As Beale (5, p. 66) records:

> "In the straight simplex method one has to update the complete tableau, involving (m + 1) x (n - m + 1) numbers, at each iteration. In the explicit inverse method one only has to update the inverse, which involves (m + 1) x (m + 1) numbers. This is a considerable saving if, as is usual, n is much larger than m. The advantage of the product form comes from the fact that even this updating is avoided".

IV. Salient Features of the Model

In Kashmir, there are 23 main renewable resource uses. These include peasant and some cash-crop farming, horticulture, sericulture, forestry, grazing and livestock-rearing, and watershed protection. The resource system extends over about 3.21 million acres.[F.N.8] The feasibility of adjusting the present use pattern is investigated in three steps: identification of the bio-technical possibilities of resource-use;[F.N.9] benefit-cost analyses for ranking the options; and optimization. The first two steps are incorporated in the third.

The total land area, Y, in Kashmir is represented by various land types 1, 2, ...,n, so that:

$$Y = \sum_{i=1}^{n} X_i \qquad (3.1)$$

where X_i is the area of the i-th land type.

With many possible commodities, the area suitable for the j-th commodity is:

$$Y_j = \sum_{i=1}^{n} X_{ij} \qquad 0 \leq X_i \leq 1 \qquad (3.2)$$

The total area for all the commodities:

$$\sum_{j=1}^{m} Y_j = \sum_{j=1}^{m} \sum_{i=1}^{n} X_{ij} \qquad 1 \leq j \leq m \qquad (3.3)$$

A commodity may have a number of production techniques, so that for the kth technique we have:

$$Y_{jk} = \sum_{i=1}^{n} X_{ijk} \qquad 1 \leq k \leq \ell \qquad (3.4)$$

The model incorporates three dimensions; an activity represents the production of a particular commodity by a particular production technique on a particular land type. For the i-th land type, 1 to m commodity dimension exists. For the j-th commodity type, we have kij technology types ranging from 1 to ℓij, so that the objective function is:

$$\text{Max } Z = \sum_{i=1}^{n} \sum_{j=1}^{m} \sum_{k=1}^{\ell} C_{ijk} X_{ijk} \qquad (4)$$

The first subscript, i, as usual, refers to the row. But there are two subscripts j and k for the column vectors, i.e., the element for X_{ijk} is in the i-th row and the jk-th column. For each i, we therefore, have:

$$\begin{bmatrix} X_{111} + X_{112} + \cdots + X_{11\ell} \\ X_{121} + X_{122} + \cdots + X_{12\ell} \\ \vdots \\ X_{1m1} + X_{1m2} + \cdots + X_{1m\ell} \end{bmatrix} \qquad (5)$$

By repeating and suitably transposing the above for all the n land types, we have the real, or structural, variables, represented by column vectors, as combinations of commodity, land and technology types. That is, each commodity type has a number of variables for every land type. The number is rarely zero, i.e., when a commodity cannot be raised from a particular land type with any of the adoptable techniques.

The model includes 87 land types, 23 commodities and a varying number of techniques per land type - commodity combination, often six. Since in theory, any commodity can be raised anywhere, the total area required for all the options could equal Y.m.ℓ,

i.e., over 6417 million acres. However, not all commodities are combined with all land types. As such, the area that would, in theory, be used by the options considered in the model equals about 16 million acres as against about 3 million acres available in Kashmir. This difficulty can be illustrated by reference to a specific commodity, say paddy. Its production can use 9,54,770 acres, i.e., besides 3,74,000 acres of land presently under paddy, 580,770 acres are suitable for various paddy options from land types presently under other 22 uses. To this extent, a design admitting all paddy activities should preclude the other activities. Instead, other activities are similarly considered for all suitable land types in disregard to present uses and other new options.

The above represents the problem of mutual exclusiveness. A commodity may be suited to more than one land type; the obverse is that the i-th land type may be suitable for a number of commodities. To handle the problem without prior discrimination among the mutually exclusive options, all are included while the matrix rows are constrained by a right-hand-side (RHS) coefficient, representing the area of each land type. The structural constraints are introduced as inequalities, so that for all j and kij:

$$\sum X_{ijkij} \leq X_i \qquad (i = 1, 2, \ldots, 87), \qquad (6)$$

subject to the non-negativity restriction:

$$X_i \geq 0, \qquad \text{for all } i$$

The row element for the variables using the i-th land type is unity, and zero when not using it. These rows are important, also because interaction among the variables in 'expressed in the form of constraints' (3, p. 108).

Not all the land types are mutually exclusive. This is because many overlap in their amenability to different commodity-technique combinations, i.e., part or whole of the area of one may be included in another type too. By such overlapping, the total land used will exceed the actual area available. To avoid this, we have done what may be called nesting of the land types. That is, the constraints are contained in one another by dovetailing the overlapping-, or sub-, types within a master constraint. The latter's RHS

coefficient is the sum of the sub-types net of the area overlapped. An activity using one or the other sub-type has positive coefficients in the sub-type as well as the master constraint rows. By specifying master constraints for every set of the overlapping types, consistency is ensured in the use of sub-type areas without sacrificing flexibility in choosing among the options.

Nesting leads to many land constraints. But we have arranged them so that some are not required in the model, e.g., the counterpart of a set of mutually exclusive sub-types. The constraint for Kashmir's total land area is also excluded, for this will be restricted by the individual master constraint. In this way we have only 87 land constraints. Through these some directly dependent activities are also linked together as transfer activities, e.g., by introducing appropriate negative coefficients for all farming variables in an extra row, constrained by a ≥ 0 inequality and having positive coefficient for the dependent farm-forestry activity in the same row.

The total number of activities considered are 1187. But those with benefit-cost ratios less than unity are excluded from programming, so that we emerge with the 'problem statistics - 154 rows, 982 variables, 24739 elements, Density = 16.35' (41, p.5). The 67 rows in addition to the 87 land type rows are for other resources, demand and output, budget and incomes. Most of them are specified separately for the earlier 5 year periods during the 30 year planning horizon adopted in the model. Such multiperiod analysis (28, p.17-25) will facilitate adjustments in response to variations through time. It enables such optimization that changing supply and demand constraints are satisfied as far as possible. From 'reduced-costs' of options at the optimal level, the economic significance of deviations from the constraint limits through time periods is also known.

The model incorporates multiple objective functions. These include three sets of benefit:cost ratios at constant discount rates of 5, 10 and 15 percent over the planning horizon, and two sets at changing discount rates. The latter are 15 and 10 percent for the first 15 years and 10 and 5 percent respectively for the later 15 years. The other four objective functions are sets of present social worth at the three constant and one changing discount rate.

V. Results Discussed

(a) Activities and Land Use

The appendix I shows the various land allocation patterns. The pattern for the Basic Model$^{F.N.10}$(BM) is the present use. It comprises 23 as against 41 to 45 activities each for the Optimal Models (OM). The latter represent optimum combinations of commodities, techniques and scales of each activity. The activities exceed the number of commodities, because optimal designs include more than one technique for producing a commodity, e.g. on different land types. Many activities of the BM are replaced by those which are different either in magnitude or in technique or both, whether or not a commodity is produced from the same land type as in the BM.

The activities, of which the scales as will as techniques are different from the BM are for paddy, maize, wheat, oilseeds, saffron, pyrethrum, scrub, fir, poplar, sylvopastoral and culturable land products; however part or all of the BM activity too may be included e.g. saffron. Activities similarly chosen for some of the OM are for apple, almonds, and farm-forestry. For some commodities no activity is included in the OM, viz. pyrethrum, scrub. Sometimes, the land area-wise magnitude is the same as in the BM but the technology differs viz., deodar, kail, village grazing, alpine grazing, watershed-protection. The sericulture, walnut, willow, and agri-silviculture activities remain unchanged both in magnitude and technique.

The BM uses 31,27,452 acres and the OM 32,07,084 acres. The magnitudes of individual activities and, in some OM, the total areas for various commodities differ markedly. Activities not in one OM may aquire a positive magnitude in another. This, or the different magnitudes for the same activity in the various OM, is because of their different objective functions.

(b) Commodities and Industries

Except for maize, wheat, oilseeds and pyrethrum, the commodity outputs in the OM are either equal to or more than in the BM. The other exceptions are paddy and firewood in OMI. Two new commodities, pulpwood and blue-pine oleoresin, will be produced. The pulpwood output will about sustain 300 tons a day pulping facility (44, p. 231). From the oleoresin, about 100 tons of

synthetic camphor can be manufactured annually.[F.N.11.]

But for OMI, the foodgrains output from the OM is higher than from the BM. This is because of improved paddy technology. The effect on food supply vis-a-vis demand, on the basis of the population trend and calorie requirements (36), is that the existing deficit of 1128 and 1322 million K. calories during the first and the second periods respectively will increase only with OMI. The other OM considerably narrow the gap. This conforms with the fourth plan priorities for Kashmir, i.e., 'the objective should be only food adequacy and not food self-sufficiency (45, p.2).

Firewood is considered as an essential commodity because of Kashmir's prolonged winters and the lack of alternate fuels. With the BM, its production has reached the limit of 6.30 million cubic feet (42, pp. 121-124). This doubles with the OM, except for OMI. Given the fuel demand projections (43, pp. 104-109), the BM output is short by 0.70 and 1.70 million cubic feet during the first and the second period respectively. Allowing for the substitution of dung burnt as fuel, the deficit increases to 2.03 and 7.20 million respectively. Correspondingly there is usually a surplus with the OM[F.N.12].

In the face of the present 'inadequate supply of fodder', it too is regarded as an 'essential' commodity (14). It is in short supply in other regions too (60). The improved range management techniques in the OM, together with the usually increased paddy straw output, enhance the forage and dry fodder supply. But for OMI, the increase is sufficient to mitigate the current underfed state of livestock, provided their numbers are not allowed to increase (61).

Increased or decreased output of all the other commodities is possible to sell or make good through trade. Most of their output, except for oilseeds, is presently traded outside Kashmir. With no or very small output from the OM, the present oilseeds import will increase [F.N.13]. This will be more than balanced by the larger exports of saffron and wood. The demand for wood is increasing fast (58). 'In every sphere of forest products, an increased requirement is forseen (49). India is already a net importer to a greater

extent than the increase (50). Scope for increased export of saffron too exists (48). The increased saffron output is possible by replacing less profitable production options.

The conifer wood production increases from a change in technology, e.g., shorter rotations. The extra poplar wood is derived from new plantations. With these increases, scope exists to expand and establish industries to meet the demand, e.g., of sawnwood, shooks, joinery and prefabs, particle- and ply-boards, and matches (15) as well as sports goods (32).

(c) Financial Implications

With the OM, the state revenue during the first period is about 12 times of the BM. The increase is larger over the planning horizon, the overall average annual revenue being about Rs. 70 million more than that during the first period. This trend, arises from the initial investment for systems' readjustment, after which most activities incur only the operation, maintenance and recurring costs.

The budgetary requirement of the OM is uneven over time. Instead of being 1/6th of the total, it is more than 1/5th during the first period and only about 1/8th during the second period. Inspite of the large outlay for the OM, the total budget over the planning horizon is little more than 1.1 times of the BM.

The OM yield surplus revenue in all the periods. It averages at over Rs. 400 million against the deficit of over Rs. 340 million with the BM. The total net financial gain, whether of the private producers or the public agencies, increases too. It is about trebled, even in the first period, for most of the OM. In the long run, it will be possible to expend more in the renewable resource sector and to mobilize resources for investment elsewhere in the economy. It, therefore, appears worthwhile to allocate adequate finance in the first period to implement an optimal design. The loosening of an arbitrary constraint, if it exists, of a tight initial budget for the sector is required. This may be possible, for annual budgeting is primarily a measure of control. It should not prevent flexibility in switching resources to more profitable options.

The level of the producers' income may be a constraint. It may be necessary to ensure that the present subsistence living standard does not ebb (14). All the OM meet the constraint, except for OMI during the first period. The net income of the peasants and other non-governmental producers is nearly doubled. It is higher than with the BM, for the first period too.

(d) Employment

The OM contribute to an equitable income distribution, also by using more labour than the BM. The only exception is OMI. For a rural labour force of over 610 thousand workers (53, p. 26), the other OM about exhaust the existing un- and under-employment pool of about 36 million man-days. They fully employ the labour as against 117 and 342 thousand unemployed, i.e., 19 and 55 percent unemployment, with the BM and OMI respectively.

On the basis of labour force projections (33), 238 million man-days will be available in the first year of the plan as against 184 million in 1960-1961 and 300 million on an average. Similarly, the peak-season labour is estimated to increase from about 30 million to 40 million man-days. Accordingly, even the maximum possible average annual employment is less than the potential rural work-force. The maximum is 69 percent for OMIV. The other OM, except for OMI, will absorb about 62 percent in contrast to 49 percent by the BM.

A redeeming feature is that the unemployment during the earlier periods is less than the average annual unemployment. The 83 percent employment possible with OMIV during the first period is 2 percent more than with the BM during the pre-plan period, inspite of the interim work-force increase. The 75 percent employment potential of the other OM, except for OMI, is also more satisfactory than the BM.

During the final plan period most OM will employ only about half the total rural labour, though still over 10 percent more than the BM. Such a situation may not arise after six 5 year plans are implemented. As development goes forward, the secondary and tertiary sectors absorb increasing proportions of labour (10). Though absolute numbers in the rural sector may not decline, the ratio vis-a-vis rest of the economy will. An immediate massive unemployment

such as with the BM or OMI, is difficult to relieve. Not so much in the later periods because of the scope to siphon off surplus rural labour into processing and service industries. The industries may develop, among other things, in response to the direct benefits and linkage-effects of an OM.

(e) Socio-economic Merits

Apart from the financial, physical and institutional analyses briefly discussed in the foregoing, it is the results of a social benefit-cost analysis F.N.14 embodied in the objective function, that condition the optimal systems designs. The marrying of such an analysis with an optimization model is novel. Another methodological novelty is that the objective function is a ratio. This is unconventional. A ratio, is not normally used to maximise a linear function. But we have devised our model in such a way that this is possible, only that it involves an extra step in the interpretation of the result. The benefit:cost ratios are the objective function coefficients. The programme chooses activities to maximise the sum of the products of their ratios multiplied by land areas. This is why the objective function value in the optimal solution is a large figure, much unlike a ratio (c.f. the last section of appendix I). This is meaningful only in terms of the maximand, because the multiplication of the coefficients is questionable in so far as a ratio should be the same for all magnitudes of an activity. Nor can ratios be additive when expressed as whole figures, as we do, instead of ratio proportions. Nevertheless, the solution is not affected; algebraically the summation procedure conforms with the linear programming theory.

The difficulty is reduced by recognising that the linear sum of the ratio products is not the benefit:cost ratio of an optimal system. Instead it is the sum of the individual ratios of the chosen activities weighted by their land areas. That done, the overall ratio of a system is identified. This will turn out to be the same as the product sum in the solution divided by the total area used in a system. Either way, the benefit:cost ratios, corresponding to the algebraic sums underlined in the last section, are those shown in the first section of appendix I.

Such a consistency prevails because all the elements in the programming matrix and the objective function coefficients are for an activity over a unit acre. Further, the ratios are always the benefits to a unit cost of inputs. Hence the weighting in the programming procedure to make the ratios directly additive is unnecessary; at unit activity level, all options are directly comparable. When they are mutually exclusive, they compete for the same unit area. When higher activity levels are considered all options are competing, again in the same directly proportionate order as at the unit level. Since at each iteration of the program there is uniquely homogeneous discrimination among the options, the choice and magnitude of the activities will be attained optimally notwithstanding the maximization of the products. The weighting is implicit in such a programming set-up.

The economic merit of options could be indicated also by their absolute (net) benefits. But these are contingent on project size, so that resources are channelled in one or the other option, disregarding their marginal yields. This is not useful when resources are scarce.

The disadvantage of the absolute criterion is illustrated by running the model for maximising present social worth (PSW), i.e., the objective function coefficients are the net discounted benefits of options. Though the PSW of the resulting systems designs are higher, their benefit:cost ratios are lower than of the OM $^{F.N.15}$(c.f. appendix II). For every 100 input units, a loss of 41 to 83 units occurs vis-a-vis the benefits possible with the corresponding OM. Thus, the absolute increase in the PSW embodies a loss to the economy through the diversion of resources from investment options as efficient as are selected by the OM. This is obvious also from the higher budget and other resource requirements for the PSW models.

Even when the net financial gain is more than in the OM, as only for one PSW model, the increase is less than the increase in material inputs alone. This indicates that the marginal productivity of additional resources does not justify increased investment for magnifying the PSW. The OM do not suffer from this disadvantage. The efficiency criterion deploys resources among the renewable resource use options and limits the total resource commitment

to the system in such a way that the economy's overall PSW is maximised.

While the PSW criterion may demand additional resources, an increase in efficiency will always increase the PSW for the same size of investment. The PSW of the OM are usually more than double of BM (c.f. appendix I). Also the benefit:cost ratios are about five times of the BM. Apparently, the efficiency, considered as 'the effectiveness with which scarce resources are used' (2, p.12), will be about five-fold by re-aligning the production pattern towards an optimal design, whichever is based on benefit-cost analyses at the appropriate discount rate.

The appropriate discount rate for socio-economic evaluation is one which is consistent with national objectives (39). The rate should represent social time preference as reflected by the target of growth set for an economy. For the relevant parameters in India's fourth five year plan, the social discount rate during this period is 10 percent. This suggests that OMII is the appropriate design. But, since social time preference changes in the long run, it may be realistic to appraise costs and benefits at discount rates varying through time. Therefore OMIV or OMV too may be desirable.

VI. CONCLUSION

The optimal designs are all geared to the same objective, i.e., maximization of efficiency in resource use. Each OM is the most efficient design possible for the premises behind it, e.g., about the discount rate. This solves the problem of systems designing.

For a choice among the optimal designs, the systems analyst may make an 'impact analysis' to show the income, employment and trade effects not only in the renewable resource sector but also in the entire economy (40). Such study is possible through an inter-industry analysis. This would reveal the structural changes in the economy that would ensue from the optimal designs. The design which is most consistent with the economy's overall needs would then be identifiable for the policy-maker's decision.

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This study would have been difficult to complete without using MPS 360/75, the fastest and one of the largest available computers in the U.K. Since the computer was recently installed at Rutherford High Energy Laboratory, Harwell, there was little experience at hand of using the Mathematical Programming System 360 for solving the problem. Many helped in operating the system and securing the facility. They include J. C. Rollett, Head of the Oxford University Computing Laboratory, R. Harrington of IBM, N. Segal now with the World Bank and, above all B. G. Jackson of Linacre College. The University of Oxford provided a grant for data card punching. C. Jackson of the Nuclear Physics Department helped at all stages and enabled test runs of the problem on the Department's IBM 1130 Computer with LP-Moss program. H. L. Wright of the Forestry Computing Section programmed and made possible the use of the University's KDF 9 computer for benefit-cost analyses. Thanks are due to them all and to J. J. MacGregor, the University Forest Economist for discussions and for going through the draft paper. However, for any errors the author is solely responsible.

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FOOTNOTES

1. The method discussed in (31) though refers to an integer problem, is a trial and error solution based on 'generalized Lagrange multiplier'. (18). Despite that these can be used to solve problems with inequality constraints under certain conditions (29), Lagrange multipliers may not yield 'fail-safe' solutions and the problem solved may not be the problem originally stated (8). A programming approach (c.f. section II) is necessary for many problems because in their 'case the gradient on the boundary of the admissible domain changes discontinuously at certain points, which makes the method of Lagrange multipliers . . . of limited applicability' (20, p. v).
2. If land is the only constraint, it is tantamount to systems designing with more than one constraint. This is because, in a region, land types are many, each with a limited area.
3. This is analogous to separable programming method (1, 35). The latter is a technique for handling certain types of non-linear functions within the framework of a general LP format. Since this technique is capable of working on non-convex problems, Hicks'(26, 98) qualification for the application of LP - 'the presence of scale economics implies the absence of convexity' - is met.
4. Rarely practicable for renewable resource production functions, especially when technological forecasting is involved.
5. It should form a feasible design. That is, the options should not be mutually exclusive and together they should not use land or other resources in excess of availability.
6. Since Dantzig (11) first reported it, the Simplex method has undergone many extensions (22; 54, pp. 70-113). He (13) elsewhere discusses the origin of the LP, the various extensions and the work of Kantorovitch (27).
7. The first step in the LP procedure is to look for a basic solution of the system (2.1), i.e., a solution with exactly n zero variables. If the solution is feasible, i.e. if $x_i \geq 0$ for all i, it serves as the starting point. If the row vectors of the matrix, corresponding to the non-zero components of x, are linearly independent, x is a basic vector and the

associated non-zero variables are the basic variables comprising the basis.

8. This excludes 241 square miles devoted to wildlife, which is not considered in this paper.

9. This is an essential component of systems designing, because the programming technique 'is designed to uncover better ways of organising the use of given resources by means of given techniques; it does not extend the range of technical possibilities' (16, p. 67), so that all practicable activities need to be discovered in advance.

10. This is not the basic model for programming. Instead, we start with a basis including slack activities at non-zero level. This is a more systematic approach.

11. Scope exists for pulping capacity expansion during the last three periods. The camphor target is achieved by producing about 320 tons of of the α-pinene rich turpentine component, besides the by-product of about 1100 tons of rosin, also readily saleable (21). The richness in α-pine is specific to kail, the Kashmir pine, as distinct from sub-tropical chir pine (35).

12. Therefore the effect of the long-run probabilistic events is reduced to a minimum by 'providing plenty of fat in the system' (12), i.e., planning is done on the higher side to act as 'shock absorbers'.

13. This contradicts the crash 'programme of putting 1.20 lac (i.e. 0.12 million) acres under oilseeds' (23). No economic analysis is known to have been made for justifying the programme as an option superseding alternative investment opportunities.

14. As against market prices for the preceding analyses, this is done at world prices for tradable commodities and at social opportunity costs (SOC) for non-traded resources, such as labour (40). The SOC are also derived from the world prices of commodities required for or substituted by the non-traded resources.

15. This is assumed to be so for OMV for which the programme was not rerun, being unnecessary in view of the consistent results for the other four models.

	BASIC	OPTIMAL		
	MODEL (BM)	OM I	OM II	
I. Comparison:				
Social Discount Rate %	–	5	10	
Benefit: Cost Ratio	4·69	15·48	14·94	
II. Land-use Pattern:				
a). Land Use (Acres).				
Paddy	374000	129713	379698	3
Maize	209000	56000	88000	
Wheat	78000	719	56782	
Oilseeds	67000	0	11300	
Saffron	2850	5219	222797	2
Pyrethrum	2369	0	0	
Sericulture	14800	14800	14800	
Apples	22522	22522	22522	
Walnuts	41958	41958	41958	
Almonds	1907	1907	1907	
Scrub	38325	0	0	
Deodar	112388	112388	112388	11
Kail	260533	260533	260533	26
Fir	341554	318754	318754	31
Willows	13089	13089	13089	1
Poplars	209	641091	92808	8
Farm-Forestry	53578	72221	53578	5
Agri-Silviculture	448	448	448	
Sylvo-Pastoral	114008	136808	136808	136
Village Grazing	153000	153000	153000	153
Alpine Grazing	519437	519437	519437	51
Watershed Protection	706477	706477	706477	70
Culturable	79632	0	0	
b) Area Used (Acres)	3127452	3207084	3207084	320
c) Number of Activities	22	41	43	4
III Production Pattern, Ar. Annual Production:				
(00 tons) paddy	2506	1950	5815	57
(00 tons) Maize	627	291	445	4
(00 tons) Wheat	195	2	149	16
(00 tons) Oilseeds	60	0	12	1
(00 tons) Foundation Potatoes	–	4	4	

Appendix I.

	BASIC	OPTIMAL MODELS				
	MODEL (BM)	OM I	OM II	OM III	OM IV	OM V
I. Comparison:						
Social Discount Rate %	–	5	10	15	10/5	15/10
Benefit: Cost Ratio	4·69	15·48	14·94	14·82	15·08	14·87
II. Land-use Pattern:						
a). Land Use (Acres).						
Paddy	374000	129713	379698	373598	596100	379698
Maize	209000	56000	88000	88000	91550	88000
Wheat	78000	719	56782	62882	0	56782
Oilseeds	67000	0	11300	11300	0	11300
Saffron	2850	5219	222797	227311	5219	222797
Pyrethrum	2369	0	0	0	0	0
Sericulture	14800	14800	14800	14800	14800	14800
Apples	22522	22522	22522	22522	22522	28622
Walnuts	41958	41958	41958	41958	41958	41958
Almonds	1907	1907	1907	1907	1907	37832
Scrub	38325	0	0	0	0	0
Deodar	112388	112388	112388	112388	112388	112388
Kail	260533	260533	260533	260533	260533	260533
Fir	341554	318754	318754	318754	318754	318754
Willows	13089	13089	13089	13089	13089	13089
Poplars	209	641091	92808	88294	136697	44151
Farm-Forestry	53578	72221	53578	53578	68765	53578
Agri-Silviculture	448	448	448	448	448	448
Sylvo-Pastoral	114008	136808	136808	136808	136808	136808
Village Grazing	153000	153000	153000	153000	153000	153000
Alpine Grazing	519437	519437	519437	519437	519437	519437
Watershed Protection	706477	706477	706477	706477	706477	706477
Culturable	79632	0	0	0	6632	6632
b) Area Used (Acres)	3127452	3207084	3207084	3207084	3207084	3207084
c) Number of Activities	22	41	43	43	45	45
III Production Pattern, Av. Annual Production:						
(00 tons) paddy	2506	1950	5815	5722	9138	5815
(00 tons) Maize	627	291	445	446	464	446
(00 tons) Wheat	195	2	149	165	0	149
(00 tons) Oilseeds	60	0	12	12	0	12
(00 tons) Foundation Potatoes	–	4	4	4	4	4

Appendix I (contd.)

	BM	OM I	OM II	OM III	OM IV	OM V
Production Pattern (Contd.):						
(000 tons) Apples	150	150	150	150	150	191
(000 tons) Walnuts	117	118	118	118	118	118
(tons) Almonds	301	301	301	301	301	7270
(mill. oz.) Saffron	0.08	0.12	4.8	5.0	0.12	4.8
(Mds.) Pyrethrum	3933	0	0	0	0	0
(000 lbs.) Silk Cocoons (RSE)	168	168	168	168	168	168
(million c.ft.) Firewood	6.30	3.91	12.86	12.86	13.12	1343
(million c.ft.) Construction timber	2.79	3.85	3.84	3.85	3.85	3.85
(million c.ft.) Sleeper timber	9.85	26.45	26.45	26.45	26.45	26.45
(million c.ft.) Shooks timber (Plr.)	7.14	133.24	19.51	18.91	27.79	13.03
(million c.ft.) Pulpwood	0	44.77	16.47	16.29	18.23	14.53
(00 tons) Oleoresin	0	17.46	17.46	17.46	17.46	17.46
(million lbs.) Fodder	1243	1515	2445	2411	3176	2445
V Essential Commodities:						
a) Foodgrains Surplus/Deficit (Million Kilo-Calories)						
1960-61	-708	—	—	—	—	—
Ist Period	-1128	-1388	-340	-359	+456	-340
2nd Period	-1322	-1582	-534	-553	+262	-534
b) Firewood Surplus/Deficit (million c.ft. round)						
Ist Period	-2.03	-4.43	+4.52	+4.52	+4.52	+4.52
2nd Period	-7.20	-9.56	-0.61	-0.61	+0.98	+2.87
VI Finance and Materials:						
a) Budget (0 million Rupees)						
Ist Year	8.28	25.16	25.63	25.08	26.33	24.31
Ist Period	41.40	62.75	63.05	62.38	65.37	63.20
2nd Period	41.40	36.55	36.31	36.20	38.34	36.73
Total	248.40	274.25	273.40	272.09	286.21	279.89
b) Budget Surplus (0 mill. Rs.)						
Ist Period	-34.60	11.86	15.96	15.98	14.02	16.39
Total	-207.60	264.26	251.44	248.84	240.74	247.20
c) Govt. Revenue (0 mill. Rs.)						
Ist Period	6.80	74.61	79.01	78.36	79.39	78.69
Total	40.80	538.51	524.84	520.93	526.95	527.09

Appendix I (Contd.)

	B.M.	OM I	OM II	OM III	OM IV	OM V
Finance and Materials (contd.):						
d) Private Profit (0 million Rupees)						
Ist Period	126.15	72.09	293.25	295.65	171.86	292.14
Total	756.90	1100.85	1459.84	1466.43	1138.68	1467.42
e) Net Financial Benefits (0 mill. Rs.)						
Ist Period	91.55	83.95	309.21	311.63	185.88	308.53
Total	549.30	1365.11	1711.28	1715.27	1379.42	1714.62
f) Material Inputs (0 mill. Rs.)						
Ist Period	61.28	45.02	76.42	75.70	98.01	75.70
Total	367.68	169.28	416.50	413.95	539.08	419.24
VI. Employment:						
a) Man-days employed (0 million)	14.79	8.09	18.52	18.47	20.67	18.63
b) Unemployment (Percent)						
1961	19	–	–	–	–	–
Average over 30 yrs.	51	73	38	39	31	38
Ist Period	41	68	26	26	17	25
2nd Period	47	71	33	33	25	33
6th Period	61	79	51	52	46	51
VII Present Social Worth:						
Rupees million at discount rate:						
5 %	6808.37	9887.51	15663.14	15511.20	19061.78	15705.78
10 %	4175.45	5591.52	9553.97	9469.57	11497.09	9570.22
15 %	2908.21	3208.68	6592.50	6465.36	7868.56	6598.9?
10%/5%	5647.83	7145.23	12870.45	12665.45	15553.21	12932.??
VIII Maximand valu						
at discount rat						
5 %	15041224	49664438	48476920	48427909	48896547	48382922
10 %	15041224	48906966	47928785	47911090	47848058	47890987
15 %	15041224	48364528	47523730	47529995	47197001	47501059
10%/5%	15041224	49178554	48251840	48201693	48376791	48225111
15%/10%	15041224	48514685	47704408	47701967	47446020	47708219

Appendix II

PRESENT SOCIAL WORTH MODELS

– Salient deviations (+ or –) from corresponding benefit: cost ratio models.

	PSW I	PSW II	PSW III
Discount Rate (%)	5	10	15
Benefit: Cost Ratio	– 0.83	– 0.57	– 0.41
Budget (Rs. million)			
1st year	+ 25	+ 28	+ 27
1st Period	+ 68	+ 67	+ 70
2nd Period	+ 49	+ 51	+ 48
Total	+ 360	+ 380	+ 367
Labour (million man-days)			
1st year	+ 195	+ 60	+ 45
Average/year	+ 162	+ 56	+ 56
Material Inputs (Rs. million)			
1st Period	+ 589	+ 280	+ 284
Total	+ 4081	+ 1583	+ 1622
Private Profit (Rs. million)			
1st Period	+ 1329	– 802	– 780
Total	+ 2940	– 560	– 880
Net Financial Benefit (Rs. million)			
1st Period	+ 1276	– 943	– 908
Total	+ 2439	– 909	– 1163

APPENDIX 12

Product Form of the Inverse Matrix Method with special reference to Mathematical Programming System 360.

To carry forward the simplex procedure for the system (2.1) of section III, appendix 11, we first look for a basic solution of the system, i.e., a basic solution with exactly n zero variables. If the solution is feasible, i.e. if $X_i \geq 0$ for all i, it serves as the starting point for the iterative process.[1] We proceed from k^{th} step of the iteration to (k + 1) step by letting one variable become positive which at the k^{th} step was zero, i.e. which did not belong to the basis and, in turn, by setting another variable equal to zero which belonged to the basis at the earlier step. Each iteration exchanges variables, one variable X_e entering the basis and another variable X_f leaving it. By setting all original variables $X_1, X_2, \ldots,$ Xn equal to zero for the first step of the iteration, the slack variables $X_{n+1}, X_{n+2}, \ldots, X_{n+m}$ form the first basis. The system of equations in (2.1) is now solved for these basic variables:

$$X_{n+j} = A_{jo} + \sum_{i=1}^{n} A_{ji} (-X_i) \qquad 0 \ (j=1,\ldots,m) \quad - \quad (2.1a)$$

If the value of the objective function (2.1) for this basic solution is denoted by A_{oo}, then

$$A_{oo} = \sum_{j=1}^{m} A_{o,n+j} X_{n+j} = \sum_{j=1}^{m} A_{o,n+j} A_{jo}.$$

---

1. If the basic solution has at least one component $X_i < 0$ it is infeasible and has to be dropped from further consideration.

From (2.1a), we then have the objective function

$$Z = \sum_{i=1}^{n} A_{oi} X_i + \sum_{j=1}^{m} A_{o,n+j} X_{n+j}$$

$$= \sum_{i=1}^{n} A_{oi} X_i + \underbrace{\sum_{j=1}^{m} A_{o,n+j} A_{jo}}_{= A_{oo}} + \sum_{j=1}^{m} \sum_{i=1}^{n} A_{o,n+j} A_{ji}(-X_i)$$

Therefore

$$Z = A_{oo} + \sum_{i=1}^{n} \left(\sum_{j=1}^{m} A_{ji} A_{o,n+j} - A_{oi} \right)(-X_i)$$

$$= A_{oo} + \sum_{i=1}^{n} \alpha_{oi} (-Xi) \qquad - (2.1b).$$

where

$$d_{oi} = \sum_{j=1}^{m} A_{ji} A_{o,n+j} - A_{oi} \qquad - (2.1c)$$

The system equations (2.1a) and 2.1b) may be expressed as the following tableau (2.1d).

		$-X_1$	$-X_2$	...	$-X_n$	$-X_{n+1}$	$-X_{n+2}$	...	$-X_{n+m}$
X_{n+1}	A_{10}	A_{11}	A_{12}	...	A_{1n}	1	0	...	0
X_{n+2}	A_{20}	A_{21}	A_{22}	...	A_{2n}	0	1	...	0
$\vdots$	$\vdots$								
X_{n+m}	A_{mo}	A_{m1}	A_{m2}	...	A_{mn}	0	0	...	1
Z	A_{oo}	α_{o1}	α_{o2}	...	α_{on}	0	0	...	0

The quantities α_{oi} in the bottom row, the valuation coefficients, correspond to the objective function coefficients (2.1b).

To check the optimality of the solution (in the second column), we calculate by (2.1c) the valuation coefficients for each variable X_i not in the basis:

$$\alpha_{oi} = \sum_{j=1}^{m} A_{ji} A_{o,n+j} - A_{oi} \quad (i = 1, \ldots, n)$$

If one or more of the valuation coefficients α_{oi} are negative, the solution cannot be optimal yet. The absolute values of

the negative valuation coefficients indicate by how many units the objective function would be increased by increasing the (zero) variable X_i by unity while retaining the solution feasible and the other zero variables at zero. Additional iterations are suggested till the optimal solution is reached, i.e., when all α_{oi} are positive.

To determine X_e the variable entering the basis, we search for a variable with an index i with the properties, $X_i = 0$ in the tableau (2.1d), $\alpha_{oi} < 0$, and at least one of the A_{ij} $(j=1,\ldots,m)$ in the X_i column is greater than zero[1]. From the definition of the α_{oi} in (2.1c), that variable X_i is chosen for which α_{oi} is most negative, i.e., for which $\max_i (-\alpha_{oi})$ is assumed. To determine X_f, the variable leaving the basis, we search for one with which none of the new basic variable becomes negative. Thus we determine the index f in such a way that the quotient A_{jo}/A_{je}, formed for all j with $A_{je} > 0$, assumes its smallest value.

in the matrix A of the tableau (2.1d), the column belonging to X_e is the pivot column and, correspondingly, the row belonging to X_f the pivot row. For transformation from one tableau to the next, the row operations for the matrix (2.1d) are selected so that the transformed pivot element A'_{fe} equals 1 while all other elements in the pivot column assume the value zero. This involves the division of all elements of the pivot row by the pivot element A_{fe}. To obtain the zeros in the other cells of the pivot column, we substract suitable multiples of the (new) pivot row from

1. If the last condition is not satisfied A_{oo} will grow indefinitely when the corresponding X_i is increased arbitrarily.

the remaining (m-1) rows of the tableau (2.1d). Such selection of X_e and X_f assures that all A'_{jo} are non-negative. The elements A'_{ji} and A'_{jo} not belonging to the pivot row are calculated with the help of the criterion equations

$$A'_{ji} = A_{ji} - A_{fi} \frac{A_{je}}{A_{fe}} \qquad - (2.1e)$$

$$A'_{jo} = A_{jo} - A_{fo} \frac{A_{je}}{A_{fe}}$$

Following this, the columns of X_e and X_f in the transformed tableau are interchanged and in the lead column X_f is replaced by X_e. The above steps are repeated until the check on optimality signifies that the optimum has been reached.

In the revised simplex method, one concentrates only on those entries of the above tableau which are needed for the exchange steps. In it the objective function and the constraint system are combined as shown in (2.4) of section III, appendix 11. The basis is exchanged repeatedly in such a way that X_o decreases more and more.[1] This process involves the determination of the Inverse Matrix B_i^{-1}. From the matrix B are removed all those columns belonging to the basic variables, including the column belonging to X_o. Then is formed the inverse B_i^{-1} of this reduced $(m + 1) \times (m + 1)$ matrix B_i. In the Product Form of the Inverse Matrix Method used here, the inverse of the basis is represented as a product of elementary matrices, each of which represents the effect of a single pivotal operation.

The effect of pivoting in the ρ^{th} row, is to premultiply the inverse B^{-1} by a matrix that is a unit matrix except

---

1. This applies to a maximization problem such as ours. On the other hand, in a minimization problem it grows increasingly larger.

for the $\underline{p}^{th}$ column, which is computed from the up-dated pivotal column in the tableau. If the components of the pivotal column are denoted by $\bar{a}_{iq}$, then the $\underline{p}^{th}$ element of the $\underline{p}^{th}$ column of the elementary matrix, referred to as η-vector, is $1/\bar{a}_{pq}$, and the i^{th} element, for $\underline{i} \neq \underline{p}$, is $-\bar{a}_{iq}/\bar{a}_{pq}$. The steps of the inverse matrix method can be carried out when B^{-1} is represented as a product of η-vectors. The first step is the backward transformation; a row vector, whose first element is 1 and whose remaining elements are zero, is post-multiplied by each η-vector successively in the opposite order to that in which they were generated. Each η-vector affects only the $\underline{p}^{th}$ element of the row vector being built up. Then we price out the columns of A to remove from the set of non-basic variables according to the most negative reduced cost. This is followed by forward transformation. The pivotal column of A is premultiplied by each η-vector successively in the order in which they were generated. A ratio test is then performed between the elements of the updated column and of the right hand side to determine the pivot and the variation to be made nonbasic. The process of updating B^{-1} is simply to add another η-vector to the end of the list. After a while, the list becomes too long. To shorten it, reinversion is done. This involves starting from an unit inverse representing an all slack-or-artificial basis, and adding η-vectors representing pivotal operations to replace unwanted slacks or artificials by genuine variables.

Reinversion consolidates the product form by, in effect, replacing the existing product form of the current inverse by a minimal (in regard to the number of eta vectors and number of nonzero coefficients) product form. Suitable control of reinversion is obviously very important to

computational efficiency. The Mathematical Programming System used in this study contains a control scheme using the built-in timer of the system/360 series of computers. It can be set to call invert on clock control. Invert computes the invert of the current basis. In order to reduce the size of the factored form of the inverse as far as possible and thus speed subsequent computations while increasing precision, Invert's method combines triangularization and partitioning. Invert demand produces a recorded basis list in the basis region and an expression of the factored inverse on the eta file. The invert demand also restores the problem when the eta file goes out of core by reducing its size. Thus we may see that the invert was demanded 9 times during the optimization procedure of the problem considered here (c.f. annexure-Optimal Systems Design Computer Output). In this way, our problem was solved only with 420 iterations; otherwise the number would have run into thousands, or an optimal solution may have been difficult to obtain for a problem of a size such as ours.

APPENDIX 13
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Impact Analysis of a Renewable Natural Resource Plan with special reference to Kashmir.

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ABSTRACT

A plan for the development of an area's renewable natural resources involves adjustments in the present land-use pattern. Through the changed production process, these adjustments directly affect the incomes in the renewable resource sector. Additionally, they affect the demand for inputs from and supply of resource products for other sectors of the economy. The effects on the related industries may considerably alter the economy's structure. This would affect the welfare of households supplying labour to these industries and consuming raw as well as processed commodities. The practice in renewable resource planning is only to quantify the direct effects, if at all. This is rarely supplemented by a description of some aspects of secondary industries for justifying a plan. This paper advocates the use of an inter-industry analysis for quantifying the total impact of alternative plans. The ease of the method is illustrated by applying it to empirical data for Kashmir. The present inter-industry flows and the overall effects on Kashmir's income, employment and trade originating from the resource sector are compared with those for a plan optimal under certain conditions. The latter include the constraints of land-use and technological possiblities. Similar evaluation could be made for plans optimized with changed set of assumptions and constraints to cover all feasible options. With such quantitative information, the comparison of options becomes simpler and reasoned. This will help decision-making and the co-ordination of the chosen plan with complementary development of the rest of the economy.

Impact Analysis of a Renewable Natural Resource Plan with special reference to Kashmir.

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After reviewing the objectives for a renewable resource plan, eight steps may be involved in the planning process (Muthoo,1970). Impact analysis is the penultimate of these eight components (c.f., Appendix I). Whether a plan is worth-while or not is related to the magnitude of contribution that it is expected to make to the objectives. However, the desirability of a renewable resource plan cannot be gauged merely from the absolute magnitude. The plan involves adjustments: renewable resources, such as soil and forests, of an area have an existing use pattern. The desirability of adjustments will depend upon the differences in the achievement of objectives between the present and the planned uses. Such comparison will indicate the impact of a plan. The investigation required for this may be called an impact analysis.

The impact analysis may be conceived as more than the identification of marginal changes in the direct contribution of renewable resources to objectives. These resources are not the only sources contributing to society's objectives. The analysis should indicate the effect on the realization of objectives in totality, i.e., the effects of renewable resource use adjustments on other sources of economic welfare too need to be evaluated.

The word 'impact' or 'effects' is often loosely implied. Much is excluded and anything else thought attributable to a

*The paper is based on a research talk presented at the University Department of Forestry, Oxford on 4th Feb.1970. The author is grateful to Mr. J.J. MacGregor, the Forest Economist at the Commonwealth Forestry Institute for going through the draft and to a number of colleagues including Mr. B.G. Jackson of Linacre College, Oxford, and Professor W.L.M. McKillop of California University for discussions. None of them are responsible for any omissions or errors.

project is included among the so-called effects. Three examples will suffice. One is the study of the 'impact of industrialisation in a subsistence economy' by Junghans (1968 a,b). The 'impact' of Rourkela steel plant in Orissa, India on the region's economy is evaluated from the income and consumption changes among the population within a certain radius of the plant. Such a study ignores the effects* on the economy through the profits and foreign exchange earnings by the owner, viz. the government, and through the linkage-effects on the raw-material supplying and steel processing industries, transport and tertiary sectors.

The study of the 'economic impact of TVA' (Moore, 1967) is even less rigorous, despite TVA's accepted importance. Except for a piecemeal analysis of the role of energy resources the study contains generalised impressions suggesting that the words 'economic impact of' only construe 'some random lessons from.'

The third example is Gane's (1966) study of the '<u>effects</u>** of forest management on the national economy and welfare' of Trinidad. It is a step forward, in ~~the~~ formally following forestry through harvesting to manufacturing instead of confining attention to forestry alone. But, since the 'effects' have not been correlated with the rest of Trinidad's economy of which forestry is only a part, this analysis does not embody a complete treatment of the system. Conceptually, Gane's study starts with tree seedlings as the earlier stage of production to processing of wood as the later stage. By tracing a linear chain of intra-system events, the forestry system is treated as if independent of other events in the economy. Further, it sets a heirarchy of industries with value being added to wood products by employing primary factors, such as labour and capital, from the earlier to the later stages. This amounts to saying that an 'earlier' industry, say

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*Besides the local inflationary effect, which could be contained by suitable regulatory measures as part of the planning process.

**Present author's italics.

forestry or farming, only sells to or produces for a 'later' industry, such as manufacturing.

In the real-world, products from the so-called later industries are required for production in the so-called earlier industries and vice-versa. Fodder serves as inputs to livestock and farm yard manure as inputs in fodder production. Coal is required for producing iron and for coal, iron is required. Farming and forestry sell to, as well as buy from, manufacturing industries. An industry is not earlier or later in the heirarchy of production. All are mutually interdependent.

The relationships are not only direct, such as the inter-dependence of two industries, but also indirect. Firewood production releases cow dung in the agriculture industry for manuring, say cotton fields. Its production effects are twofold: increased supply for and from textile industry and reduced demand for fertilizer industry's output. The household sector too is involved. The demand for labour increases and decreases wage incomes in the different industries. The demand and supply schedules of consumer goods ~~is~~ are also altered. The import-export sector may be affected: less fertilizer may be imported and more cotton-piece goods exported. All this is traceable to the manner of use of cow dung. It illustrates that to study the effect of forest management or of a planned renewable resource development on the economy, the whirlpools of industrial relationships need to be considered. This would be an important aspect of the impact analysis.

The complex interrelatedness in an economic system is illustrated in a simplified manner in the ~~following~~ diagram in Appendix 2. The core shows the physical flows in the production process, such as the use of a forest. The periphery represents the consequent income flows in an economy. The two are interlinked at many points, as exemplified by the dotted line between ~~been~~ 'consumption and the'household account.' Any one flow can be traced to any

other. The explanations of the material aspects of society in terms of such variables as supply and demand or wages and prices are inadequate in view of the circularity and interdependence. As Leontief (1966, p.15) says,

> 'between a shift in wages and the ultimate working out of its impact upon prices there is a complex series of transactions in which actual goods and services are exchanged among real people. These intervening steps are scarcely suggested by the classical formulations of the relationships between the two variables.'

An analysis is indicated, which brings to surface the internal transactions of an economic system. It should relate a resource-use with all other industries inputs of which it uses or output to which it contributes, instead of only considering the effects directly ensuing. Then the less conspicuous indirect effects of a resource-use adjustment which may crucially alter the economy's structure*, will not remain camouflaged.

The evaluation of impact in a total economic context will include the consideration of intermediate sales and purchases, i.e., the outputs and inputs, that carry goods and services from industry to industry and from producer to consumer. Such inter-industry analysis would tie the indirect flows of supply and demand within the production system to external features of the economy conventionally expressed as gross national or regional product, total output, value-added, expenditures and exports. We will adapt this technique for projecting the intersectoral impact and the ultimate contribution of a region's renewable resource base to income and employment. This will involve a quantitative identification of the major flows of goods and services with and without a resource plan during comparable periods of time.

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*The word 'structure' in this paper implies the relative importance in the economy of different economic activities and variables, e.g., the proportions of the labour force employed in different industries, the proportion of the national income earned by different sectors of the economy. Since the major proportion of Kashmir's economic activity is in the renewable resource sector, its structural analysis is important from the total economy's view-point besides its own.

It is usually assumed that an industry does not use any of its own goods as inputs in its productive process. Dorfman, Samuelson and Solow (1958, p.205) say that this 'is a harmless convention', but such a statical model conflicts with the dynamic functioning of an industry, for inputs 'must be produced before they can be used' (Dorfman, 1954). We use seed from last year's harvest for the propagation of a farm crop, timber from a felled forest to fence it for regeneration, and adult livestock for its reproduction. The production system exhibits relationships within and among industries. These are illustrated for the three conventional sectors in the following table.

Table 1. STRUCTURAL MATRIX.

Sales to (i.e., User of Output) →

Purchases from (i.e. producer of inputs) ↓

Sectors	Primary	Secondary	Tertiary
Primary	.2	.2	.1
Secondary	.4	.1	.3
Tertiary	.2	.5	.1
Labour (and other Factors)	.2	.2	.5
Total	1	1	1

The figures in the cells down the columns show the proportions of inputs used by a sector from different sectors in producing a unit quantity or a unit's worth of goods. The first column shows that one rupee unit of primary sector output requires 20 paisa in primary and 40 paisa in secondary commodities, and 20 paisa each in tertiary and labour services. The rows indicate the relative value of output of a sector required within the sector and for other sectors. Of the total primary output worth a rupee, 20 paisa worth is used each in the primary and secondary sectors and 10 paisa worth in the tertiary sector. These

coefficients represent the technological relationships between the sectors; they are based on the flows of physical quantities of goods and services in a production process.

A table showing the complete set of the input coefficients of all sectors constitutes the structural matrix of an economy. The expression of the technological interdependencies in the matrix ensures the planning of the economy in an internally consistent manner. Suppose the output targets for consumption from primary, secondary and tertiary sectors are Rupees (Rs.) 100, Rs.20 and Rs.40 respectively. With information in the above tabular form, one knows how much of goods and services to produce in each sector to avoid waste likely through overproduction in any sector as well to satisfy the consumer demand without shortages. To achieve this, we need to solve the following three simultaneous equations:

$$P = .2P + .2S + .1T + 100$$
$$S = .4P + .1S + .3T + 20$$
$$T = .2P + .5S + .1T + 40$$

The quantities of P, S and T, which represent the total output values of primary, secondary and tertiary sectors respectively, will become known. So will the composition of the total outputs, i.e., besides the quantities going to final demand, those required from a sector for other sectors and itself. However, the targets are consistent, or the demand will be met, subject to the linear inequality,

$$.2P + .2S + .5T \leqslant 500,$$

assuming the total value of labour - hours (and other factors) available to the economy is Rs.500. If this constraint is not satisfied, the targets are unrealistic, guiding the planner toward adjustments that match the economy's factor endowment.

A structural matrix can be translated into a quantitative input-output table. It shows the actual physical quantities, instead of the coefficients of different inputs required in a

sector for a given total output. The following table is an hypothetical example.

Table 2. PHYSICAL INPUT-OUTPUT TABLE.

Input from ↓ / Output to →	Agriculture	Forestry	Labour (and other primary factors)	Total output
Agriculture	14	6	30	50 tons paddy
Forestry	25	20	55	100 m^3 timber
Labour(and other primary factors)	130	130	40	300 man year (and other factors

The physical interindustry flows in the table can be expressed in money terms. If the prices are Rs.5 per ton of paddy, Rs.2 per m^3 of timber, and Rs.1 per man-year, the physical flows may be represented as follows:

Table 3. RUPEE INPUT-OUTPUT TABLE.

Input from ↓ / Output to →	Agriculture	Forestry	Labour (and other primary factors)	Total Output Rs.
Agriculture	70	30	150	250
Forestry	50	40	110	200
Labour (and other primary factors)	130	130	40	300
Total Inputs Rs.	250	200	300	

In the above rupee flow table we are able to show the combined values of inputs absorbed or outputs produced by an industry. Such input-output table 'is a way of arranging the national

accounts which focuses attention on the productive relationships between industries' (Ellman, 1969). It can be interpreted as a set of national or regional accounts. The rows and columns - i.e., the outputs and inputs, or sales and purchases, making up the total economic activity - strike a balance in a double entry bookkeeping system. The third row shows the income payments received for the factor services rendered and their combined total, viz. Rs.300. This equals the total purchases made by factor owners, i.e. Col.3, and represents the national or regional income. If we have one more column and row respectively for the exports and imports, the third and the export column together are the 'total final demand.' This expresses the total activity of the economy in terms of the expenditures by which goods and services are acquired for final use by consumers and the government and for investment and exports. This then is the 'gross national or regional product.'

From the absolute values in the above rupee flow table, one can derive the proportions of interindustrial transactions, i.e., the value of purchases made by an industry in a given year for each rupee's worth of output, by dividing each input value by the industry's total output value. The coefficients so derived set the technological relationships among industries, according to which the flows are amenable to modifications for reaching envisaged targets of final demand or consumption. The multiplication of the input-output coefficients, which may be obtained directly from the physical input-output table, by the desired output increases will provide the measure

of the increased inputs required from each source.*

Potential 'bottlenecks can then be pinpointed, and efforts made to ensure that supplies of inputs increase at the required rate.' (Ross and Philpott, 1968). Such use of input-output tables for planning production poses limitations. The figure in each cell of the structural matrix expresses the current ratio of the input from the industry in whose row the cell appears to the total output of the industry in whose column the cell appears. The method cannot be used in the solution of problems which call for changes in the input-output ratios, since each change requires a whole new solution of the matrix. The conceptual limitation is the assumption of a given technology. Inputs are assumed to be employed in rigidly fixed proportions, the use of which expands in proportion to the level of output. A labour intensive technique, for instance, offers no option for a capital intensive technique. This is unrealistic and defeats the purpose of evaluating consequences of substitution and changed renewable resource use technology. Secondly, the interidustry relationships are based on technological empiricism, i.e., the effect of possible price, demand and supply changes are neglected. The third is a practical limitation

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*The concept and application of input-output analysis has recently been reviewed by Leontief, Mathur Bharadwaj and others (1969), and separately by Nambiar (1969) and Mathur (1969), the last named summing it up as a useful tool to solve 'practical economic problems.' The essence of the technique is represented by the accounting balance equation:

(1) $Xi - \sum_{a=1}^{n} xia = Yi$, where Xi is the total output of of industry i, Xia the amount of i products absorbed by industry a. Given the number of industries 1,2,...,n, the above equation yields the amount of i products going to final demand, i.e. Yi. The structural equations are given by the production coefficients for each industry.

(2) $Xia = piaXa$, a and i = 1,2,...,n, where pia is the production coefficient indicating the amount of i needed to produce a unit of a. Substituting (2) in (1), we have

(3) $Xi - \sum_{a=1}^{n} piaXa = Yi$.

Then the system of linear equations may be solved for X, if a bill of final demand Y_1 , Y_2 , ... Y_n is known.

of the paucity of data. Stone (1963) records that 'most important, the extreme scarcity of data on inter-industry relations forced (them) to use very simplistic hypotheses on trends...of these relations', since the object was to project British economy's growth on the basis of past structure. Such problems are more acute in developing economies (Bharadwaj, 1969).

To overcome these limitations, we make a fundamental departure from the above procedure by making no assumption about the values in the output vector.* These will be generated as a result of a given plan, i.e., we assume that a given resource plan is optimal, so that 'optimality' is not dictated by specifying in advance the output targets. This is consistent with our schema in which a plan is optimally formulated at an earlier stage of the planning process, viz., steps 5 and 6 (c.f. Appendix 1).

Our procedure gets round two other assumptions associated with input-output analysis, One is the 'identity of industry and product', i.e., the motor industry only makes motor vehicles though it makes aero-engines too. The other is the 'product homogeneity', i.e., all motor vehicles are the same (Stone,1963). We split multiproduction into separate options, e.g.,agriculture industry produces paddy, wheat, maize and *oilseeds* . After plan formulation, the actual flows resulting from the optimum levels of each option can be aggregated without invoking the first assumption. Similarly, we incorporate product heterogeneity by considering different kinds of outputs of a commodity as separate activities, e.g., the production of timber as an option in forest industry is itemised as the production of pulpwood, poles, lumber in round, railway sleepers and construction or saw timber.

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*As will become obvious from the following pages, ours is the reverse of the conventional method of experimentation, which involves the 'prediction of intermediate demand given final demand for the predicted year and applying the input coefficients for the base year as they are expressed in current value.' (Tilanus, 1966, p.134).

Besides the technical constraints, such as land capability the optimisation process considers the demand for the different products of resource sector, their prices, labour and capital availability and other socio-economic constraints. Therefore, planning is not confined to technological empiricism. Instead, it is normative, leaving the evaluation of positive effects to the later stage of impact analysis.

Plans can be framed for any mix of feasible technologies. We do away with the restrictive assumption of fixed proportions by separately examining the transactions, final demand and total outputs associated with different combinations of options. The interindustry flows vary for each plan from changes in the technological relationships among industries. The structural matrix gets altered and varies from plan to plan, carrying different input-output coefficients. Besides the changed production pattern in an industry with new technology, the consequences of adopting one or the other plan are transmitted to the rest of the economy step by step via the chain of transactions that links the whole system together. If two interindustry analyses are done, one for the present and the other for the planned resource use pattern, we will have the structure of the economy exposed for either situation.

We need not present a detailed structure of the entire national economy. Firstly, the input-output model can

> 'be usefully applied in the investigation of regional development as against national development. In geographically large countries with substantial differences in income levels, technical methods of production, consumption behaviour, etc., the model can be adapted to take account of the regional aspects of production and demand.'
> (Yanovsky, 1965, p.172).

In fact, this could be a realistic adaptation for India.* Secondly, the interindustrial sales and purchases among themselves do not reflect economic welfare, i.e., the changes in interindustrial relationships are not relevant to the impact of a plan except in so far as they affect the demand for primary resources and the value added. Therefore, the data limitation too is overcome by focussing attention on the sector the impact of which is under investigation and by aggregating the rest of the industries in one sector. Thereby we can make do with a small interindustry table manageable at the micro-analytical level. It has been found that the aggregation of a number of industries or sectors into one does not distort the input-output coefficients of the various sectors. This is borne out by experimentation for random aggregation. The results, recorded in Appendix 3, suggest that the degree of aggregation does not affect the evaluation of the impact;** only the detail that is not required is not presented.

A renewable resource plan involves adjustment in the various current uses. The implications of changes need to be identified for each of the group of 'homogeneous' uses. This is because the diverse products and production functions will affect other industries, and through them the households and the value-added, in different ways. For this reason, we may have as many

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*Conceptually, the intersectoral flows can be analysed for an area unit smaller than a large geo-economic region like Kashmir. Blake and McDowall (1967) have prepared a 'local' input-output table for a town in Scotland with a population only of about 10,000, with no distinction drawn between intermediate and final goods or services, e.g., households of the town are 'conveniently' included among the internal sectors in quadrant 1. This, of course is objectionable, for the domestic population does not have a uniform propensity to consume.

**Prasad (1969) also 'spells out a situation in which inverse elements of the unaggregated sectors will remain unaffected by aggregation', contrary to general belief.

industrial sectors in the technology matrix - i.e., in the first quadrant of the input-output table - besides the aggregated one for the rest of the economy as are the major products and production processes in the sector concerned.* Accordingly, we may have seven renewable resource sector industries and one more in the first quadrant as shown in Appendix 4.

It shows the present interdependence among the renewable resource industries and the rest of the economy in Kashmir. There is lack of readily available data about the inputs and products, and more so the flows, from the resource industries. This problem is overcome by physically quantifying and valuing in money terms the flows on the basis of the current production functions. The latter are computed** for the benefit-cost analysis of options in step 4 of the planning process (c.f. Appendix 1), so that the functions for the optimal plan would be those

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*One such analysis in which only one sector of a region is considered in detail is the input-output analysis of the southern forest economy in the United States (Kaiser, 1969). The forestry sector is broken down into a number of primary and processing industries. The rest of the forestry related economy is depicted among the final demand flows. This, however, is different from our approach: we make the relationship between renewable resource industries and the rest of the industrial sectors explicit by including the latter in quadrant 1 instead of in the final demand or quadrant 3. By so doing, we are able to study not only the direct impact of renewable resources on final demand but also that occurring through the resource based industries in the rest of the economy. Further, Kaiser's study too is a conventionally oriented empirical analysis; the model is developed only 'to show the flow of goods through' the sector for a particular year in the past. Nevertheless, while it does not evaluate the impact of changed interindustrial interdependencies, say, due to substitution, it does illuminate the sector's current relations. Otherwise these remain masked by the information in an input-output table for the entire economy because, for instance, 'forestry is usually merged with agriculture and fisheries, and the scope is either national or for regions outside the' one under consideration. (Ibid).

**As Nambiar (1969) concludes 'there is no need to be panicky about the computational errors since many of them are compensatory in nature.'

pertaining to technologies in the solution. This is a useful method even if aggregated data of the 'primary sector' were available. It would be difficult to disaggregate correctly the data for the various industries. Such statistics cannot be relied upon, for it only includes flows that undergo market exchange or which are arbitratily estimated. This is because much of the output is bartered, a sizeable area of Kashmir's economy being non-monetized and of subsistence type. Further, the information largely based on census record cam be misleading such as for the work-force in rural sector where significant amount of labour may be underemployed and only partly contributing to production.

The entire technology matrix is developed from production function analyses. The 'other sectors' have input and product values in quadrant 1 to the extent these represent purchases from and sales to the renewable resource industries. However, the data for the labour used in other sectors, i.e., in quadrant 3, and in household sector, i.e., in quadrant 4, represent the actual figures for Kashmir. This is to ensure that the constraint of total labour availability is not violated. That may appear unnecessary however; the total labour input in terms of man-days turns out to be less than the available supply.* That may not hold for peak harvest season; as such,we may limit the peak labour demand during the formulation of the optimal plan so that it is realistic.

The data for imports and exports in quadrants 3 and 4 are reliably available for Kashmir, because it has only one land route for communication with the rest of the world and record is maintained of commodities that pass through a check point at Banihal**

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*This tests our earlier contention of a potential labour surplus in Kashmir.

**The manner of treating imports appears to be of 'special importance if we are concerned with possible balance of payments problems' (Cameron, 1968, p.28). This is not important here for we do not use input-output analysis for the allocation of resources, i.e., renewable resource use optimization.

in position for the purpose. The data for sales to the household sector are firmly available, for these can be tallied with the value of output less that of exports and vice-versa. Such cross-check feeds back to the technology matrix. This tests the validity of the underlying production functions and of the break-down of commodities into those exported or used domestically for consumption, processing and accumulation.

The contribution to the national income is indicated by rows 10 and 11. Row 10 shows the income to households for supplying their labour. The flows in it are based on the production functions for each industry. —— R 11 shows the entrepreneurial profits or the returns to capital. The flows in it are computed as the difference between product output values and the material and labour input values, including imports used in production processes. Since the flows in row 11 are the residual, they represent the net result of transactions for each industry. The fact that these are negative in some cases and in total is not paradoxical. Firstly, a negative profit may indicate capital accumulation in the context of this flow table, i.e., disinvestment from the concerned sector and capital flows to others. That, however, is not significant in a subsistence economy like Kashmir's. Secondly, it does not show the total value-added in the 'other sectors', for we are not attempting to find the absolute magnitude of the total value-added; it represents only the production processes and transactions related with the renewable resource industries. Importantly, the other value-added in the subsistence agriculture and the peasant-proprietorship cash-crop industries includes a concealed 'subsidy' paid by the owners. This occurs through very low real wages received by own-labour as compared with the prevalent man-day wages which we have imputed to the labour used in these industries. For instance, only 3 per cent of the labour is hired and wage-paid (Kamili, 1965). As such, the household sector flow to agriculture could be taken as Rs.11

million. Then the other value-added is + 64 million. Such 'subsidy' effect does not alter the total value-added of the industries and their impact on the 'other sectors.' We may conclude that the total contribution flowing to the economy from the renewable resource sector as a whole, including the renewable resource related industries in the 'other sectors' is Rupees 429 million* (i.e., 500,288-71,552). This represents over 55 per cent of the total State income recorded for 1958-1959 (Planning Department, 1961).

The employment generated from the present resource use pattern is the man-day equivalent of the total intermediate sales by the household sector. This equals 153 million man-days. Of these, 148 million man-days are employed in the resource industries as against 183 million man-days available to the sector.** The current unemployment in the sector, therefore, is 116,895 men out of 611,601 workers, i.e., 19 per cent. This actually reflects the disguised unemployment or underemployment rather than open unemployment. That is because the sector actually sustains 611,601 workers and which are only available to 'other sectors' at a positive minimum wage (much higher than they may receive now).

Now, if we make an interindustry analysis for the optimal plan similar to that for the basic model, we can overlay the two flow tables to study the impact of the plan. The Flow Table No.2 (i.e. Appendix 5) shows the interindustry transactions

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*This may be reduced by 41129, i.e. the rupee flow of the labour employed by households, such as servants, for it is not necessarily related to the resource sector and if so, only partly. However, this adjustment is not crucial to the impact analysis, because the household labour input will be valued identically in the other flow tables.

**The latter figure is based on the classification of workers according to various trades in 1961, reported by the State Statistics Bureau (1964, pp. 26-29).

for an optimal plan for Kashmir.* The plan has a benefit:cost ratio of 15.48 as against 4.69 for the basic model. The ratios signify the comparative efficiency in resource use but not the effects. Firstly, it will be seen that the total output is about 220 per cent of that generated with the present resource use pattern. Since throughput is not the desideratum, the increase by itself does not show the change in economic welfare. This would be indicated by the net increase in the incomes of householders and entrepreneurs, i.e., the likely change in people's standard of living. The effect on Kashmir's income is measurable from the difference in the value-added contribution. Therefore, the crucial figure is of the total value-added, which is enhanced by Rs. 395 mn. [i.e., (328931 + 494596) - (500288 - 71552)]. This represents the impact that permeates the economy as a result of the adjustments envisaged in the plan.

The income originating from the planned resource industries is (Rs. 45 mn.) more than the total state income accruing from all sectors of the economy in 1958-59 (Planning Department, 1961). The implementation of the plan would result in a per capita income increase of Rs.28, i.e., about 12 per cent increase in the per capita income recorded for 1958-59 (ibid). This potential is possible because of the changed structure of the economy, save for the horticulture and sericulture industries which remain unaffected.

Agricultural production is curtailed by about half in value terms. This makes 282 thousand workers (i.e. 375294 - 121878) redundant in agriculture. On the other hand, it wipes off about 75 per cent of the concealed subsidy (i.e. 300289-767715) that the economy bears for the agriculture industry. However, its

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*The optimality of the plan rests on the assumptions that the social discount rate is 5 per cent - because that is the rate used in discounting the benefits and costs of options -, and that the technological constraints of the different renewable resource use possibilities only are binding. These assumptions can be altered and another resource use model prepared to suit the case.

diminished scale increases the shortfall in local food grains supply worth Rs. 42 million (i.e. 79966 - 38386). The increased deficit would necessitate an increase in food grain imports. Also the imports of fertilisers and other agricultural inputs are increased by Rs. 5 million (i.e., 5889 - 512).

The output of the cash crops industry is increased and the industry becomes profitable, i.e., it will have a positive instead of the present negative 'other value-added' by giving up the unprofitable pyrethrum cultivation.* (Chopra, Sobti and Handa, 1962, pp.27-34). This also obviates the need for any direct imports by the industry, while its exports increase.

The forestry output is almost trebled. It provides more than twice (i.e. Rs. 148 million as against 60 million) in value of raw materials to manufacturing and construction industries in the 'other sectors.' It gives a spurt to activity in the rest of the economy by generating a three-fold demand (i.e. Rs. 207 million worth as against Rs. 60 million) for transport, logging and sawmilling, services and other investment from 'other sectors.' It will employ a labour force almost three times the present size and its profits will more than double. While forestry's imports will only increase by Rs. 335 thousand (i.e. 921-586) its direct exports of railway sleepers and sawtimber will increase more than threefold by Rs. 150 million (i.e. 214249 - 64145).

The total output from the plantation industry increases more than nine-fold and so will the profits. Besides supplying firewood for household consumption, it will contribute to the rest of the non-renewable resource economy materials worth Rs. 233 million. This is about 19 times the present contribution.

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*A declining trend in the production and profitability of pyrethrum is recorded also for the premier pyrethrum producing country, viz., Kenya (National Christian Council of Kenya, 1968, pp. 35-36).

These materials, together with those from forestry now available for processing by the 'other sectors', will enable the setting up or expansion of pulping, veneering and plywood facilities, alpha-pinene rich oleoresin based synthetic camphor industry (Ganapathi, 1966), matches, joinery works, sports goods and shooks manufacture. The demand for these products is high as compared with supply. Through their sale outside Kashmir, the forestry and plantation industries will contribute to a major share of the increased exports by the rest of the economy.

The livestock and grazing industry contributes an additional output of Rs. 40 million (i.e., 188288 - 148730). Over 60 per cent of this goes to partly offset the burden of increased foodgrain imports for domestic consumption by alleviating meat, and to some extent, milk shortages. The remainder of the extra output is taken up by the rest of the economy for wool, milk products (viz. ghee or purified butter) and leather industries, nucleii of which exist in Kashmir (Directorate of Industries and Commerce - Statistics Branch, 1966). These products too contribute to exports by the processing industries. The livestock industry will use more of its own inputs, viz., Rs. 62 million worth as against 48 millions. This reflects the more intensively organised use of the range potential. Such use compensates for the limited fodder available from grain straws. It enables the enhanced material outputs and profits, though the reduced demand for draft power due to the shrinkage in agriculture also contributes.

The impact of the renewable resource-use adjustments discussed above is most profound on the remaining sectors of Kashmir's economy. They will be able to produce additional output worth Rs. 483 million (i.e. 674477 - 191698). This is more than the total income generated by all the sectors other than the renewable resource sector in the entire State in 1958-1959, viz. Rs. 409 million (Planning Department, 1961). Besides the

overall expansion of the economy, such change in its structure implies the diversification of the rural base. Kashmir will have more secondary and tertiary industries, which will employ additional workforce on regular basis equal to 10 million man-days (i.e. 45159 - 13922). Profits to manufacturing, transport, trade and other service enterprises will increase by Rs. 59 million (i.e. 147513 - 88092).

Assuming an unchanged taste and consumption pattern, the extra disposable income at the command of the people or the increased savings potential of the economy can be computed from the difference between the total value-added and the household sector purchases. This amounts to Rs. 516 million (i.e. 328931 + 494596 - 307612) as against the current potential of Rs. 121 million (i.e. 500288 - 71552 - 307612). Thus it is theoretically possible to siphon off resources for investment 420 per cent larger than possible now, if society so wishes.

The effect on trade-balance is obvious by comparing the import and export sector flows in the two interindustry tables. While imports will about double, it will be seen that as against the present trade surplus of Rs. 120 million (i.e. 219475 - 99871), it increases to Rs. 513 million (i.e. 696325 - 183530). This is more than four-fold. Kashmir will have so much more capital goods for economic development and other commodities. The other regions too will benefit. With larger imports that Kashmir's increased production enables them to make through the linkage-effect of Kashmir's increased demand for their products, expansion of their economies results, setting up an interregional development spiral.

It is possible to quantify inter-regional effects by including in an analysis the industries in the economies of other

regions.* Haveman and Krutilla (1968, 37-64) estimate by this method the occupational and industrial demands imposed on the regions of the U.S. national economy by the assumed construction of alternative types of water development projects in each of the regions. Since in developing countries, the levels of production and suitable locational pattern need to be arrived at simultaneously, 'a linear programming cum interindustry approach is most suitable for this purpose' (Mathur and Hashim, 1969). Our model would differ in detail from Mathur and Hashim's: while they have four regions for India, we need consider only two - one for Kashmir and the other for rest of the country - to study the impact of adjustments in one region on others as a whole.** The model is not applied in the present study. The total size of Kashmir's renewable resource sector is so small compared with the rest of India's economy that the model would be costly to apply unless the impact of the entire range of industries and the planning of the entire economy were the object. The other reason is the lack of access to data for the other regions. Nevertheless, the theoretical framework exists to make interregional evaluation for estimating the impact individually for different regions and their various economic sectors.

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*Following on from the conceptual framework of the input-output technique presented in the footnote on Page 9, equation (3) can be expanded to include the regional dimension as follows

(4) $rXi - \sum_{q=1}^{m} \sum_{j=1}^{n} rqxij = rYi \ , \quad i = 1,2...,n$

It will be seen that here Xi becomes rXi to represent the total output X, of industry i, in region r.
Here rqxij represents the flow from industry i in region r to industry j in region q, with a given number of regions $\hat{q}$, r = 1,2,..., m . Then the production coefficients appear as

(5) $\frac{rqxij}{rXi} = rq\hat{a}ij,$

showing that inputs from industry i in region r to industry j in region q are some proportion of the total production, X, of commodity j in region q.

**Khan (1967) has attempted a similar two region, multi-sector model which takes into account the intersectoral flows and reflects the implications of differences in regional technologies and behaviour.

The impact analysis of planned resource use helps the politician or the decision-maker to reach a quickly reasoned decision and the planner to make an assessment of the concomitant changes in the rest of the economy. By presenting the economy's structure with and without the plan in a quantitative manner, the reasons for accepting or rejecting the plan will be explicit. For instance, we have shown that the implementation of the plan could increase incomes, diversify the economic base, improve the trade situation and provide greater scope for sustaining development through the increased investment potential. At the same time, the direct employment in the renewable resource industries would fall by 225 thousand workers i.e. (459159 - 13922) - (287802 - 45159). This raises the sector's under-employment from the present 116,895 workers or 19 per cent to 341,995 workers (i.e. 225100 + 116895) or 55 per cent. Despite the fact that the effective employment in the manufacturing and tertiary sectors would be increased by over 300 per cent, the decision-maker may reject the plan because of the rural unemployment effect considering it to override the other beneficial impact*.

Conversely, the decision-maker may be convinced that the increased unemployment would only add to the existing rural underemployment pool and yet enable a bigger share to all owing to the increased output. He may consider this to be better than the present unproductive employment. He may base his argument on the fact that a 'condition of economic progress' is a progressive reduction of labour force employed in the primary sector (Clark, 1957). He may, therefore, opt for the plan, simultaneously seeking to remedy the unemployment problem by expanding the 'other sectors', for which more resources would become available through the readjustments. In the interim, he

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*Especially in view of the forecast increases in the labour force (Mehra, 1967).

may work out measures for subsidies and doles. These would be possible to pay at least at the average rate of the increase in the per capita income without causing additional financial burden.

Whatever the decision, the choice is the decision-maker's. The choice is easier and likely to be more rational with the pros and cons quantitatively reflected by the interindustry flow tables. This is because of the directness of our approach to the problem

> 'in contrast with the indirect and often misleading, statistical inference based on the analysis of market demand and supply functions.'
> (Barna, 1955, pp. 19-38).

We can allow for the demand, producer's incomes and other economic, social and political variables during the optimization process. To give flexibility to decision-making, we need to prepare a number of plans instead of one. Each would be optimal for the set of constraints, assumptions and decision-variables incorporated in it.

We may present a plan similar to the one analysed above except for employment in the resource sector and/or for food grain output levels which would be no less than at present. We will be able to inform the decision-maker about the opportunity cost of maintaining* the employment and/or foodgrains output, i.e., the reduction in efficiency as will be reflected by the lowering of the benefit: cost ratio from 15.48 for the model without these constraints. We will be able to add content to this in terms of the changed flows and transactions by making another interindustry flow table for the revised plan. By presenting a number of tables, the impact of each plan vis-a-vis others as well as the present resource use pattern will be clearly discernible. Besides making the choice easier, the planner by

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*or even enhancing, whatever is desired

inspecting the tables for the basic model and the chosen plan, will have a quantitative over-view of the economy for coordination and efficient planning according to the changed structure. Such impact analysis is a bridge between micro-economics (i.e. optimum planning of a region's renewable resources) and macro-economics (i.e. intersectoral effects and responses in the whole economy). It discloses

> 'the economic implications of alternative development proposals. Thus it can facilitate decisions on whether a particular plan appears consistent with the needs, capabilities and aspirations of the area' (Hirsch, 1963).

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APPENDIX 1. & appendix 13

Chronological steps in Renewable Resource Planning.

0. Object of Analysis (Policy and Development Strategy).

1. Delineation of Problem (Total Problem Analysis - regions and renewable resources).

2. Present Use Survey (Basic Model Analysis - mapping, review of techno-economic data and obstacles to resource adjustments).

3. Use Possibility Assessment (Biotechnical Analysis).

4. Options Appraisal (Benefit-cost Analysis).

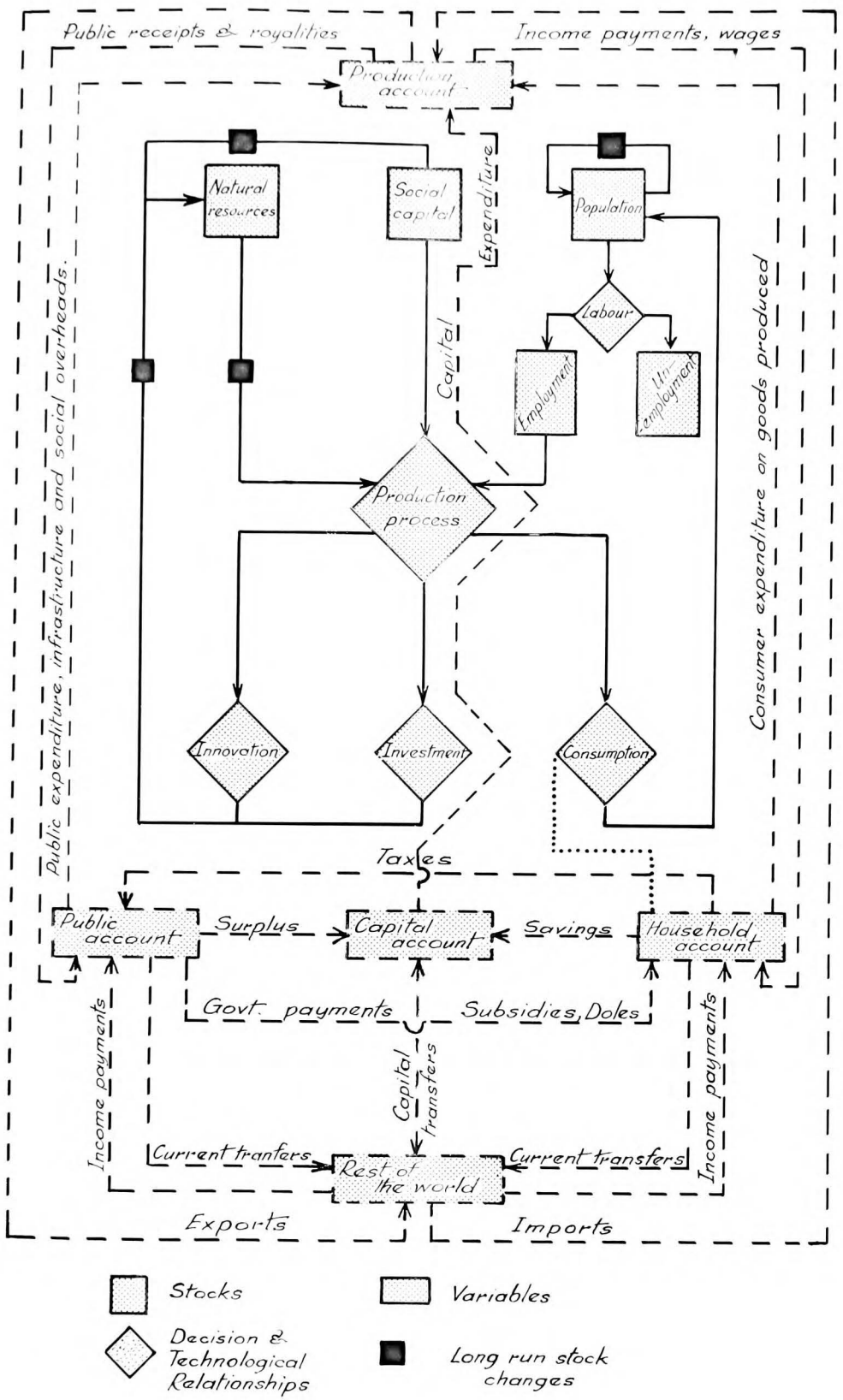
5. Optimization (Operations Analysis).

6. Investment Scheduling (Dynamic Analysis).

7. Inter-industry relationships (Impact Analysis).

8. Implementation of the Plan (Administrative and Institutional Infrastructure Analysis).

FLOWS IN AN AREA ECONOMY



APPENDIX 2

APPENDIX 3. ~~to~~ appendix 13

Aggregation of Sectors.

An inter-industry model with the required number of sectors and the one aggregated to represent the remaining sectors serves the purpose of an impact analysis. This is borne out by an empirical study of two input-output models. One is an actual 27 sector model (W.model) for the Washington economy (Bourque, Chambers, Chiu et.al, 1967, Bourque,1969). The other is an hypothetical 25 sector model (H.model) constructed by the Monte Carlo method (random numbers).

The H. model was designed to represent an actual situation. Since a real inter-industry flow table of similar size has about one third of its entries zero, one third of the entries were assumed so. These were arbitrarily placed in the flow table. Then the endogenous portion of the table was completed with non-zero elements, using a random table. The entries were allowed to range from 0 to 100. Primary inputs were then assumed to range from 0 to 70 per cent of each sector's output, determining the exact percentage by a random table. Again using a random table, the percentage of each sector's primary inputs going to households as income was determined to compute the income multipliers.

Three sectors in each model were randomly chosen to remain unaggregated, viz., sectors 4, 13 and 24 for W. model and sectors 1, 16 and 24 for H. model. The remaining sectors were then aggregated in each model, in a random manner, by adding together two sectors each time until the model was aggregated down to a four-sector model. The direct and interdependent coefficients were computed for each matrix size of the models, e.g., for the H. model, there were 22 different matrices of interdependent coefficients. From these the output multipliers were obtained. For the H. model, also the income multipliers were computed by selecting at random a percentage between 50

and 90, which was the amount of final demand attributed to household income. The output and income multipliers were then used to determine the effect of aggregation (i.e. the size of the matrix) on the magnitude of the multipliers of the non-aggregated sectors.

The results indicated in Table 4 are self explanatory. The multipliers for the three sectors of each model before and after aggregation (cols. 1 and 2) show that the changes (col.3) are small. The regression coefficients (col.4) measure the slope of the line resulting from regressing the size of the model against that of the multiplier. The coefficients, being approximately zero, indicate no relation between the two variables. The variances of the multipliers for each sector as the models were aggregated (col.5) indicate a small amount of variation. The coefficient of variation, presented in col.6, is a measure of relative variation where the standard deviation is expressed as a percentage of the arithmetic mean. These coefficients indicate a small variation in each multiplier.

The above results show that the multiplier size or the interdependence coefficients are little affected by the size of or aggregation in an interindustry model. This suggests that when data and research resources are limited, small input-output models can be useful if the object is to estimate the impact or relationships of few sectors in the economy.

Model	Sector multiplier (Unaggregated Model) 1	Sector multiplier (Aggregated Model, 4×4) 2	Difference 3	Regression coefficient 4	Variance (10^{-3}) 5	Coefficients of Variation (Percent) 6
W MODEL						
Output multipliers:						
Sector 4	1.1383	1.1398	−.0015	−.00005	.016	.3509
Sector 13	1.1263	1.1301	−.0038	+.00002	.002	.1242
Sector 24	1.1930	1.1931	−.0001	+.00019	.005	.1847
H MODEL						
Output multipliers:						
Sector 1	1.6764	1.5597	.1167	.00606	1.531	2.4118
Sector 16	1.8426	1.7376	.1050	.00477	1.369	2.0789
Sector 24	2.7533	2.4904	.2629	.01019	4.414	2.5491
Income multipliers:						
Sector 1	1.3898	1.3808	.0090	−.00044	.063	.5674
Sector 16	1.8184	1.8328	−.0144	−.00133	.230	.8363
Sector 24	3.4429	3.4772	−.0343	−.00683	3.037	1.5902

Table 4. Selected Data for two Interindustry Models.

Appendix 4 to appendix 13

INTERINDUSTRY FLOW TABLE NO. 1

Sectors		Agriculture 1	Horticulture 2	Cash Crops 3	Forestry 4	Plantations 5	Livestock & Grazing 6	Sericulture 7	Other Sectors 8	Total Intermediate Output 9	H h
		← QUADRANT 1 →									←
Agriculture	1	3245	2	0	0	0	30491	0	0	33738	7
Horticulture	2	0	79	0	0	0	0	0	2098	2177	
Cash Crops	3	0	0	286	0	0	0	0	0	286	
Forestry	4	0	2764	25	2146	63	1918	0	60037	66953	
Plantations	5	1269	2252	0	0	85	0	0	12744	16350	1
Livestock & Grazing	6	31521	1874	16	0	0	48216	0	4952	86579	6
Sericulture	7	0	0	0	0	0	0	31	533	564	
Other Sectors	8	2152	321	6	60362	381	931	30	0	64183	1
Total Intermediate Inputs	9	38187	7292	333	62508	529	81556	61	80364	270830	17
		← QUADRANT 3 →									←
Households	10	375294	7372	2055	18634	3795	35853	2234	13922	459159	4
Other value-added	11	-300289	30446	-48	56875	22542	30274	556	88092	-71552	
Imports	12	512	210	12	586	27	1047	7	9320	11721	8
Total Primary Inputs	13	75517	38028	2019	76095	26364	67174	2797	111334	399328	12
Gross Total Inputs	14	113704	45320	2352	138603	26893	148730	2858	191698	670158	30

Appendix A to appendix 13

INTERINDUSTRY FLOW TABLE NO. 1

Rupees 000

		← QUADRANT 1 →									← QUADRANT 2 →				
		Agri-culture	Horti-culture	Cash Crops	Forestry	Plan-tations	Livestock & Grazing	Seri-culture	Other Sectors	Total Intermediate Output	House-holds	Stock Change	Exports	Total Final Demand	Gross Total Output
Sectors		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Agriculture	1	3245	2	0	0	0	30491	0	0	33738	79966	0	0	79966	113704
Horticulture	2	0	79	0	0	0	0	0	2098	2177	5025	0	38118	43143	45320
Cash Crops	3	0	0	286	0	0	0	0	0	286	17	0	2049	2066	2352
Forestry	4	0	2764	25	2146	63	1918	0	60037	66953	7505	0	64145	71650	138603
Plantations	5	1269	2252	0	0	85	0	0	12744	16350	10543	0	0	10543	26893
Livestock & Grazing	6	31521	1874	16	0	0	48216	0	4952	86579	62151	0	0	62151	148730
Sericulture	7	0	0	0	0	0	0	31	533	564	0	0	2294	2294	2858
Other Sectors	8	2152	321	6	60362	381	931	30	0	64183	13126	1520	112869	127515	191698
Total Intermediate Inputs	9	38187	7292	333	62508	529	81556	61	80364	270830	178333	1520	219475	399328	670158
		← QUADRANT 3 →									← QUADRANT 4 →				
Households	10	375294	7372	2055	18634	3795	35853	2234	13922	459159	41129	0	0	41129	500288
Other value-added	11	-300289	30446	-48	56875	22542	30274	556	88092	-71552	0	0	0	0	-71552
Imports	12	512	210	12	586	27	1047	7	9320	11721	88150	0	0	88150	99871
Total Primary Inputs	13	75517	38028	2019	76095	26364	67174	2797	111334	399328	129279	0	0	88150	528607
Gross Total Inputs	14	113704	45320	2352	138603	26893	148730	2858	191698	670158	307612	1520	219475	487478	1198765

Rupees 000

APPENDIX 5 to appendix 13

INTERINDUSTRY FLOW TABLE NO. 2

Sectors		Agri-culture	Horti-culture	Cash Crops	Forestry	Plan-tations	Livestock & Grazing	Seri-culture	Other Sectors	Total Intermediate Output	House-holds	Stock Change	Exports	Total Final Demand	Gross Total Output
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		← QUADRANT 1 →									← QUADRANT 2 →				
Agriculture	1	1518	2	0	0	0	27067	0	0	28587	38386	0	0	38386	66973
horticulture	2	0	79	0	0	0	0	0	2098	2177	5025	0	38118	43143	45320
Cash Crops	3	0	0	522	0	0	0	0	0	522	17	0	3138	3155	3677
Forestry	4	0	2764	0	2636	450	3105	0	147748	156703	7505	0	214249	221754	378457
Plantations	5	592	2252	0	0	290	0	0	233232	236366	10543	0	0	10543	246909
Livestock & Grazing	6	13136	1874	13	0	920	61992	0	23340	101275	87013	0	0	87013	188288
Sericulture	7	0	0	0	0	0	0	31	533	564	0	0	2294	2294	2858
Other Sectors	8	675	321	2	206666	2976	1203	30	0	211873	31758	2320	438526	457072	674477
Total Intermediate Inputs	9	15921	7292	537	209302	4636	93367	61	406951	738067	180247	2320	696325	878892	1606959
		← QUADRANT 3 →									← QUADRANT 4 →				
Households	10	121878	7372	2174	51332	19232	38421	2234	45159	287802	41129	0	0	41129	328931
Other value-added	11	-76715	30446	966	116902	222891	52037	556	147513	494596	0	0	0	0	494596
Imports	12	5889	210	0	921	150	4463	7	84854	96494	86236	+800	0	87036	183530
Total Primary Inputs	13	51052	38028	3140	169155	242273	94921	2797	276726	878892	127365	800	0	128165	1007057
Gross Total Inputs	14	66973	45320	3677	378457	246909	188288	2858	674477	1606959	307612	3120	696325	1007057	2614016

APPENDIX 14

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COST-BENEFIT EVALUATION OF WATERSHED PROTECTION AND EROSION EFFECTS

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Abstract: The ranking of renewable resources use options involves the evaluation of erosion and protection effects associated with each use. A method is proposed in this article which enables the comparison of these effects without quantifying them in monetary terms.

Introduction

The non-market consequences of protection on erosion and stream flow are difficult to estimate commensurably with the market effects of a renewable resource use. They are complex too, for they occur conjointly with other consequences by affecting the productivity of a renewable resource. King (1968) says that the effects of erosion are so far-reaching and can do so much damage to an economy that 'the protection of areas that are liable to erode is the chief consideration in any land-use policy'. This assertion assumes the community's willingness to pay for protection. It ignores the relationship between the social costs of erosion and protection. How can one justify soil conservation if its costs exceed the gains? To make a case for less or more protection, we need to evaluate how'much damage to economy' stems from erosion and its concomitant effects.

Cost of Substitution

Francois (1962) advocates the 'cost of substitution' index for evaluating forest influences*1, i.e., the minimum cost of the method to be employed to avoid the damage attributable to the absence of the influences or to ensure the same benefits. Almost any influence can be produced by an alternative means, but the difficulty is that it may not produce identical effect. The substitutes may necessitate estimation of supplementary benefits occurring outside the area or in addition to desired protection, so that the problem of valuing the intangibles is not resolved.

Willingness to Pay

Marglin (1962) suggests the'direct evaluation of the damages that successive degrees of flood protection prevent' to measure the benefits of flood control, assuming that the value reflects the beneficiaries' willingness to pay. It circumvents the measurement of the latter but assumes that the benefits are provided in the cheapest way; demand for them would vary if provided in another way. This condition is unhelpful because the aim of the evaluation is to find the

* The author is grateful to Mr. J. J. MacGregor, Forest Economist, Oxford University, for going through an earlier draft of the article.

*1 These influences include the effect of forest cover in protecting soil and regulating water regime, besides the amenity effects.

'optimal' way of providingthe benefit.

Quantification Problem

The need to value the alternative non-market costs poses difficulties. Eckstein (1961) quotes different assessments of losses likely to be averted through a flood control project. These varied by 600 per cent 'not due to the method of economic analysis' but because of faulty hydrologic, agronomic and engineering estimates. Such variations cannot be guarded against, especially when costs have to be estimated for untested anti-erosion measures for diverse resource uses and sites.

Opportunity Cost cum Efficiency Ranking

We will now attempt a synthesis between the concepts of opportunity costs and efficiency evaluation, i.e., benefit:cost ratio of options. This synthesis dispenses with the actual valuation and the assumptions of willingness to pay or of identity of effects by substitute methods.

Each renewable resource use has an associated degree of erosion, depending upon the choice of technique. The degree varies from little or no more than that in the natural state to the highest. The former represents extreme protection and the latter none. The costs of protection are included in the measurable costs of an option as are the additional measurable benefits that may ensue. The problem of intangibility is confined to the evaluation of the non-market benefits of protection.

The benefit:cost ratio of a resource use may be seen as a composite of the ratios of measurable benefits to measurable costs and of non-market benefits to non-market costs. The economic justification for leaving a resource in its natural state, such as the subalpine forest belt in the Rocky Mountains, the Himalayas and the Alps, would be that the social gains equal the social costs. It implies that the social opportunity cost of retaining the resource in an unused form does not exceed the benefits of protection to society, i.e., the benefit: cost ratio of such an option is not less than unity. A ratio of gross benefits to gross costs equal to unity makes a project pass muster on its own. Symmetrically, we may assume that an option accepted by society purely for 'complete' protection has such a ratio.* If the resource can be and is used for providing net material benefits in addition to the protection, the ratio is different from unity; it has the additional measurable component. The latter comprises the ratio of the benefits of the value of wood extracted to the costs

* By consistently applying this assumption to all options which afford 'full' protection, it will not distort their ranking order. This assumption also is valid on the grounds of 'precedential evaluation' (Hughes, 1965), e.g. since the Netherlands Government is continually backed by people for land reclamation even though its costs are twice the net income from commercial farming, society values the programme such that the appropriate discount rate is one half of the market rate (International Institute for Land Reclamation, 1960).

of infrastructure, extraction and maintenance, and the non-measurable component has equal benefits and costs. The composite benefit:cost ratio is a combination of 'x' representing the measurable effects and '1' representing the non-market effects. The value of 'x' may or may not exceed unity, depending upon the actual costs and measurable benefits.

The above example is analogous to other uses involving 'complete' protection with or without additional activity. The cost of erosion is the value of damage it does. The benefit of 'complete' erosion control equals the value of the damage, because that is prevented from taking place. Hence, the ratio of an effective soil conservation practice, by adopting a resource use technique which affords 'full' protection, can be expressed as unity. Since this would be so no matter what the nature of damage prevented be, the values of the numerator and the denominator need not be computed. Different techniques, such as terracing, bunding, sodding or afforestation, involve different costs; our result may appear unsatisfactory if erosion control is an activity by itself. This difficulty does not arise because each option has measurable benefits against which the costs are weighed. The effect on actual costs of the different conservation techniques is reflected in the measurable component of the ratio.

If no protection is provided or the soil is allowed to erode unhindered, there are no benefits in the non-measurable component. It equals zero, because the ratio of zero benefits to any value of costs remains zero, and the valuation of the damage is unnecessary. Thus the values for the social opportunity costs or benefits expressed as a benefit:cost ratio vary from the extremes of zero to one for 'no' protection to 'complete' protection. The range starting from zero for critical erosion has the intermediate values of 0.25 for very severe erosion, 0.50 for severe erosion, 0.75 for moderate erosion till the maximum of 1.0 is reached for a situation with negligible erosion.

The adoption of the above range and its division into equidistant intermediate values allows little deviation from realism. Even if the values were not precise, the ranking of options remains unaffected, firstly, because options with similar erosion effects are credited with identical values. Secondly, the values are in the correct direction. Thirdly, the intrinsic ratios are likely to be close to these values because of the number of the intermediate values. If more accuracy is desired, the proximity can be narrowed further by increasing the number of erosion classes and the intermediate values. Another class between severely and very severely eroding classes may be included with a value of 0.37, for erosion effects on slopes exceeding 25 per cent. By attaching equidistant values, we have allowed for the possibility of overlap at extremes between two successive erosion classes. The six values together with the erosion classification and the complementary land use data provide compatible indices of the present erosion and the erodibility range for resource uses in

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* The range from zero to unity may be applied to any range of erosion and protection effects and its intermediate divisions made to correspond with erosion classes recognised for a particular area.

an area.

Combination of Market and Non-Market Ratios

The two compenents of the composite ratio may be combined by subtraction or addition. Consider two options with the same measurable component ratio of 2.0. The one with 'full' protection engenders 'no' erosion damage while another with no protection does. It may be argued that the composite ratio for the latter is less than 2.0 because of the non-market losses. Nothing is lost in obtaining the first option's measurable benefits so that its efficiency stands reflected by the ratio, i.e. 2.0. Such combination involves subtraction of the measurable component by values in a reverse, descending order through the range of values for the different degrees of erosion/protection, i.e., subtract from the measurable component one less by the non-measurable value. Thus the composite ratio for moderate erosion is 2 - (1 - 0.75) or 1.75, for very severe to severe erosion 2 - (1 - 0.37) or 1.37 for full protection 2 - (1 - 1) or 2, for no protection 2 - (1 - 0) or 1, and so on.

The addition of the two components involves a change in the above rationale. It implies additional social gains from protection, so that the market benefits need to be increased for the degree of erosion control. While some losses are 'acceptable', the addition of no gains for 'full' protection in the subtraction method assumes that it is expected to adopt conservation techniques and anything less than fully effective conservation is undesirable. Addition of the two components implies no such value judgement. It signifies an explicit indifference between marketable and non-marketable benefits.

Both the methods yield similar ranking of options. The differences between the values of composite ratios for different options are of the same magnitude and in the same order. However, addition is preferable because it is straightforward and consistent with the objective function in resource use planning, i.e., maximisation of the sum of gains. Addition does not fail, where subtraction may. If protection is the primary aim, as in a forest managed for influences, the non-market component ratio with 'full' protection is 1.0 and the measurable zero. By subtraction, such options are inadmissible because of a zero composite ratio. This is erroneous, for protection alone may be socially desirable if the additional (market-oriented) action has a ratio of less than one. Such difficulties do not arise in addition.*

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* Multiplication of the two components gives similar results as addition, even though the absolute values of the composite ratio may be different. However, multiplication is fallible if one of the two components has a zero value resulting in an illogical zero for the composite ratio.

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Appendix 15

Basic Model showing present resource-use pattern

S. No.	Use Category/ Site characteristics	Paddy X_1	Maize X_2	Wheat X_3	Oilseeds X_4	Saffron X_5	Pyzethrum X_6
1	Alpine	-	-	-	-	-	-
2	Sub-alpine	-	-	-	-	-	-
3	Upper Temperate	-	-	-	-	-	-
4	<5%	-	-	-	-	-	-
5	Poorly drained	-	-	-	-	-	-
6	Well drained	-	-	-	-	-	-
7	>5%	-	-	-	-	-	-
8	Lower Temperate	344,800	209,000	78,000	67,000	2,850	2,369
9	>25%	-	12,400	6,250	-	-	-
10	12-25%	-	89,100	41,600	4,600	-	1,100
11	Karewa light erosion	-	-	-	-	-	-
12	Karewa M. erosion	-	-	-	1,600	-	1,100
13	Karewa severe to very severe erosion	-	39,000	10,000	3,000	-	-
14	Kandi Shallow/ S. to V.S. Erosion	-	50,100	31,500	-	-	-
15	5-12%	-	51,500	20,000	38,200	900	1,269
16	Karewa light erosion	-	-	-	-	-	-
17	K. M. eroding	-	-	-	7,000	-	-
18	K. S. eroding	-	13,000	5,400	14,200	900	-
19	K. V.S. eroding	-	26,000	6,300	3,600	-	-
20	Kandi Shallow/ S. to V.S. erosion	-	12,500	8,300	8,300	-	-
21	Kandi Deep/L. to M. erosion	-	-	-	5,100	-	1,269
22	<5%	344,800	56,000	10,150	24,200	1,950	-
23	Ill drained	-	-	-	-	-	-
24	Poorly drained	-	-	-	-	-	-
25	Badly drained	-	-	-	-	-	-
26	Well drained	344,800	56,000	10,150	24,200	1,950	-
27	Payeen/light erosion	344,800	-	-	1,800	-	-
28	Karewa light erosion	-	-	-	-	-	-
29	K.M.E.	-	49,000	5,000	13,100	1,950	-
30	K.S.E.	-	-	1,450	1,300	-	-
31	K.V.S.E.	-	2,000	1,000	-	-	-
32	Kandi Shallow/S.E.	-	5,000	1,600	3,000	-	-
33	Kandi Deep/L-M.E.	-	-	1,100	5,000	-	-
34	Sum (above)	344,800	209,000	78,000	67,000	2,850	2,369
35	Sum (below)	29,200	-	-	-	-	-
36	Critically eroding	-	-	-	-	-	-
37	Flood affected Payeen	29,200	-	-	-	-	-
38	Grand Total	374,000	209,000	78,000	67,000	2,850	2,369

contd.....

Appendix 15 (contd)

S. No.	Sericult. X_7	Apple X_8	Walnut X_9	Almond X_{10}	Scrub X_{11}	Deodar X_{12}	Kail X_{13}	Fir X_{14}	Willow X_{15}
1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	101,000	341,554	-
4	-	-	-	-	-	-	-	81,000	-
5	-	-	-	-	-	-	-	22,800	-
6	-	-	-	-	-	-	-	58,200	-
7	-	-	-	-	-	-	101,000	260,554	-
8	14,800	22,522	41,958	1,907	38,325	112,388	159,533	-	-
9	-	-	-	-	21,600	52,600	38,600	-	-
10	3,200	4,400	-	525	9,220	25,500	26,203	-	-
11	-	-	-	-	-	2,800	16,000	-	-
12	-	3,000	-	-	2,100	-	-	-	-
13	-	1,400	-	125	1,120	-	-	-	-
14	3,200	-	-	400	6,000	22,700	10,203	-	-
15	9,000	10,100	10,418	872	5,105	21,088	66,230	-	-
16	-	-	-	-	1,100	-	38,100	-	-
17	2,100	6,100	-	-	1,000	-	-	-	-
18	6,900	1,600	-	312	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-
20	-	-	-	560	2,200	9,088	12,100	-	-
21	-	2,400	10,418	-	805	12,000	16,030	-	-
22	2,600	8.022	31,540	510	2,400	13,200	28,500	-	13,089
23	-	-	6,500	-	-	-	6,300	-	13,089
24	-	-	6,500	-	-	-	6,300	-	-
25	-	-	-	-	-	-	-	-	13,089
26	2,600	8,022	25,040	510	2,400	13,200	22,200	-	-
27	-	3,022	20,000	-	-	-	-	-	-
28	-	3,200	-	-	800	-	4,200	-	-
29	2,600	1,800	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-
32	-	-	-	510	1,000	-	2,400	-	-
33	-	-	5,040	-	600	13,200	15,600	-	-
34	14,800	22,522	41,958	1,907	38,325	112,388	260,533	341,554	13,089
35	-	-	-	-	-	-	-	-	13,089
36	-	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-	13,089
38	14,800	22,522	41,958	1,907	38,325	112,388	260,533	341,554	13,089

contd....

Appendix 15 (contd)

S. No.	Poplar X_{16}	Pak-For. X_{17}	Agri-Silvi. X_{18}	Sylvo-Past. X_{19}	Vill. Graz. X_{20}	Alp. Graz. X_{21}	Wahd. Pn. X_{22}	Cult. X_{23}	Total Area
1	-	-	-	-	-	519,437	-	-	519,437
2	-	-	-	-	-	-	706,477	-	706,477
3	-	-	448	72,198	-	-	-	-	515,200
4	-	-	448	39,100	-	-	-	-	120,548
5	-	-	-	22,000	-	-	-	-	44,800
6	-	-	448	17,100	-	-	-	-	75,748
7	-	-	-	33,098	-	-	-	-	394,652
8	209	44,378	-	41 810	153,000	-	-	30,632	1378,570
9	-	-	-	7,500	-	-	-	5,400	144,350
10	-	-	-	4,300	28,000	-	-	10,000	247,748
11	-	-	-	-	-	-	-	6,632	25,432
12	-	-	-	-	-	-	-	-	7,800
13	-	-	-	-	12,500	-	-	3,368	70,613
14	-	-	-	4,300	15,500	-	-	-	143,903
15	-	-	-	12,000	47,500	-	-	6,100	300,282
16	-	-	-	-	-	-	-	-	39,200
17	-	-	-	-	-	-	-	-	16,200
18	-	-	-	-	-	-	-	-	42,312
19	-	-	-	-	9,100	-	-	6,100	51,100
20	-	-	-	7,200	38,400	-	-	-	98,648
21	-	-	-	4,800	-	-	-	-	52,822
22	209	44,378	-	18,010	77,500	-	-	9,132	686,190
23	-	13,078	-	10,010	12,500	-	-	-	61,477
24	-	13,078	-	10,010	2,400	-	-	-	38,288
25	-	-	-	-	10,100	-	-	-	23,189
26	209	31,300	-	8,000	65,000	-	-	9,132	624,713
27	-	31,300	-	-	-	-	-	-	400,922
28	-	-	-	-	-	-	-	-	8,200
29	-	-	-	-	-	-	-	-	73,450
30	-	-	-	-	18,200	-	-	-	20,950
31	-	-	-	-	22,500	-	-	9,132	34,632
32	-	-	-	5,100	24,300	-	-	-	42,910
33	209	-	-	2,900	-	-	-	-	43,649
34	209	44,378	448	114,008	153,000	519,437	706,477	30,632	3,119,684*
35	-	9,200	-	-	-	-	-	49,000	87,400*
36	-	-	-	-	-	-	-	49,000	49,000
37	-	9,200	-	-	-	-	-	-	38,400*
38	209	53,578	448	114,008	153,000	519,437	706,477	79,632	3,207,084*

Appendix 16

Use-Possibility for Paddy Option

S. No.	Use Category/ Site characteristics	X_1	X_2	X_3	X_4	X_5	X_6	X_7
1	Alpine	-	-	-	-	-	-	-
2	Sub-Alpine	-	-	-	-	-	-	-
3	Upp. Temp.	-	-	-	-	-	-	-
4	<5%	-	-	-	-	-	-	-
5	Poorly drained	-	-	-	-	-	-	-
6	Well drained	-	-	-	-	-	-	-
7	>5%	-	-	-	-	-	-	-
8	Low Temp.	344,800	129,000	30,350	55,700	2,850	2,369	11,600
9	>25%	-	-	-	-	-	-	-
10	12-25%	-	39,000	10,100	4,600	-	1,100	-
11	Karewa light erosion	-	-	-	-	-	-	-
12	K.M. erosion	-	-	-	1,600	-	1,100	-
13	K. S. to V.S. erosion	-	39,000	10,100	3,000	-	-	-
14	Kandi Shallow/ S. to V.S. erosion	-	-	-	-	-	-	-
15	5-12%	-	39,000	11,700	29,900	900	1,269	9,000
16	Kar. L.E.	-	-	-	-	-	-	-
17	K. M. E.	-	-	-	7,000	-	-	2,100
18	K. S. E.	-	13,000	5,400	14,200	900	-	4,600
19	K. V. S. E.	-	26,000	6,300	3,600	-	-	2.300
20	Kandi Shallow/ S. to V.S.E.	-	-	-	-	-	-	-
21	Kandi Deep/ L. to M. erosion	-	-	-	5,100	-	1,269	-
22	<5%	344,800	51,000	8,550	21,200	1,950	-	2,600
23	Ill drained	-	-	-	-	-	-	-
24	Poorly drained	-	-	-	-	-	-	-
25	Waterlogged	-	-	-	-	-	-	-
26	Well drained	344,800	51,000	8,550	21,200	1,950	-	2,600
27	Payeen light erosion	344,800	-	-	1,800	-	-	-
28	Kar. L. E.	-	-	-	-	-	-	-
29	Kar. M. E.	-	49,000	5,000	13,100	1,950	-	2,600
30	Kar. S.E.	-	-	1,450	1,300	-	-	-
31	Kar. V.S.E.	-	2,000	1,000	-	-	-	-
32	Kandi Shallow/ S. to V.S.	-	-	-	-	-	-	-
33	Kandi Deep/ L. to M.E.	-	-	1,100	5,000	-	-	-
34	↑Sum	344,800	129,000	30,350	55,700	2,850	2,369	11,600
35	↓Sum	29,200	-	-	-	-	-	-
36	Critically Eroding	-	-	-	-	-	-	-
37	Flood Affected	29,200	-	-	-	-	-	-
38	Grand Total	374,000	129,000	30,350	55,700	2,850	2,369	11,600

contd.....

Appendix 16 (contd.)

S. No.	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	22,522	41,958	437	7,525	28,000	96,230	-	-	209
9	-	-	-	-	-	-	-	-	-
10	4,400	-	125	3,220	2,800	16,000	-	-	-
11	-	-	-	-	2,800	16,000	-	-	-
12	3,000	-	-	2,100	-	-	-	-	-
13	1,400	-	125	1,120	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-
15	10,100	10,418	312	2,905	12,000	54,130	-	-	-
16	-	-	-	1,100	-	38,100	-	-	-
17	6,100	-	-	1,000	-	-	-	-	-
18	1,600	-	312	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-
21	2,400	10,418	-	805	12,000	16,030	-	-	-
22	8,022	31,540	-	1,400	13,200	26,100	-	-	209
23	-	6,500	-	-	-	6,300	-	-	-
24	-	6,500	-	-	-	6,300	-	-	-
25	-	-	-	-	-	-	-	-	-
26	8,022	25,040	-	1,400	13,200	19,800	-	-	209
27	3,022	20,000	-	-	-	-	-	-	-
28	3,200	-	-	800	-	4,200	-	-	-
29	1,800	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-	-	-
33	-	5,040	-	600	13,200	15,600	-	-	209
34	22,522	41,958	437	7,525	28,000	96,230	-	-	209
35	-	-	-	-	-	-	-	-	-
36	-	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-	-
38	22,522	41,958	437	7,525	28,000	96,230	-	-	209

contd.....

Appendix 16 (contd.)

S. No.	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	Total
1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-
8	44,378	-	17,710	64,700	-	-	25,232	925,570
9	-	-	-	-	-	-	-	-
10	-	-	-	12,500	-	-	10,000	103,845
11	-	-	-	-	-	-	6,632	25,432
12	-	-	-	-	-	-	-	8,800
13	-	-	-	12,500	-	-	3,368	70,613
14	-	-	-	-	-	-	-	-
15	-	-	4,800	9,100	-	-	6,100	201,634
16	-	-	-	-	-	-	-	39,200
17	-	-	-	-	-	-	-	16,200
18	-	-	-	-	-	-	-	40,012
19	-	-	-	9,100	-	-	6,100	53,400
20	-	-	-	-	-	-	-	-
21	-	-	4,800	-	-	-	-	52,822
22	44,378	-	12,910	43,100	-	-	9,132	620,091
23	13,078	-	10,010	2,400	-	-	-	38,288
24	13,078	-	10,010	2,400	-	-	-	38,288
25	-	-	-	-	-	-	-	-
26	31,300	-	2,900	40,700	-	-	9,132	581,803
27	31,300	-	-	-	-	-	-	400,922
28	-	-	-	-	-	-	-	8,200
29	-	-	-	-	-	-	-	73,450
30	-	-	-	18,200	-	-	-	20,950
31	-	-	-	22,500	-	-	9,132	34,632
32	-	-	-	-	-	-	-	-
33	-	-	2,900	-	-	-	-	43,649
34	44,378	-	17,710	64,700	-	-	25,232	925,570
35	-	-	-	-	-	-	-	29,200
36	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-
38	44,378	-	17,710	64,700	-	-	25,232	954,770

Appendix 17

Composite Use Possibility Model

Land Class	Use Category							
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-
8	925,570	1,005,570	973,220	936,870	925,570	925,570	928,770	925,570
9	-	12,400	6,250	-	-	-	-	-
10	103,845	153,945	135,345	103,845	103,845	103,845	107,045	103,845
11	25,432	25,432	25,432	25,432	25,432	25,432	25,432	25,432
12	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800
13	70,613	70,613	70,613	70,613	70,613	70,613	70,613	70,613
14	-	50,100	31,500	-	-	-	3,200	-
15	201,634	214,134	209,934	209,934	201,634	201,634	201,634	201,634
16	39,200	39,200	39,200	39,200	39,200	39,200	39,200	39,200
17	16,200	16,200	16,200	16,200	16,200	16,200	16,200	16,200
18	40,012	40,012	40,012	40,012	40,012	40,012	40,012	40,012
19	53,400	53,400	53,400	53,400	53,400	53,400	53,400	53,400
20	-	12,500	8,300	8,300	-	-	-	-
21	52,822	52,822	52,822	52,822	52,822	52,822	52,822	52,822
22	620,091	625,091	621,691	623,091	620,091	620,091	620,091	620,091
23	38,288	38,288	38,288	38,288	38,288	38,288	38,288	38,288
24	38,288	38,288	38,288	38,288	38,288	38,288	38,288	38,288
25	-	-	-	-	-	-	-	-
26	581,803	586,803	583,403	584,803	581,803	581,803	581,803	581,803
27	400,922	400,922	400,922	400,922	400,922	400,922	400,922	400,922
28	8,200	8,200	8,200	8,200	8,200	8,200	8,200	8,200
29	73,450	73,450	73,450	73,450	73,450	73,450	73,450	73,450
30	20,950	20,950	20,950	20,950	20,950	20,950	20,950	20,950
31	34,632	34,632	34,632	34,632	34,632	34,632	34,632	34,632
32	-	5,000	1,600	3,000	-	-	-	-
33	43,649	43,649	43,649	43,649	43,649	43,649	43,649	43,649
34	925,570	1,005,570	973,220	936,870	925,570	925,570	928,770	925,570
35	29,200	29,200	29,200	29,200	-	-	-	-
36	-	-	-	-	-	-	-	-
37	29,200	29,200	29,200	29,200	-	-	-	-
38	954,770	1,034,770	1,002,420	966,070	925,570	925,570	928,770	925,570

contd.....

Appendix 17 (contd.)

Land Class	Use Category							
	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	424,787	-	-
3	-	-	-	-	101,000	414,200	-	-
4	-	-	-	-	-	120,548	-	-
5	-	-	-	-	-	44,800	-	-
6	-	-	-	-	-	75,748	-	-
7	-	-	-	-	101,000	293,652	-	-
8	925,570	669,090	413,544	431,923	890,671	-	452,389	907,860
9	-	136,850	45,650	136,850	136,850	-	-	-
10	103,845	243,448	186,820	142,403	243,448	-	-	103,845
11	25,432	25,432	6,632	2,800	25,432	-	-	25,432
12	7,800	7,800	4,800	-	7,800	-	-	7,800
13	70,613	70,613	69,088	-	70,613	-	-	70,613
14	-	139,603	106,300	139,603	139,603	-	-	-
15	201,634	288,282	178,674	139,470	288,282	-	-	196,834
16	39,200	39,200	1,100	-	39,200	-	-	39,200
17	16,200	16,200	10,100	-	16,200	-	-	16,200
18	40,012	40,012	37,200	-	40,012	-	-	40,012
19	53,400	53,400	53,400	-	53,400	-	-	53,400
20	-	91,448	69,700	91,448	91,448	-	-	-
21	52,822	48,022	7,174	48,022	48,022	-	-	48,022
22	620,091	510	2,400	13,200	222,091	-	452,389	607,181
23	38,288	-	-	-	6,300	-	51,467	28,278
24	38,288	-	-	-	6,300	-	28,278	28,278
25	-	-	-	-	-	-	23,189	-
26	581,803	510	2,400	13,200	215,791	-	400,922	578,903
27	400,922	-	-	-	-	-	400,922	400,922
28	8,200	-	800	-	8,200	-	-	8,200
29	73,450	-	-	-	73,450	-	-	73,450
30	20,950	-	-	-	20,950	-	-	20,950
31	34,632	-	-	-	34,632	-	-	34,632
32	-	510	1,000	-	37,810	-	-	-
33	43,649	-	600	13,200	40,749	-	-	40,749
34	925,570	669,090	413,544	431,923	991,671	838,987	452,389	907,860
35	-	-	49,000	-	49,000	-	38,4009	[illegible],400
36	-	-	49,000	-	49,000	-	-	49,000
37	-	-	-	-	-	-	38,400	38,400
38	925,570	669,090	462,544	431,923	1,040,671	838,987	490,789	995,260

contd.....

Appendix 17 (contd.)

Land Class	Use Category X_{17}	X_{18}	X_{19}	X_{20}	X_{21}	X_{22}	X_{23}	Total
1	-	-	-	-	519,437	-	-	519,437
2	-	-	-	-	-	706,477	-	1,131,264
3	-	95,446	72,198	-	-	-	-	682,844
4	-	62,348	39,100	-	-	-	-	221,996
5	-	44,800	22,000	-	-	-	-	111,600
6	-	17,548	17,100	-	-	-	-	110,396
7	-	33,098	33,098	-	-	-	-	460,848
8	139,760	17,710	41,810	593,126	-	-	30,632	13,060,795
9	3,730	-	7,500	45,650	-	-	5,400	537,130
10	27,060	-	4,300	186,820	-	-	10,000	2,167,549
11	-	-	-	6,632	-	-	6,632	327,880
12	320	-	-	4,800	-	-	-	103,520
13	10,420	-	-	69,088	-	-	3,368	999,320
14	16,320	-	4,300	106,300	-	-	-	736,829
15	21,940	4,800	12,000	178,674	-	-	6,100	3,158,862
16	-	-	-	1,100	-	-	-	472,600
17	1,400	-	-	10,100	-	-	-	216,000
18	6,250	-	-	37,200	-	-	-	561,064
19	7,180	-	-	53,400	-	-	6,100	760,880
20	5,820	-	7,200	69,700	-	-	-	455,864
21	1,020	4,800	4,800	7,174	-	-	-	692,454
22	87,030	12,910	18,010	181,982	-	-	9,132	7,197,254
23	-	10,010	10,010	12,500	-	-	-	463,157
24	-	10,010	10,010	2,400	-	-	-	429,868
25	-	-	-	10,100	-	-	-	33,289
26	87,030	2,900	8,000	169,482	-	-	9,132	6,734,097
27	69,320	-	-	1,800	-	-	-	4,481,262
28	-	-	-	800	-	-	-	91,800
29	13,420	-	-	69,700	-	-	-	891,070
30	550	-	-	20,950	-	-	-	251,950
31	600	-	-	34,632	-	-	9,132	425,316
32	1,920	-	5,100	34,900	-	-	-	90,840
33	1,220	2,900	2,900	6,700	-	-	-	501,859
34	139,760	113,156	114,008	593,126	519,437	706,477	30,632	15,394,340
35	5,840	-	-	49,000	-	-	49,000	444,440
36	-	-	-	49,000	-	-	49,000	245,000
37	5,840	-	-	-	-	-	-	199,440
38	145,600	113.156	114,008	642,126	519,437	706,477	79,632	15,838,780

APPENDIX 18

Standardisation of Benefit:Cost Ratio.

An outcome of the benefit:cost analyses done in the course of this research is the importance of standardising the concept of benefit:cost ratio. Otherwise the B/C ratios can be dangerous, and a need exists to qualify how each ratio has been computed. This is because there are varieties of B/C ratios. The way they are compiled may result in more or less favourable answers.

Sometimes only capital costs are put underneath and net output on the top, i.e., $\frac{\text{Net output}}{\text{capital}} = \frac{B-C_o}{C_c}$,

where B = gross value of output,

C_o = Operating costs, and

C_c = Capital costs.

If $C_o = 1000$, $C_c = 10$ and $B = 1100$, we get:

$$\frac{1100 - 1000}{10} = 10.$$

But if total cost is put underneath, we get:

$$\frac{B}{C_o + C_o} = \frac{1100}{1010} = 1.09$$

Other cases arise when increases in social benefits are treated as reductions in social costs and vice versa. Consider a project for, say, irrigation. It involves the construction of a dam. The latter makes it unnecessary to build flood protection barriers downstream. If the dam will not be built, the barriers will be essential. Suppose the project benefits are 10 and the costs 2, before allowing for the barriers. If the barriers would have cost 1, this amount can be treated as the additional benefit of the project. This is because this amount will be saved. Of

course, the direct benefits of the flood control are a better measure of the additional benefit of the project. But failing their assessment the cost substitution index may be used as a reasonable guide (c.f. appendix 14). Now we have:

$$\frac{B}{C} = \frac{10 + 1}{2} = 5.5.$$

If, on the other hand, we consider the above benefit as a cost reduction, we get:

$$\frac{B}{C} = \frac{10}{2-1} = 10.$$

Inconsistency in computing the benefits and the costs has to be avoided to ensure commensurate evaluations. In so far as the inconsistency is due to inadvertence, no comment is warranted. But when it is a matter of concept, this needs to be analysed and made explicit for application before undertaking an appraisal. This aspect has been ignored in the past. Since the practice continues without recognising the possible anomalies, decision-makers must ask questions as to how a ratio has been derived.

It has been pointed out above that a common error arises from the interchangeable treatment of costs and benefits. Reversing them by changing signs makes no difference when considered purely mathematically, the negative and positive benefits being the two sides of the same coin. If costs and benefits of a system are Rs. 100/- and Rs.250/- respectively, these can be re-written as Rs. 50/- and Rs. 200/- or Rs 1 and Rs. 151/-, in all cases with the same net difference. But, other things being equal, the decision-maker may prefer the third case over second and the second over first because of their relative capital intensities. From an efficiency standpoint, divergences are more striking, the

benefit to cost or the benefit less cost to cost ratios being respectively 2.5, 4 & 51 or 1.5, 3 & 150. Thus whether the objective is maximisation or efficiency, the implications are contrasting even though the cost-benefit streams are identical. The corollary is that interchangeability incorporates inconsistency and should not be resorted to even if it simplifies calculations.

Illusory ranking occurs also by a 'disguised' alteration of one or more of the components of a benefit-cost stream. For instance, an option in which fertilizing is avoided by green manuring every 5th year, the fertilizing cost component is correspondingly deducted. In the 'balance-sheet', therefore, the total costs are reduced by fertilizing costs less the green manuring costs every 5th year. This is a favoured kind of practice; for it involves no modification on the benefit side and appears a straightforward thing to do. But this leads to erroneous results when compared with another method where both the costs and the benefits to the extent of the direct consequences of manuring are summed individually; i.e., manuring is considered as an identifiable activity from fertilizing though it substitutes the latter in the particular years. Even for a limited period of 10 years and in a simple hypothetical example the two approaches, as tabulated below, yield significantly different results.

Table: Two approaches to computation of benefit:cost ratios of an identica stream of consequences.

Cost-Benefit Stream	Case 1.	Case 2.
Costs		
1. Fertilizing (8 years)	400	400
2. Fertilizing - 5th + 10th Yr.	100	(100)
3. Green Manuring - 5th + 10th Yr.	40	40
4. Other Costs	500	500
Benefits.		
5. Manuring	(100)	100
6. Other	1000	1000
Total Costs (C)	400+100-(100-40)+500	400+40+500
Total Benefits (B)	1000	1000 + 100
B-C	60	160
B/C	1.06	1.17
B-C/C	0.06	0.17

This is a case not only of inconsistency but also a misleading method of counting the costs and benefits, deflating or inflating either and giving rise to wrong assessment. However, if one or the other of the various a proaches is adopted consistently for all the options, comparative ranking may not be erroneous. Consistency suppresses the reflection of such distortions in comparing similar options. Notwithstanding that, we cannot hedge under the intrinsic role of consistency when the various options embrace resources use activities with unlike cost and benefit components. To make consistency operational, we, therefore, take recourse to the with and without principle (c.f. subsection 5.ii, chap V). All the individual costs and benefits associated with each component activity, whether a substitute or

complement of another, are to be counted. Thus we favour the second of the two approaches cited in the above example.

The above recommendation conceives benefit to cost ratio as an index of all actual benefits and all actual costs captured through the course of action, when the former is divided by the latter. This conforms to 'with and without principle' for identifying project costs and benefits as well as the discussion in subsection 5 v, chap. V. This concept would bring the social costs and social benefits, as they arise in the economy as a whole, into direct relationship with each other. The compilation of gross effects separately for the numerator and the denominator, would avoid analyses which treat projects as isolated segments of the economy. This practice will also ensure consistent evaluation of projects and avert the dangers of distorting the social desirability of options.

APPENDIX 19

SOCIAL PRICES IN KASHMIR

Table 19.1. Traded Goods

S.N.O.	Commodity	Social Price (including transport) (Foreign exchange Rupees).	Remarks
1	Paddy	737 per ton	
2	Maize	560 per ton	
3	Wheat	615 per ton	
4	Oilseeds	1400 per ton	
5	Saffron	8 per tola	(1 tola = 0.41 oz.; air freight for transport.)
6	Pyrethrum	80 per maund	(1 maund = 37.32 Kg.; 0.9% Pyrethrum content; Av.content imported Japanese Pyrethrum is 1.2%; transport cost includes delivery to drug factory at Jammu).
7.	Apples	1.16 per Kg.	
8.	Walnut fruit	0.70 per Kg.	(Rubbed and shelled).
9.	Almonds	1.88 per Kg.	
10.	Lumber		(Per c.ft. duly converte and at depot site)
	(i) Deodar	2.70	
	(ii) Kail	2.30	
	(iii) Fir	2.00	
	(iv) Walnut Class I	13.00	(Veneer grade)
	(v) Walnut Class II	5.00	(Turnery and furniture)
11.	Railway Sleeper Timber	4.90 per c.ft.	(Broad gauge)
12.	Poles		
	(i) Deodar	2.50 per c.ft.	
	(ii) Kail	2.10 per c.ft.	
	(iii) Fir	1.90 per c.ft.	

13.	Pulpwood	1.86 per cft.
14.	Resin	2.50 per Kg.
15.	Moong	0.56 per Kg.
16.	Feed and Cake Meal	665 per ton
17.	Ammonium sulphate	600 per ton
18.	Superphosphate	750 per ton

Table 19.2.

Social Price of Unskilled Non-wage Labour

(1) Reference Man-Day (8 hours moderate work in 10°C) Requirement = 3,200 Cals.

(2) Cereal Input Requirement = 2,400 Cals/head/day

(3) Cereal Availability = 1,400 Cals/head/day

(4) Production(consumption) of cereals in Kashmir

(i) Rice (Milled)	= 63.71 lakh mds.[1]
(ii) Maize	= 54.29 " "
(iii) Wheat (Flour)	= 21.06 " " [1]
Total	= 139.06 " "

(5) Assuming unchanged taste, quantity of extra cereal required per reference man day.

	Percentage of total production/ consumption	Extra Calories Required	Quantity of Cereals required
(i) Rice	46	460	127.77 gms.
(ii) Maize	39	390	109.65 gms.
(iii) Wheat	15	150	42.85 gms.

This is on the basis that calories/100 gms of rice = 360, Maize = 356 and Wheat = 350.

(6) Value of the extra 1000 Calories at social prices in Kashmir for the quantities in Col. 3 of (5) above = F.E.Rs. 0.20.

(7) Allowing for other goods including protective foods, the social price of total extra consumption is F.E.Rs. 0.20 + 0.06 = F.E. Rs. 0.26 per reference man day.
The psychological and other displacement cost for the non-wage labour is little, because the labour is retained in the peasant households.

1. Conversion rate of $\frac{2}{3}$.

(8) The actual social price of labour in the subsistence sector is F.E. Rs. 0.28 after allowing for hired labour component.

Table 19.3.

Abstract of High-Forestry Overhead Costs.

1. Skilled Personnel.	Nos.	Salary	Total Cost. Rs.
(a) Professional			
Conservators	2	1500	3,000
Divisional Officers	6	1950	5,700
Assistant Conservators	6	500	3,000
Rangers	25	300	7,500
Foresters	92	200	18,400
Direction office	-	-	400
			38,000
(b) Ministerial			
Circle offices	6	150	900
Divisional offices	18	150	2,700
Range offices	25	150	3,750
			7,350
		Total Rs.	544,200 per year

2. Regular unskilled labour

a) 237 Beats @ 1 Guard and 1 Watcher = 474 ns.

b) 139 Orderlies

c) 613 workers @ F.E.Rs. 0.80 per day = F.E.Rs. 1,78,996 per year.

3. Working Plan, Research, Development, Statistical and Planning Divisions,

a) 2 Divisions, ½ Circle, 2 AC's F, 8 Rangers, 20 Foresters, 4 Clerks = Rs. 1,21,800 per year.

b) 45 Unskilled workers = F.E.Rs. 13,140 per year.

4. Total establishment cost per year.

Skilled - Rs. 6,75,000.

Unskilled - F.E.Rs. 2,00,000.

5. Total Commercial Forest Area

7,67,238 Acres. (Excluding Plantation Division).

6. Cost per acre/year.

Skilled Personnel - Rs. 0.87

Unskilled Labour - F.E.Rs. 0.26.

7. Other expenses

Travelling, inspection, training and 'development'.

(a) Commodities (including cost of petrol and oils, maintenance and replacement of jeeps, timber and material for rest houses and offices, instruments for surveying and training, tentage and other equipment, tools and plant for road and inspection path maintenance and extension) - F.E.Rs.4,60,344 per year

(b) Cost of engineers, specialists and consultants (including those from Forest Research Institute, Dehrun Dun not paid by Kashmir Government) - Rs. 23,210

(c) Number of wage labour days (employed on muster rolls departmentally and those by contractors) and including semiskilled carpenters, masons and drivers for repair, maintenance and operation of roads, huts, offices, jeeps and equipment, and for regeneration works - 1,09,500 days ≡ F.E.Rs.1,91,800

8. Grand Total Overhead Costs per acre/year.

a)	Non-wage labour -	Nil.	
b)	Wage and unskilled labour -	F.E.Rs.	0.50
c)	Skilled labour -	Rs.	0.90
d)	Commodities -	F.E.Rs.	0.60
	Total Social Cost	F.E.Rs.	2.00

Table 19.4.

Social Cost of Bullock Labour for Ploughing and Soil Working.

(1) Bullock (Ox) Power in India

Average wt (Kg).	Approximate Draft (Kg).	
980	123	(Maximum for India).
500-900	60-80	
350	55-70	

(2) Average Ploughs in India

Wt.(Kg)	Depth of operation (cm.)	Draft Total (Kg).	Rate of work m^2/hour
-	10.7	52.3	318
21.3	12.0	79.5	338

③ Productivity per bullock (one).

From 2 above, per 4 hour day = 1352 m^2 or about 2.6 kanals for an Indian bullock, properly yoked.

④ Present productivity per bullock pair.

.33 acres for one pair.

⑤ Assuming 20 bullock pair days for rice and 10 for non-irrigated agricultural crops, the total number of bullock pair days required for 1959-60[1] = 1,10,50,000. Assuming one bullock pair to work for 50 days per year, the number of pairs required = 2,21,000 (as against 2,29,000 bullocks recorded in census data, and 2,21,000 ploughs in the general statistics).

⑥ From above, 1 bullock-pair per annum is needed for 2.5 acres of paddy crop and 5 acres of other crops.

⑦ Now assuming (i) non-working age = 3 years from birth.
(ii) working-age = 10 years after 3 years' age.
(iii) Free disposal after 3 + 10 years.
(iv) 50 working days (4 hours/day), one human labour-day per 4 bullock pairs during non-working days; and one reference-man day per pair during working days.
(v) New bullocks are raised between 3rd and 5th, 13th and 15th and 23rd and 25th years and no purchases are involved,[2] we have:

		Human labour days	Other Inputs
Years 1,2,6-12, 16-23, 26-30 (Adults)	Paddy/ acre	52	F.E.Rs. 48 for feed and cake meal, F.E.Rs.69 for fodder and F.E.Rs.4 for veterinary charges and overheads = F.E.Rs.121.
	other crops/ acre	26	= F.E.Rs.61.
3,5, 13-15, 23-25 (Adults and Young)	Paddy/ acre	76	F.E.Rs. 73 for feed and cake meal, F.E.Rs. 96 for fodder and F.E.Rs. 11 for veterinary charges and overheads = F.E.Rs. 178.
	Other crops/ acre	38	F.E.Rs. 89.

1. This implies 6-7 ploughings for paddy and 3 ploughings for all the other crops.

2. Any purchases (or barter exchanges) of bullocks are income transfers within the sector and do not count towards the capital cost of bullocks unlike the conventional practice.

Table 19.5.

Social Cost of Irrigation Input.

1. Present Sources of Irrigation	Acres
Government Canals	52,000
Zamindari khuls (Private Canals)	4,13,000
Wells (Private)	6,000
Other sources (Govt.)	
Tank Irrigation	1,000
Lift Irrigation	14,000
Total net area irrigated . . .	4,86,000

2. Operational Costs of Irrigation Works	F.E.Rs. Per Acre.
Gravity (Government) Canals)	3.00
Gravity (Private) Canals	0.28
Wells	0.28
Lift Irrigation	64.00

3. Weighted Average Cost of(existing) Irrigation per acre F.E.Rs. 2.54.

4. The sunk costs are ignored. The cost is for maintenance and operation, inclusive of desilting and recurring costs on diesel power for lift irrigation.

4. Additional Irrigable Potential.	Acres
Gravity Canals (Extension, remodelling and new schemes)	2,75,800
Lift Irrigation (Hydro-Electric and Diesel)	1,18,200
Total	3,94,000

5. Cost of New Irrigation Schemes.		F.E.Rs./Acre
a) Outlay:	Gravity	130.00
	Lift	455.00
	Weighted average outlay	227.50
b)	Weighted average operation and maintenance cost	21.30

Table 19.6.

Social Prices of non-Traded Commodities

S.No	Name of Commodity	Price (Foreign Exchange Rupees)	Remarks
1.	Silk Cocoons (green)	87.12 per maund	(1 green cocoon maund ≡ 7.26 lb. of raw silk)
2.	Fuelwood	1.65 per cft. stacked	(Mainly willow and Phhu).
3.	Poplar wood	1.70 per c.ft.	(for Shooks).
4.	"	1.82 per c.ft.	(For match manufacture).
5.	Potatoes	260 per ton	(For food)
		292 per ton	(For seed,- local varieties).
6.	Paddy Straw	0.38 per Kg.	(Paddy:Straw:: 1.05:1.0; 90% dry matter;for fodder
7.	Maize Straw	0.20 per Kg.	(Corn:Straw:: 0.33:1.0; 87% dry matter;for fodder)
		0.084 per Kg.	(For fuel).
8.	Wheat Straw	0.18 per Kg.	(Grain:Straw:: 0.70:1.0; 85% dry matter; For Fodder)
		0.010 per Kg.	(For mud plastering).
9.	Village Grazing		
	6 cow units per acre	47. 62 per acre	
	5 " " " "	78.85 per acre	
	4 " " " "	110.19 " "	
	3 " " " "	159.00 " "	
	2 " " " "	237.14. " "	
	1 " " " "	294.63 " "	
	No Grazing	365.20 " "	(Hay making)
10.	Forest Grazing		
	3 cow units per acre	281.20 per acre	
	3 cow units per acre drained	294.50 "	
	2 cow units per acre drained on impeded land	262.20 "	
	2 cow units per acre	324.71 "	Some haymaking
	2 " and drained	334.78 "	"
	1 cow unit per acre	402.80 "	"
	1 " and drained	414.20 "	"

1Cow unit per acre closed later 3 months	463.60	Some haymaking.
1 Cow unit per acre closed for 3 months	446.50	
No Grazing	509.20	Complete haymaking.

11. Range pasturage

0.42 cow unit per acre	209 per acre
0.84 cow unit per acre	418 "
1.0 "	495 "
1.5 "	742 "

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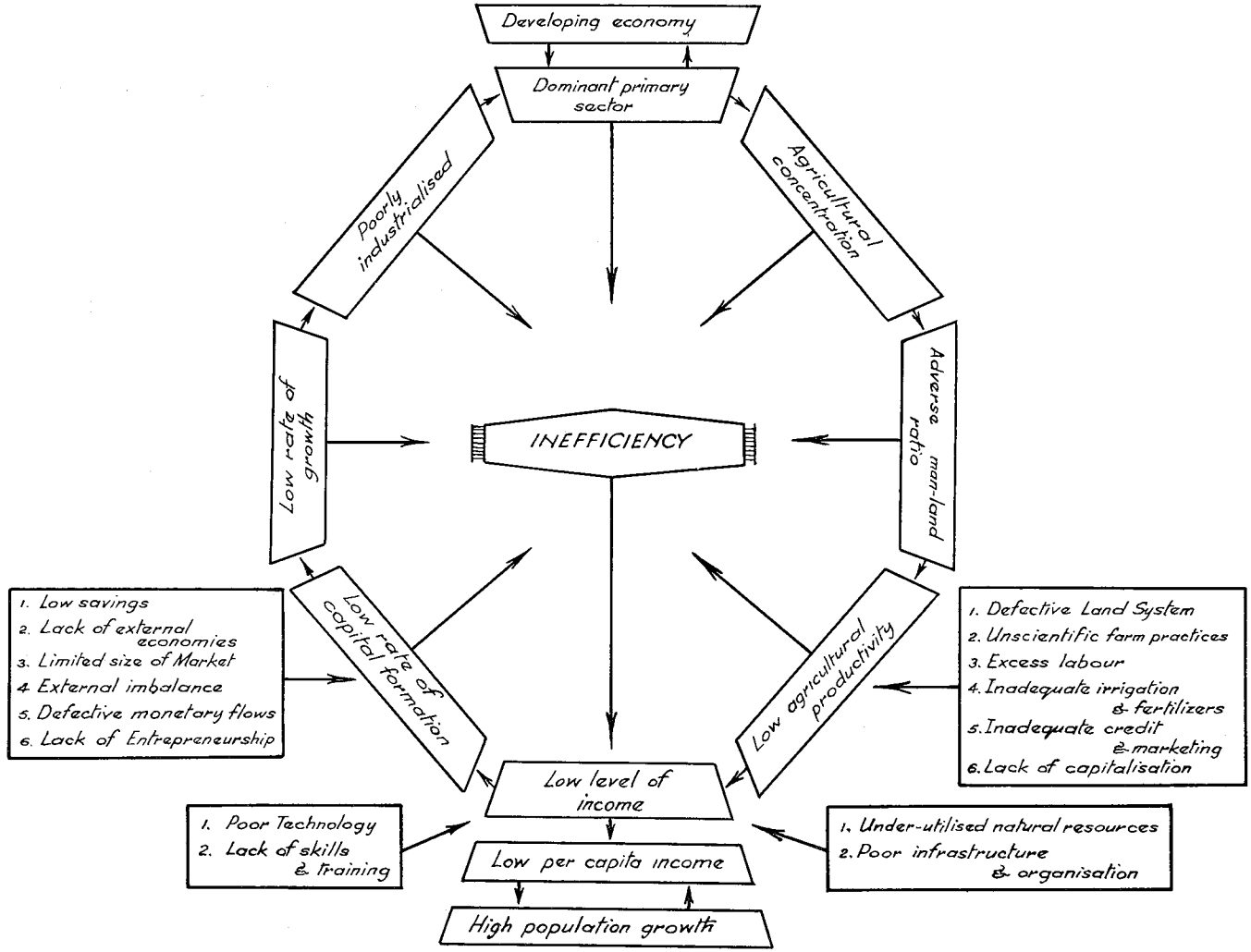
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30, 40, 51, 80, 104, 106, 107, 122-125, 153-154, 162, 179, 189, 257, 274-277, 279, 284-285, 293, 316, 321, 323, 324, 328, 371, and 416.

References to appendix 8:

4, 15, 16, 19, 20, 29, 35 and 37.

VICIOUS CIRCLES OF A DEVELOPING ECONOMY



APPENDIX 21

ECONOMIC AND INSTITUTIONAL INFRASTRUCTURE

1. Introduction

Though the land sector[1] constitutes the dominant segment of Indian economy, and much more so of Kashmir's, it is only a segment. Its scope and role is interrelated with other spheres of the economy, which need to be viewed within the framework of overall development. Significant as its propulsive role is, the emergence of other sectors and a systematized decline in its relative share of the economy is a long-run feature of sustained growth. In order to make full contribution to development, optimal use of renewable resources involves certain requisites of economic and institutional infrastructure within and without the LS. The place of industrialisation has been discussed in section 4, chap. II. Other aspects will be considered here.

2. Transport and Communications.

A major reason for the continued subsistence oriented production is the inadequacy of transport. Clark and Haswell (1967) class its provision as 'the first requisite for the improvement of the production of a subsistence economy'. Transport plays 'a dynamic role..and decisions in this sector affect all other sectors' (Brown, 1966).

Transport is linked with marketing and its costs, and with producer prices of commodities, most of which are bulky and many perishable. Poor transport checks the

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1. As in chap. II, land sector will be referred to as LS, connoting the renewable resource sector or the rural economy of a developing country.

development of markets. It increases inter-market price spreads of products, and scope for arbitrage and collusion. This may necessitate control over inter-state commodity trading, as resorted to in India, and give rise to other disadvantages, e.g., distortions in market mechanism.

The development of renewable resources in distant areas is dependent on the nature of communication system. Its lack or high transportation costs, due to underdeveloped lines of 'export', leaves many resources economically inaccessible. This jeopardizes the exploitation of physical resource potential. With cheap and efficient transport, factors can move to combine with immobile resources and enable enhanced overall production. The commercial use of a resource depends on the cost of transporting extracted goods to consumers and the cost of transporting consumers to the source of resource services, e.g., recreation, fishing and hunting. Tourism based on the LS cannot develop without efficient means of mobility to and in a particular area.

Without transport facility, specialization that could yield economic benefits on the basis of resource-proportions cannot take place. Inadequate transport forces 'uneconomical' use of resources. This happens in Kashmir by converting high grade lumber into firewood for supply to nearby consumption centres or inappropriate use of land by raising 'wrong' or less valuable crops to overcome transport bottleneck. Poor transport hampers the operation of economies of scale and integrated utilization both at raw production and processing levels. It precludes investment in or causes underutilization of indivisible production requisites.

Besides its influence on prices and rentals, town and country development, transport determines the location of

activity. Poor communications accentuate the spread between urban and rural living with adverse consequences on development of the rural sector. Efficient transport enables supply of food and other essentials to deficit areas from surplus ones where, otherwise, these are both a physical and an economic waste. Inaccessibility of remote hinterland may result in the dissipation of local resources for the benefit of foreign countries, as in India's Nagaland and North East Frontier Agency where producers would look to neighbouring China. The lack of cheap transport restricts mobility of seasonally underemployed labour and, besides low incomes to them, this resource remains under-used.

Without efficient transport it is difficult, if not impossible, for extension, other service institutions and administrative machinery to penetrate the rural sector. This impedes communication of ideas and provision of production facilities as well as contribution to development that depends on taxation, savings and market for urban goods. Good transport facilities induce private investment and innovation. The impact of an improved road from Srinagar to Pathankot, linking Kashmir with the nearest railhead, has been so great that one of the biggest timber markets in India has grown there. This has encouraged the expansion of owner-operated trucks bringing consumer goods and materials to Kashmir and carrying back-load of timber and fruit.

Expansion and improvement of all modes of transport help the LS. Ocean transport helps commodity exports, railways and inland waterways help raw material and grain movement, but road transport is flexible. It is of special import in ramifying through the rural sector and enhancing productivity and incomes of small as well as big producers.

Feeder roads play a vital role in the transformation of rural sector. Haswell (1968) highlights that these can 'revolutionise' subsistence production and emphasizes that the highest impact per unit of investment in the LS lies in road projects that link villages with highways. She emphasises priority for roads over projects providing inputs for direct improvement of production, e.g., fertilizers and irrigation. This, however, is one-sided, because of the interdependence of the various inputs, incentives and services. Each of these aspects have their own place and priority in different circumstances, e.g., many small feeder roads are more advantageous and 'most economic when capital is scarce' (Mumby, 1963). Provision of these roads and their phased upgrading would permit gradual replacement of bullock cart over longer hauls by motorised transport as the former is considered uneconomical over distances greater than 8 miles (Haswell, 1968).

Community Development Organizations could sponsor extension and improvement of existing rural roads. Maintenance of village roads can be done through the village communities to a substantial extent. However, opening up of new resource areas will invariably have to be initiated by construction of arterial roads by central or state governments. Construction of link roads can largely be followed up through the agency of local governments and, sometimes, through private interest groups. Religious bodies, if encouraged through governmental material and technical help, undertake construction of approach roads to religious sites. This has a popular appeal, which can be used advantageously for improving village communications.

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3. Public Works and Information

Besides transport and communications, public finance and sponsorship are essential for undertaking capital works which are beyond the capacity of an individual producer or village. Such works include public forest regeneration, canals, irrigation ponds and tube-wells, anti-erosion embankments, pasture improvement, warehousing, market depots and labour sheds.

Depending upon various factors such as the motivations and solvency of producers and overall economic feasibility, government may induce the use of better inputs in appropriate packages by subsidized supply of fertilizers and pesticides, improved varieties of seeds and other planting material, silkworm cocoons, livestock and poultry breeds. Subsidies may be a short term measure; once the benefits of these inputs are known to producers and their incomes rise, price elasticity of demand usually runs high, e.g. the demand for fruit planting stock in Kashmir has overshot expanding supply position even after sale price was raised from Rs.0.25 in 1953 to a profit margin level of Rs. 1.50 in 1966.

Under certain social and economic conditions, some of the capital works can also be carried out under subsidy schemes through local governments, village panchayat and community institutions. The subsidies may be in the form of free, cheap or loaned out planting or livestock propagation material, chemicals, tools and supervisory staff. Such subsidies help production where price supports may be ineffective in their impact or smaller producers, due to largely non-monetized rural economies. The effect of maintaining high producer prices is negated by expensive sale price of inputs, e.g., fertilizers prices in India in real terms. The role

of direct public investment through subsidisation of production requisites and land development works is greater in raising output than through indirect measures, which do not involve the treasury.

An important investment, for which there is no substitute to governmental activity, is in geotopographical, hydrogeological, soil, vegetation, techno-economic and land-use surveys and mapping. Despite their importance in developing hitherto untapped or underutilized resources, improving productivity and minimising waste of resources, 'land development investments have been much too small in most newly-developing countries' (Schickele, 1965). A problem is of proper use of limited funds and evaluation of benefits that accrue by investing in intensifying renewable resource use. Often 'agriculture is hampered more by the wrong employment of capital than by its relative scarcity' (Giarroca, 1966).

Nevertheless, the bottleneck is overall shortage of public finance. Even under current state of arts, investment in minor irrigation, soil 'conservation', fertilizer and hybrid seed and livestock supplies in India needs to be enhanced manifold. Smaller irrigation and land development projects may be preferred because of capital scarcity, and the quick maturing and lower distribution and maintenance costs of such projects. Also they enable the use of local low- or un-productively employed labour. This brings out the need to work out suitable choice of techniques and modes of administering public finances.

In order to generate maximal benefits from public works, rationalisation of renewable resource use pattern is required. For this, information about resource potential

and opportunities for investment is required. Herfindahl (1969a) emphasises that without sufficient information, attempts at resource development do not accrue much fruit. An important aspect of public works would, therefore, be collection, processing and collation of information. Meier (1965, p.81) also states that greater the 'flow of information the greater is the rate of social improvement'.

The seed of change is information about conditions in other areas, e.g., the cropping techniques in the intensive agricultural district programme area of Anantnag which do not occur in other districts of Kashmir, or the economic organisation in Punjab which may be imitated for use in Kashmir. However, programmes and strategies cannot be transported to a new environment, in toto. The process of transfer required an equivalent amount of information concerning the structures of societies which are the potential imitators.

Nevertheless, the underlying point is that collection and dissemination of information through governmental and supporting organisations is necessary. This is axiomatic because a decision system consumes information. However, even here, the need is for renewal of knowledge through continuous functioning of a public information system. And the information and knowledge requires to be so acquired and developed that these are ultimately capable of quantification. The structural development of the LS is a mental task, requiring first the assimilation of new images and then the relationships between all the images. An example of one such attempt is this thesis.

4. Power and Energy

Energy in the LS., derived from natural solar source, is drawn mainly through human and animal power and plant anabolism. Little use is made of other energy sources. The increasing need for energy requires the development of 'conventional' energy resources and their use with greater efficiency simultaneous to a gradual changeover to 'modern' energy sources. The LS is more suited than rest of the economy to allow such a marriage of energy resource-use.

World energy consumption is only a minute fraction of the available solar energy that impinges on land (Gupta and Saxena, 1967). 'While the biological efficiency in the capture of solar energy is low, the aggregate quantity (of which over 55 per cent is contributed through forests and the rest through agricultural - and grass lands) is large, the annual fixation of carbon on land being about 7 times the fixed carbon in the fuels consumed per year'. (Hubert 1962). This vast energy, obtainable through the Plant Kingdom, can be available in perpetuity and its availability enhanced by increasing the LS productivity. Other than animal and human power, out of a total of about 160 metric tons coal equivalent consumed in India, about 100 of these units are contributed by renewable resource products, such as fuelwood, agricultural residues and dung.

An obvious channel for tapping the solar energy is production and use of fuelwood. More than half of world's wood use is as fuelwood; this proportion in the developing countries varies from 67 in Asia-Pacific to 90 per cent in Africa and Latin America. The trend in the total consumption is upward being projected at 2.4 per cent in South Asia and

2.8 per cent in Western Africa during 1961 to 1975 (FAO, 1966, p.45).

Of the total wood output in India 69 per cent constitutes fuelwood (Venkataramany, 1962); the requirement is estimated to increase from 60 million tons (i.e. nearly 12 times the amount of industrial wood) in 1961 to 100 million tons in 1975 (Von Monroy 1961). Because of the lack of alternate fuels in a widely dispersed rural sector, fuelwood supply may have to be stepped up to meet the increasing demand. The supply should be made locally available through farm-forestry (Kaith and Erasmus, 1965). Increased fuelwood production is necessary also for releasing cowdung manure. Simultaneously, the use of improved hearths and stoves for cooking and heating, change in cooking habits and substitution of wood and charcoal, especially by industry is warranted.

Another channel is food as input for human and animal power. The available flux of solar energy can be captured in larger fraction by enhanced food supply which will lead to more energy for greater production. This mainly involves increase in production from agricultural and pasture-lands.

To augment development of human and animal energy an improvement in tools and implements which minimises waste of energy and promotes fuller use in its application is useful. Improvements in old fashioned ploughs, in design and material are capable of increased efficiency and better performance in the use of animal power. This may necessitate not only better feed but also replacement of existing animals by better breeds. Use of work-study and labour productivity techniques will enhance efficiency in human power use.

Replacement of human and animal power by machine power in 'overpopulated' developing countries does not seem feasible, except in limited areas where mechanisation may be obligatory. In addition to the problem of wide distribution of fragmented holdings of a producer, mechanisation cannot be useful in many instances, e.g., the inapplicability of tractorisation in small terraced rice fields that characterise a dominant land use in Asia.

However, the use of improved aids and less cumbersome mechanical devices, as development proceeds and labour ultimately starts getting increasingly absorbed in other sectors, may be promoted to bring about gradual orderly substitution. But in this, the transfer of heavy equipment used in developed countries is not suitable, because of different systems of land-tenure, socio-economic structure and production processes. The crucial point is adaptation and local innovation instead of wholesale adoption; this is necessary also to avoid a heavy burden of imports.

A policy to give priority under rural electrification programme to the energisation of pumping sets is well considered. Its implementation will help reclamation through drainage as well as extended lift irrigation. The task, however, is stupendous; over large tracts human and animal power will continue to be used. It should be employed more intensively and with greater efficiency for drawing and distributing water under gravity, building storage ponds, irrigation wells, drainage and flood control catch-water channels, ditches and diversions.

Tapping solar energy directly could help by substituting less productive use of commodities, such as by employing devices for domestic heating as in Japan or the light-cooking

solar stove as in India (Ghai et. al 1953, and Telkes and Andrassy 1961). It may help by forcing up subsoil water as is being experimented in Israel. Nuclear energy is already in some use; its radioactive byproducts can be used particularly in breeding high-yielding and disease-resistant varieties and in soil fertility and nutritional investigations.

5. Producer Price and Marketing

An adequate and fairly stable price is an essential incentive for producing for market. This may be accomplished through a suitable marketing system, which also enables equitable distribution and minimum waste of production surplus over subsistence needs. The interdependent factors of proper price and marketing system jointly reinforce the incentive and minimise the gap between the available supply and increasing urban demand. This could happen through a reduction in the propensity to consume locally, thereby generating savings for development.

The seasonal and long-term producer price fluctuations introduce risk and cause disincentive for increased productivity. Uncertainty from unregulated price engenders stagnant outputs as increased production, more so after good harvests, leads to lower prices. The lack of marketing facilities and knowledge of current market prices, coupled with the existing monosponic structure, do not permit the producer to receive a fair share of the consumer price.

Mellor's (1966, pp.333-35) statement that 'marketing margins...tend to be..low..(and) seasonal price fluctuations are not large' is not corroborated by facts. The wholesale price of rice in India and Pakistan over the period 1961 to 1965, for example, varied by 100 per cent and the

fluctuations are numerous, with a price variation of even 50 per cent in a single year (FAO, 1966a). The depression of post-harvest producer prices due to rushed sales are a common feature. The price of paddy usually falls to about Rs 20/- in October-November in Kashmir as against Rs 45/- or more from March onwards. Similarly the (wholesale) marketing margins for the least-perishable (Ambri) variety of apples in Kashmir are as high as 300 per cent and cannot be accounted for by storage and handling costs. These are mainly due to the lack of a local fruit marketing organisation. This contrasts with Kulu valley where a local cooperative marketing society has brought down the margin to about 100 per cent, including comparable, if not higher, transport, handling, storage and distribution costs.

Some believe that increased producer price leads to smaller sales, because it enables the small 'subsistence' producer 'to retain more than usual..to satisfy his commodity needs..to a somewhat greater extent than usual' (Mathur and Ezekiel, 1961). Such a doubt about the producer-price stimulus does not seem to be very well founded. Prima-facie, the argument of the so-called backward sloping curve or inverse response to price change by the small 'subsistence' producers is inconsequential; for these producers, in any case, do not produce for the market. Dandekar (1964a), for instance, shows that jowar (sorghum) sales by the small farmers in India with holdings under 15 acres accounted for negligible marketed quantities as against 80 per cent by larger ones with holdings over 30 acres.

Certainty of prices and assured markets influence production positively. They help bring about commercialization even on small subsistence holdings. As a corollary, the producers neglect and/or switch away from production of items not covered by such institutional systems. Comparisons of sugar-cane and paddy production on small-sized holdings in India provide such evidence and show that 'peasants respond to the stimulus of prices and marketing facilties... to benefit from high returns per acre' (Gupta and Majid, 1965).

An Agricultural Prices Commission has recently been established in India. Instead of only devising means to check price rises, it should aim at finding for each commodity 'a minimum price, guaranteed by the government..(as) an essential prerequisite of increased market production.. evidence (having accumulated)..to show a direct response to price incentives' (FAO, 1967a, pp.81-83). It, however, is not construed to institute disproportionately high farm support policies or subsidies for maintaining high prices for LS products. This may not be feasible; apart from contributing directly to investment resources in the long run, the LS should do so indirectly by providing essential and industrial commodities at prices that do not cause hardship to fixed income groups or hamper the growth of other sectors. Instead, the aim should he to eliminate insecurity due to wide price fluctuations, to maintain a feasible price parity between farm products and others, and to provide the producer with the highest possible share of consumer price through a market system that ramifies the rural sector.

Leaving or forcing the commodity prices at low levels in the hope of helping urban-industrial development, on the

other hand, is fallacious. A decline in producer profits in real terms will prolong and intensify the shortages that are at the root of rising consumer prices. To remove the handicap to increased LS productivity and to permit development of rest of the economy, a via-media has to be struck between too high and the inadequate prices effective at production level.

Stable price levels favourable both for the producer and the consumer may be possible through a unified marketing system. It should, among other things, concern with announcement of minimum prices well before the sowing season guaranteed for a long enough period. Government may publicize the minimum prices at which it would purchase all quantities offered to it. This would remove uncertainty, and encourage to produce more for delivery to the market.

The establishment of an efficient marketing machinery takes time and its effectiveness depends on development in related aspects. Nevertheless it has to be started. Even if it functions through or in conjunction with existing traders, it will lead to erosion of disparity between producer and consumer prices. The setting up of a State Food Corporation in India in 1965, (though primarily to ensure consumer supplies at low price) is one step forward, provided suitable minimum procurement prices are maintained in building the envisaged buffer food stock. It will discourage the rampant hoarding and profiteering by intermediaries. It will check the producer price depressions in post-harvest periods or in good harvest years, if it offers to buy surplus produce at a guaranteed price. Here, it is important to safeguard, by ensuring least interference with market functioning, against a usual feature of the floor prices becoming ceilings.

The marketing procedures and prices need to be reviewed constantly to suit projected domestic demand, costs and prices vis a vis international supplies, prices and trade possibilities. Provision of marketing facilities also need to be integrated with establishment of other institutions such as for tenure reform and credit availability and of ancilliary infrastructure such as warehousing and transport. Instances are not lacking when producers are willing to offer their surpluses for the market but physical handicaps of transport and storage facilities prevent its realization. The setting up of a collection and distribution system seems to be an important aspect for enabling producers to benefit from increased productivity and market demand.

6. Money and Credit

Monetization of a subsistence economy is important for enhanced productivity through commercialization and exchange. A socio-economic transformation involving increasing use of money is impeded by the lack of sufficient credit in the rural sector. Provision of adequate credit facilities stimulate transition to monetized economy and reliance on the market. This removes disadvantages that go with barter-exchange, whereby the usury gains at the cost of producers and production. This would also help minimize market imperfections, increase mobility of labour and other factors, and reduce distorted valuation of the various goods and services.

A lack of credit checks expansion of production by producer's inability to obtain production requisites. Expensive credit is a disincentive, because of the little profit that accrues to the producer by using it. Without medium and long term credit, the producer cannot undertake improvements, which lead to a temporary reduction in returns,

e.g. erosion control, sodding, stocking or rotational closure for grazing. Nor can he adopt uses where returns are delayed, though higher in the long run, e.g., agro-silviculture, fruit and other perennial crops. The need for rural credit is accentuated by a land reform; for want of credit, not infrequently, the insolvent peasant takes recourse to sell to the landlord (at low price) or accepts to be, what in effect, is a share cropper denovo (but now without the erstwhile paper guarantee).

Adequate and cheap credit facilities are necessary for creating a suitable climate for investment; otherwise the usurious money-lender's institution persists as a necessary evil. Such a climate cannot exist when producers are born in debt, live in debt and die in debt. This circumstance reinforces the vicious circle of low or no investment for measures to increase production and of consequently increased indebtedness. This leads to preharvest sales with low returns to producers. Thus, orchardists in Kashmir often sell their produce at very low prices negotiated many years in advance with intermediaries.

A basic problem, is of finding domestic investment funds, for the credit institutions. Because of competition with other sectors, the wherewithal may be needed from the LS itself. This is possible in the form of capital which can be created with very little or no outside capital, wholly from available rural labour. The need is to develop suitable financial institutions which can both funnel savings in the sector as well as provide credit to break the vicious circle.

The provision of adequate and cheap rural credit should be instituted so that it is easily accessible to the needy

at proper time and in proper form. Otherwise, the credit will be borrowed merely to repay non-institutional credit and vice-versa. An integrated approach needs to be adopted to ensure a full advantage of complementary services, e.g. marketing and taxation for productive use of the credit and its repayment. A major reason advanced for the recent nationalization of domestic banks in India is the provision of credit in the rural sector; its impact is not known yet however.

7. Land Taxation and Insurance.

Taxation in the LS can be used for enhancement of output, for reinforcing growth of supporting institutions and for orienting production to demand at home and abroad. But, taxation that has a salutory effect on production, and yet is equitable, needs to be based on the role that the LS has to play in development. The pattern will vary according to stages of development and local conditions. Essentially, it should help speed up transition from subsistence system to greater use of available resources and increased productivity.

An ill-conceived tax structure could nullify benefits from other measures. Apart from its arbitrary effect on the purchasing power, the prevalent reliance on indirect taxation may not act as an incentive for increasing productivity. It plays a limited role in crude regulation of export-oriented use through export taxes, exemptions and multiple exchange practices. Also, the benefit of obtaining savings through export taxation can be significant only in those developing countries that are major exporters of resource commodities.

The argument that indirect taxation is easily administered evades the issue. Such taxation applies to only a small portion of the output, viz., that changes hands through the market. Thus it is not only unable to tap the entire production but is a disincentive for commercialization and use of the market. It retards monetization by encouraging barter exchange of disposable surplus. As it falls on marginal production, it discourages increased use of production inputs. Since indirect taxation usually takes the form of sales tax, it is likely to be regressive by impeding the development of wider and diverse markets. Its greater burden falls on the low-income urban-industrial sector and is unhelpful for the expansion of rest of the economy. The real reason against direct taxation is political expediency.

Of the various direct taxes, income taxation in the LS is difficult and ineffective. Expenditure tax was tried in India as an alternative, to discriminate in favour of savings and investment. It has been abandoned because of its greater complexity. It suffers from the same weaknesses as income taxation and can act as a disincentive for expenditure that would ultimately enhance production.

Land taxation, adjusted to various aspects of resource use, may be helpful in encouraging and siphoning savings for investment. Japan relied on it during early stages of development, when 50-80 per cent of total taxes were drawn from agriculture. It is relatively easy to administer in countries like India, where cadastral surveys are complete and land revenue and record agencies are established. When assessed on area basis, such taxation does not discourage

increased production and the use of improved technology and greater inputs. Aided by a proper land classification, it is equitable in taxing according to 'potential' productivity and income potential. It can be made politically palatable by introducging progressive taxation on holdings larger than a minimum ceiling in line with requirements of land-reform.

By introducing various differentials, land taxation can be employed to encourage development and improvement or to penalize the owners who misuse resources. But without such adjustment and without coordination with other institutions, the results may not be encouraging and may even be negative. For example, the lack of a suitable adjustment in Kashmir results in the retention of land in low producing Khushki, dry farm, class even if it may be irrigable.

The payment of the land tax in cash encourages commercialization, though it nedessitates fairly frequent revisions for price inflation. Because of poor monetization, the tax may be accepted in kind, i.e. some part of the produce. This too assures surpluses for market through government, with the added advantage of more stable prices and equitable distribution. This, nevertheless, involves coordination with transportation and marketing institutions.

The taxation in rural sector may be effected in kind through labour tax. This facilitates payment by landless workers and use of seasonally underemployed or otherwise low- or un-productively employed labour for capital building. Coordination with rural and community development institutions and applying it in the spirit of Shramdan[1] is helpful. Obstacles to this and other forms of taxation can be weakened also by demonstrating that it can swamp the

1. Voluntary labour.

practices of quasi-taxation rampant in the forms of high interest rates, low-price postharvest sales and absentee-owner sharing.

The insurance of publicly owned resources, e.g. forests in India, is not meaningful, but that of private crops and livestock normally induces risk-taking and adoption of innovations. It removes insecurity due to unpredictability of crop yields. Insurance schemes for certain commercial crops have been introduced in India with encouraging productivity results. But insurance could lead to waste; for example producers covered for weather risk may apply inputs like fertilizers, without regard to irrigation facilities. The extension of the schemes to other crops and areas needs evaluation, both social and economic vis-a-vis other options for investment under the existing financial constraints.

8. Land Tenure.

Share-cropping, as in India, or 'vague' communal ownership, as in Africa, and insecurity of tenure are disincentives for increased productivity. The disincentives for investment, even for maintaining productivity, in share-cropping is both for the owner and the producer; insecure tenure kills whatever incentive the producer may have by his inability to secure credit or to borrow inputs against the land.

Land reform can be useful for removing disincentives and for promoting increased output, if properly implemented. It is necessary for social and political stability, for minimising increase in open unemployment and for preventing further sub-division or grouping of holdings into uneconomic units. A reform that caters to all these ends may be difficult due to a conflict between some of the objectives.

No single tenure system can answer all the problems and will have to be worked out according to priorities.

Dandekar (1964) is against individual peasant holdings: 'whatever the form of the institutional structure.., it must provide for a feudal overlord who will collect the tithe and hand it over to the non-agricultural sector'. He overlooks the greater efficiency of institutions which bring about monetization, create incentives and enhance productivity for market and the logic behind a reform by which the 'head of each peasant family is turned into a feudal entrepreneur' (Georgescu-Roegen 1964). A positive incentive to the improvement of land exists when the occupier is also the owner, provided the ownership is real and not illusory. This seems logical because 'the magic of property turns sand into gold'. But Dantwala (1963) doubts whether peasant farming 'is an ideal solution for developing agriculture. Assuming that ten acres would be an economically viable unit under Indian conditions, the land cultivated at present would accommodate no more than half the population. But what is to be done with displaced population?' The doubt and the question need not arise if the ceiling is scaled down to say five acres; indeed the reason for 'half the rural households hav(ing) either no land or..less than one acre' leading to very low- or unproductive employment is that 'more than 66 per cent of the cultivated area is..in holdings of more than 10 acres.

Implementation of reform is often frustrated by politically and economically powerful landed gentry, or Jagirdars. Success of a land-reform can not, therefore, be insured without suitably devised tenancy regulations, ceilings for holdings, compensation which may be in the form of bonds with deferred payments from new owners, and lobbying to

convince the Jagirdars about its inevitability in a violent form, if not undertaken now. Once moved, land-reform legislation must be enacted as well as implemented speedily to avoid circumvention by the interested parties.

It is a tenable argument that, though productivity from land through its redistribution, say, among the landless, is increased, productivity per worker may be less on the smaller holdings. But the matter is not of marginal labour productivity but of maximising the output per unit of the bundle of inputs. As, Georgescu-Roegen (1969) explains,

> 'an overpopulated economy does not operate efficiently unless some labourers earn more than their own contribution to output'.
>
> He emphasizes that
>
> 'to regulate production by profit maximization is probably the worst thing that can happen to an overpopulated economy, for that would increase unwanted leisure while diminishing the national product.'

Land-reform properly implemented leads to increased production as in Japan and Taiwan. In UAR, for instance, 'it has been estimated that the income of farmers in..land, reform areas has increased by about 50 per cent' FAO, 1967a, p.104). But this comes about only after certain complementary measures, including institutional supports and services.

9. Legislation

In addition to providing the force of law to tenure and taxation systems, enactments and regulations may be used to assist in shaping a desirable renewable resource use pattern. Legislation can be used to complement the various institutions. This is needed to a greater extent where producers appreciate only to a limited degree, if at all, their social responsibility and conceive no obligation to adapt resource use for the benefit of the economy. Further, the general public in

developing countries is poorly informed, lacks knowledge of the broader implications of various land use methods and have a high individual time preference. In these circumstances, government restrictions through legislation are necessary and need not be construed as un-democratic. Legislation can, in fact, be oriented to engender a voluntary improvement in the use pattern in line with considered public opinion and for minimising external diseconomies.

Legislation can be used to promote renewable resource development measures in many ways. But it should not be complicated, or one law should not run counter to another. Simplicity helps enforcement, because the rural populace and many others cannot comprehend or support difficult legislation.

Various enactments, for use in conjunction with or without fiscal measures, do not serve the purpose, unless supported by incentives, education and pursuasion. The Jammu and Kashmir Soil Conservation and Land Improvement Schemes Act of 1959 has remained only on paper for, among other reasons, lack of initiative and public cooperation. Stewart (1968) refers to the need to offer help to graziers in Sahara with more wells, free vets and subsidised fodder 'as an inducement to accept the regulation of grazing', which at present is impossible. Important as their role is, reliance on legal reforms at developmental stage can only be of a limited nature. Their enforcement needs a stable government with consistent policy over long periods.

10. Research and Extension

Research is required to explore avenues for improved production possibilities and for their feasibility in application. Research needs to be coupled with extension

so that results suitable for application are transmitted in an acceptable manner for adoption by the numerous producers and individual decision makers that characterise the LS.

It is often argued that developing countries cannot afford the 'luxury' of research. But research that relates to collection and processing of data is inescapable. Reliable and sufficient local data are a basic necessity for both the proper orientation of applied investigations and the fruitful application and adaptation of any research results to fit in with the local physico-biological, socio-economic and institutional environments. Investment in research is subject to increasing returns, only if it is properly oriented and coordinated to meet the needs of development.

Griliches (1964) gives an 'underestimate' of the rates of return on hybrid corn, and sorghum research investments in the U.S. at about 700 and 400 per cent respectively! Thielbein (1963) reports that through the use of new rice varieties, yield per hectare was raised by 35 per cent in Egypt and, in money terms, it accrued a ten-fold return in Japan. He estimates that the contribution of developing improved planting material alone in the 'complex of various production factors is..25 to 30 per cent'. The recent innovations in wheat, and now rice, production in the tropics through the development of Mexican and other seed varieties are a testimony to very high dividends from research.

In addition to data improvement investigations need to be concentrated on development and use of existing renewable resources. Such research includes what Mellor

(1966, p.284) calls 'development research', 'Adaptive Research' and 'Test Demonstrations'.

Generally, attention is focussed on individual technological problems, prominently breeding and fertilizing. But research for improving production possibility cannot be of much help if it tackles only isolated problems. All the factors in the production functions and their different combinations, together with influence on subsequent resource productivity, need to be investigated. Research indicating irrigation without studying consequent drainage and salinity problems have harmed productivity in Sindh in West Pakistan. Explaining the contrasting production response to fertilization in rice in the U.S. and India, Herdt and Mellor (1964) show the wide range of disciplines that are involved in making even one type of input profitable and/or acceptable.

Research on consumer preferences and behavioral aspects as an important segment of socio-economic investigations relating to land sector is important. The need for combining broad technical and economic aspects can not be overemphasized; an interdisciplinary approach is required for handling the interrelated problems of renewable resource use. Investigating the conditions in which higher output-input ratios, already existing in certain localities and devising methods to duplicate their techniques and/or environment elsewhere, with or without modification, is more effective research than disjointed approaches that may have little bearing on practical situations. Inter-disciplinary techno-economic research, which takes an overall view of the resources and interacting factors, will meet the immediate requisites of development.

Extension in the circumstances discussed above is aimed at not only popularising innovations and inducing acceptability of tested results, but also to carry back the local and regional problems in the context of biological as well as socio-economic environment. The latter aspect can be usefully integrated within the framework of techno-economic research.

Without the complement of an efficient extension agency, research results remain locked up in files. The extension agency should rely on local leaders, i.e. go-ahead producers, for demonstrating to the other producers the benefits of innovating. Farm forums and mass media communication methods, such as audio-visual publicity, evoke much interest. The role of research and extension should not be confined to improving productivity. It should include popularising the use of foods and inputs which are locally available, more nutritive or effective but under-used, weaning away from habits of excessive but unproductive consumption or employment of production factors.

11. Education and Health

Rural education and health programmes can contribute to productivity through human capital formation. Education is required to train LS personnel for running the various LS institutions, and for motivating producers to accept change and to improve resource use. It has, as such, to be considered in a broad perspective. It would include training extension, workers, specialists and resource managers on one hand, and of dissemination of information and of providing training and guidance in problem appraisal and decision making at production unit level on the other hand.

Apart from formal and higher education, the need is greater for in-service and on-the-job training. Because of mass illiteracy, education can be effective in the form of Panchayat and zila group discussions, demonstrations, films and illustrations. Intimate contact has popular appeal in the assimilation of know-how and innovation. Such education should embrace related aspects such as the role of family planning and diet habits.

Adult education and on-the-job training have little element of consumption. These have a low opportunity cost, because the large share of it that is accounted by an income foregone is very low or nil. Formal schooling on the other hand may cause waste through stagnation and dropping-out (Government of India, 1967). It adds to urban unemployment and demand for white -collar jobs.

Investment in health is of similar nature as in education. It also needs to be considered in its broad aspects and not just the provision of hospitals and doctors. This is particularly true of the subsistence rural economy. Besides providing and creating nutritive and sufficient food supplies, sanitary living conditions and rural recreation facilities as part of this investment, its concept should be widened to fit in with LS development, e.g., malaria eradication that enabled the release of thousands of square miles in fertile Terai belt in Indo-gangetic region for cultivation and quick growing plantations.

12. Human Factor

All the methods to bring about increased productivity in the rural sector and the institutions referred to earlier are intimately tied with human factor and socio-cultural aspects. The success of institutional reforms in helping

development depends on the understanding of and the degree to which these are oriented to the nature of those aspects. A 'positive attitude towards the "human-factor" - which means the living culture of a population' is needed (Hofstee 1965) to promote economic development as also to balance it by the development of cultural aspects of human life.

The human factor is closely linked with motivations. Nair (1961) found it untenable to assume

> 'that given equal opportunity, financial incentive and resources, all communities will respond, and respond similarly, in their productive efforts and economic achievements...A community's attitude to work can be a more decisive determinant for raising productivity in Indian agriculture than material resources, or..even technology'.

The many causal relationships and connections between purely economic factors, and social and cultural conditions are important and are reflected in the degree of persuasion required for different communities in adopting new methods.

Economic development and 'human development' are interdependent and not mutually exclusive. Traditional factors need to be given the due weight and regarded in proper perspective to foster overall development. Cow 'worship', caste and joint family systems all seem to have been motivated by economic conditions, e.g., to offset shortages in dairy products and draught power in the face of increasing population and rising land culture (Raj, 1969), to enforce division of labour and orderly organisation, and to provide insurance and distribution of welfare. These institutions are not necessarily incompatible with envisaged socio-economic structure nor can they be swamped by legislation and decrees. This is illustrated by rioting and the failure in India of the move to introduce legislation

against banning of cow slaughter in 1966 and by the caste system, which, far from disappearing, has 'become more strongly entrenched in the modern political organization..owing to legislation intended to assist backward castes' (Gluckman 1965). Instead, these would be eroded or modified by pressures of economic development and human enlightenment, warranting a 'human approach' to these problems. For instance, how can the joint family system be transformed without providing an alternative hedge against insecurity and lack of opportunities?

Dube (1965b) says that in India 'powerful landed interests have..combined to defeat the spirit of recent land reforms,..cooperatives,..(and) consolidation'. But these interests have flourished because of factionalism that characterizes the group dynamics of Indian villages; without going to the core of such problems, reforms and new institutions cannot be very effective. The problem runs through the entire range of socio-cultural, political and psychological features and needs to be tackled on a broad front. For instance, ownership of land continues to be highly valued and, therefore, absentee landlordism continues in one form or the other. Profits are generally invested to own anew or extend landed property instead of improving productivity of existing holdings. Because of social values and psychological satisfaction, profits are locked up also in jewellery and gold.

Eisenstadt (1965) rightly says that modernization of the land sector involves

> 'not only the growth of technical know-how and output but also far-reaching structural changes in..rural society and economy i.e. the weakening of production for self consumption, growth of production for the market and the progressive weakening of the closeness and self-sufficiency of rural society..in a more differentiated economic and social system'.

The impediments due to the distortion of religious practices or the retention of inimical traditions, values, status symbols and other cultural norms however, can not be eliminated without mounting resistance. This can be overcome largely by economic incentives that foster change and innovation[1] with consideration to sociological and psychological aspects of different rural communities.

The attitude to change is involved with producer's choice of risk action or inaction which, in the first instance, depends on his own personality and psychological make-up. To stimulate new forms of culture, a modus vivendi approach between the traditional and the new elite needs to be adopted, so that there is least resistance to the penetration of change. The underlying factor to enable the LS to contribute to overall development thus is the development of a social, political and economic system capable both of generating continuous changes and of absorbing these within the institutional system it has developed. Community development and rural reconstruction programmes, therefore, have a role to play in the process of economic development.

13. Organisation and Administration

The efficiacy of organisational and administrative machinery sets limit to the benefits from the various measures

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1. That peasants do respond to tangible technical development and the economic benefits of increased productivity, has been demonstrated by the recent adoption of seed-fertilizer-irrigation innovation that have had to the so-called 'green revolution' in India. Of course, this 'revolution' is not the result of an overnight change, as seems to be implied. It involved the application of results of research and the development of rural infrastructure. over past years. However, the response of Indian farmers indicates that the so-called unecomonic traditions and outlook are not an insurmountable barrier to development.

directed to increased productivity. The successful implementation of these measures depends on the extent to which its structure is geared to the coordination of activities within the LS and with those outside. This is required to avoid the commonplace divergence of approaches and effects of different institutions and agencies. Because of the numerous individual decision makers in the LS, which is characterised by spatial and temporal variations of a great magnitude, the machinery has to be flexible and oriented to tackle local problems; yet it should be compatible with the requirements of overall development.

The organisation should be designed to cope with all the facets of the LS and the institutions and services that support it. This necessitates that the organisation of individual agencies must be complementary to each other and take account of the interrelationships between different sections of the socio-economy. To effectively perform its functions, the organisation of credit institutions, for instance, must be armed to compete with non-institutional credit. It should be conditioned to quick disposal of applications and timely provision of supplies and production requisites to the needy as well as purchase of or procurement against loans the producers' disposable surpluses. The single purpose credit organisations of western type have made little headway in India and Pakistan, though set up at the end of 19th century simultaneously with those by Japanese who were quick to adapt to their requirements.

The above aspects predispose comprehensive organisations with an integrated overall approach to the problems. The organisation should be a positive link between the grant of credit and the improvement of productivity. The organisation should implement and coordinate supervised

credit facilities with essential and production supplies, procurement, processing, transport, marketing and extension.

The multipurpose organisation can be of different forms to suit local conditions, ideology and stages of development. As against the collectivisation in centrally planned economies, China (Taiwan) has farmers' associations

> 'controlled and managed by farmers..(whose) service activities, which range from marketing to home economics, are varied and cover nearly all the aspects of farm life..' (Hsieh 1963).

Initiative is required from government and outside agencies. But, governments cannot substitute the role that the producers themselves have to play, for they must cooperate with each other for proper functioning of any organisation. Thus while

> 'the pattern of new systems of rural finance, sale and supply and processing should be cooperative, the building up of cooperative organisations in rural communities..whose individual members are weak and unorganised..requires external guidance and assistance' (Gadgil, 1965).

The multipurpose cooperatives, in these circumstances, are useful and can act as a bridge between producers and government. Government serves as a catalyst in the initiation and continued rejuvination of such societies run for and by the producers. The cooperatives can be a 'means of meeting a dual goal of increased efficiency and increased social justice' (Mellor, 1966, p.341) but they should be organised to market commodities and supply inputs and other facilities including consumer credit. Cooperation in the field of production can be to the advantage of small producers in particular by facilitating division of labour and economies of scale. Indivisible outlays on tube wells, pumps, warehousing, and processing plants can be made possible through joint effort. In this way,

'internal' cooperation increases not only 'peasant' saving capacity and provides short cuts to extension activity but also facilitates productive utilization of savings.

Membership and response to cooperative movement depends on the extent to which the organisation is locally oriented. The functioning of cooperatives needs to be linked with that of the local governments and village panchayats. Though governments may continue to foster cooperation, the local people should be encouraged to play an increasing role. This may involve delegation of authority to committees in remote areas at village or Halqa levels for the grant of credit, sales, settling of disputes and the like.

Governmental organisations can help to expand the contribution of the LS to development if the administrative machinery is organised to synthesize the role of all pertinent agencies and departments to the common end. Non-coordinated activities of administrative organisations often negate each others' work and results in much overlap and dissipation of effort. A single ministry or council for the LS is necessary, so that the departments of agriculture, animal husbandry, fisheries, forests and wildlife, horticulture, soil and water conservation, minor irrigation, cooperatives community development and extension service work in liaison with each other. Such an organisation may have either a cell or be assisted by an independent advisory cum planning and evaluation board manned by an inter-disciplinary team of subject matter specialists. The organisation should also concern, through appropriate national agencies as well as directly, with international and interregional economic cooperation, trade, and export promotion.

The central government organisation should be in rapport with state and provincial governments for a continuous two-way flow of basic data and appraisal information, and periodic review and exchange of news. The state governments too need parallel organisations though smaller in size and with emphases on local problems and resources.

Mapping out resource use patterns is not enough, a key task being execution. The commonplace lack of adequate field organisation leaves a serious gap between the multitude of individual producers and the governmental superstructure at headquarters. The headquarter organisation should not be top-heavy to overburden the meagre staff in the field. It should be tailored to the size of field organisation and release excess hands for field work, research and education. As the field organisation expands, the central coordinating and appraisal organisation can be adapted to ~~to~~ match its size and not vice-versa. A strong field organisation will permit decentralization, which is necessary because of great distances and poor communications, heterogeneity of the nature of land resources and of economic problems.

However elaborate and apt the structure and size of the organisation be, its role is dependent on the efficiency amd quality of personnel engaged and the manner in which it is run. For example, in 1964, the amount considered bad represents nearly 94 per cent of over Rs 2·7 million advanned to various cooperative societies by the four central cooperative banks in Kashmir (Government of Jammu and Kashmir, 1965). This is attributable to corruption and mismanagement in the cooperative societies and the banks' lack of knowledge of or indifference to the character of societies. Cases exist where the members of the committees of cooperative credit societies

> 'were themselves in default....(Seed Growers') Society could not sell the seed (till it lost viability)..Apart from the acts of mismanagement the factors that have contributed to the failure of (Forest Cooperative) society are the lack of technical efficiency..and..capacity to face.. competition...Milk Producers' Cooperative..did not organise supply of milk from the local sources.. and it was..a one man's show. The staff...in the cooperative banks lacks..training' (ibid) and even senior officers have been appointed (by the government) out of school leavers who consider cooperative societies as a segment of the civil service.

Honesty and integrity of services is of paramount importance. Inefficient rural administrations need to be cleansed off the malaise of bureaucratic red-tape, that isolate them from the producers, and of personnel given to graft, who are substitutes to erstwhile landlords and usuries. In addition to the necessary rationalisation of procedures and staff, infructuous expenditure and misuse of government finance and property need to be curbed, among other things, by external revenue and expenditure, and efficiency audits. Various reforms, for promoting efficient and honest administrations can, however, take place only under stable political conditions.

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Appendix 22

Natural Endowments and Economic Development

This appendix is extracted from the work of Meier (1965)[1] and contains no contribution by the present author. However, it supports the view (c.f. chap.II) that natural endowments, including renewable resources, can contribute to development. But, as shown in Table 1 here, richly endowed conntries, e.g. the oil-rich middle Eastern and Persian gulf or the forest-rich Latin American countries, have lower per capita incomes than many other countries.

The set of calculations compiled for the said table represents a series of approximations. The most serious difficulties that its author encountered were with the pricing of commodities produced directly from the resources. In general, the supply-and-demand outlook that lies behind it is the same as that arrived at in a study of the American economy.[2] That assessment is relevant, because the United States is by far the largest consumer of raw materials, and price changes in North America cause worldwide shifts with little lag. In these calculations the values assigned to the respective resource stocks are set at the lowest regional prices during the 1962-1963 period. The price assigned 'reflects in considerable part the value of the opportunities made available to a country as a result of the possession of (a raw material resource). (ibid).

Soil resources have hitherto been set aside or treated separately in assessments of natural-resource endowments,

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1. R.L.Meier, 1965. Development Planning. McGraw-Hill Book Co., New York. pp. 12-19.

2. H.H.Landsberg, L.L.Fischman, and J.L.Fisher, Resources in America's Future, The Johns Hopkins Press, Baltimore, Md., 1963.

Table 1. The Stocks of Natural Resources Available on a Per Capita Basis in Selected Countries of the World (APPENDIX 22)

Rank	Country	Population	Agricultural forests and fisheries	Coal reserves	Iron ore	Oil	Nonfuel, nonferrous	Hydro	Total
1	Kuwait	220,000				$210,000			$200,000
2	Qatar	40,000				75,000			75,000
3	U.S.S.R.	210,000,000	$ 70	35,000	240	9,000	6	490	44,000
4	Norway	3,600,000	790	5,600	520		100	2,100	10,000
5	Rhodesian Federation	8,100,000	160	2,200	3,000		100	3,500	9,000
6	Colombia	13,800,000	280	4,900	16	82		2,500	7,800
7	Venezuela	6,500,000	50	2	610	4,400		2,000	7,100
8	Poland	29,300,000	60	5,100	20		870	1,400	7,300
9	Bahrein	140,000				6,300			6,300
10	Cuba	6,600,000	860		5,000		310	2	6,200
11	Iceland	170,000	510					5,000	5,500
12	Saudi Arabia	6,000,000				5,000			5,000
13	Czechoslovakia	13,600,000		4,200	40			30	4,300
14	Iraq	6,900,000	30			3,800		11	3,800
15	Ecuador	4,200,000	303			21		3,000	3,400
16	Costa Rica	1,100,000	700					2,200	2,900
17	British Guiana	550,000	770				500	1,600	2,900
18	Malayan Federation	6,700,000	890	4	40		13	1,700	2,600
19	Brazil	64,200,000	170	170	1,070	50	10	1,080	2,600
20	Chile	7,500,000	37	37	106	240	1,000	970	2,400
21	Liberia	1,300,000	280		130		33	2,000	2,400
22	Peru	10,500,000	130	480	12	43	75	1,571	2,200
23	Denmark	4,500,000	1,980				60	140	2,200
24	Iran	20,100,000	60			1,940		40	2,000
25	Honduras	1,900,000	340	1.3	60			1,500	1,900
26	Argentina	20,600,000	610	6.6	47	35		670	1,370
27	Spain	29,900,000	100	670	300		17	140	1,230
28	Trinidad	820,000	360			920			1,220
29	Finland	4,400,000	880				21	150	1,050
30	Mexico	33,300,000	130	230	100	120	70	390	1,040
31	Ireland	2,800,000	820					130	950
32	Burma	20,500,000	100			7	4	800	910
33	Philippines	24,700,000	200	5	450		27	200	880
34	Sierra Leone	2,400,000	60		460			250	770
35	India	402,000,000	13	340	260		3	80	700
36	Uruguay	2,700,000	360					300	760
37	Korea	23,800,000	2	590	32			5	630
38	Algeria	10,900,000	280	9	89	30	6	215	630
39	Tanganyika	9,100,000	150	220			160	105	630
40	Nicaragua	1,400,000	400					190	590
41	Japan	93,700,000	43	440		1		73	570
42	Uganda	6,500,000	390					120	510
43	Israel	2,000,000	360				32	90	480
44	Ethiopia	21,800,000	30					400	430
45	Ceylon	9,600,000	380					45	420
46	Yugoslavia	18,400,000	110	5	33	62	5	195	410
47	Greece	8,300,000	210		66		33	95	410
48	Lebanon	1,600,000	$ 130					160	$ 290
49	Portugal	9,000,000	130	6	61		14	59	270
50	Italy	49,100,000	120	8	13		14	110	270
51	Turkey	26,900,000	120	37	9		9	80	260
52	Afghanistan	13,200,000(?)	49					200	250
53	Formosa	10,200,000	150					87	240
54	Bulgaria	7,800,000	180				24	34	240
55	Thailand	21,900,000	140		1		20	44	210
56	Egypt	25,400,000	140		6	$ 21		13	180
57	Indonesia	90,300,000(?)	65	11	12	33	8	12	140
58	Viet-Nam	13,800,000(?)	52					52	100
59	Pakistan	86,800,000	24	5				70	100
60	Sudan	11,500,000	16					13	30

Source. R. L. Meier, 1965.

because they are believed to have quite different effects. But, it is recognized that countries such as Denmark, New Zealand, Malaya, and Brazil have achieved significant economic progress by developing soil resources. On the other hand, the huge output of agricultural products in China and India have in the past barely kept their populations alive. It is apparent that soils used for export crops (to other countries or other regions in the same country) can provide the potential for economic growth, whereas those used merely for subsistence do not. Therefore, a reasonable appraisal of soil resources relevant to development, comparable with the appraisal worked for minerals, is the economical value of land required for the production of exports; 'it is approximated by taking ten times the value of the annual exports..Since land is predominantly a renewable resource, its properties are very similar to those of hydroelectric power, where, according to a popular convention for achieving comparability, the underdeveloped capacity was multiplied by ten years of production in order to estimate a present value of output...This manner of defining soil resources implies that if the institutions lack the capability for switching into new export crops, the resource might as easily disappear through a deterioration in the world market for certain commodities...as through a decline in the fertility of the soil'. (ibid).

A feature of the resource levels comparisons with per capita incomes[1] is that Meier (ibid) found 'a high correlation

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1. As compared in a sample of countries in 1957 with that in 1949 by S. Andic and A.T. Peacock - The International Distribution of Income, Jour.Roy.Stat.Soc. Ser.A, Vol.124, pt. 1, pp. 206-18, 1961.

between resource level and the level of per capita income ($r = 0.90$, $p < .00,001$) showing 'that a high-resource level has..promoted opportunities for Economic Growth'. Nevertheless exceptions do exist, e.g. Israel and Lebanon. For these, Meier explains that they have found means of obtaining capital and skills from overseas through the use of family and ethnic ties. As regards Italy and Japan their economic progress is ascribed to manufacturing enterprises which compete for price and quality anywhere in the world, even though almost all the value of the raw materials, other than fuel, is based upon agriculture.

From the foregoing, it may be said that countries can ward off effects of the niggardliness of endowments by employing more capital and skills in a better organized manner, and those richly endowed could secure an advantage over others if they make use of their resources in a similarly productive manner. Otherwise mere richness of endowments may be of no object.

APPENDIX 23

LABOUR USE IN AGRICULTURE

Value of agricultural production per person engaged (*rupees per year)	Number of persons engaged in agriculture per square kilometre of cultivable land.					
	0-5	5-10	10-15	15-20	20-25	25-30
Below 1000		Phillipines				India
1000-1500			Turkey, Yugoslavia USSR			
1500-2000			Poland	Rumania		Italy
2000-2500	Brazil	Greece	Cyprus Bulgaria	Portugal		
2500-3000		France Austria	Spain		Hungary	
3000-3500	Sweden	Ireland	Syria			
3500-4000			Germany Czecho-slovakia	Belgium		
4000-4500						
4500-5000		Britain		Nether-lands		
over 5000			Denmark			

*Indian rupees convertible on pre-1966 value.

Source: Colin Clark, 1963, Population Growth of Living Standards, in Agarwala. A.N. and S.P.Singh, Economics of Underdevelopment O.U.P., New York (A Galaxy Book) p.37.

APPENDIX 24

Average Degree of Interdependence of Economic Sectors

(Italy, Japan, and the United States).

Activities	Interdependence through purchases from other sectors (a) (Backward Linkages)	Interdependence through sales to other sectors (b) (Forward Linkages)
1. Intermediate Manufacture"		
Iron and Steel	66	78
Nonferrous metals	61	81
Paper and Products	57	78
Petroleum Products	65	68
Coal Products	63	67
Chemicals	60	69
Textiles	67	57
Rubber Products	51	48
Printing & Publishing	49	46
2. "Final Manufacture"		
Grain Mill Products	89	42
Leather and Products	66	37
Lumber and Wood Products	61	38
Apparel	69	12
Transport Equipment	60	20
Machinery	51	28
Nonmetallic Mineral Products	47	30
Processed Foods	61	15
Shipbuilding	58	14
Miscellaneous Industries	43	20
3. "Intermediate Primary Production"		
Metal Mining	21	93
Petroleum and Natural Gas	15	97
Coal Mining	23	87
Agriculture & Forestry	31	72
Electric Power	27	59
Nonmetallic Minerals	17	52
4. "Final Primary Production"		
Fishing	24	36
Transport	31	26
Services	19	34
Trade	16	17

(a) Ratio of Interindustry Purchases to total Production (%)

(b) Ratio of Interindustry Sales to total demand (%)

Source: Chenery and Watanabe, "International Comparisons of the Structure of Production", Econometrica, 1959, p.493; Reproduced in A.O.Hirschman, 1966, Strategy of Development. Yale Paperbound, pp.106-107.

APPENDIX 25

Watersheds and Subwatersheds

This thesis embodies the first attempt to delineate the catchments or the main watersheds and their subwatershed units in Kashmir. Five main watersheds have been identified for the Jhelum river basin, which comprises the Kashmir valley or the Kashmir region. A map of each of these watersheds and their subwatersheds is given in the annexure to this thesis. These maps show the present land-use pattern, the distribution of the various renewable resources such as forests and pastures, and the location of problem spots such as the different degrees of erosion, which is of importance in a mountainous region. The prepartion of such maps, too, is the first attempt of its kind for Kashmir. These will serve as the reference points for resource-use adjustments.

The extent of each of the watershed and the subwatershed units is given below. This information has been of use in assessing the bio-technical potential of the region. It is hoped that these data will be of use for further investigations, especially for sub-regional, or detailed local planning.

S. No.	Name of Watershed*	Plan Area (Acres)
	I UPPER JHELUM CATCHMENT	
1.	Vyath Vethur	57359
2.	Vishav	227060
3.	Rembiara	139814
4.	Sasra	69811
5.	Romshi	138403
6.	Dudh Ganga	180440
7.	Sukh Nag	148248
	Sub-Total	961135

* The names have been coined after either a major drainage line or an important centre of habitation.

S. No.	Name of Watershed	Plan Area (Acres)
	II LOWER JHELUM CATCHMENT	
8.	Jhil Link	55429
9.	Firozpur	74526
10.	Baba Reshi	36467
11.	Ningli	47898
12.	Sangrom	6808
13.	Baramulla Delina	11802
14.	Narwao	27656
15.	Khadanyar Drangbal	7690
16.	Bambyar Zainapora	16412
17.	Gantmulla	12276
18.	Hapatkhai	42521
19.	Limber	20042
20.	Bagna Islamabad	7032
21.	Uri Nambla	29237
22.	Bijhama	33447
23.	Zambur Pattan	10378
24.	Shahdara	13857
25.	Thanda Pani Salamabad	23944
	Sub-Total	477422
	III POHRU CATCHMENT	
26.	Dakil	14381
27.	Viji	21174
28.	Hamal	31234
29.	Hardu Khari	14519
30.	Mawar	45681
31.	Talri	37994
32.	Dangerwari	19393
33.	Bangas Drangyari	25876
34.	Donari	14618
35.	Bodnambal	11994
36.	Kahmil	15360
37.	Hodkol	24631
38.	Owura	26301
39.	Haihama	20747
40.	Khumriyal	5762
41.	Kalaruch	31303
42.	Putshai	13551
43.	North Lolab	31046
44.	South Lolab	20341
45.	Upper Pohru	23563
46.	Harwan Zalura	12768
47.	Zaingari	35909
	Sub-Total	498146
	IV WULAR-SINDH CATCHMENT	
48.	Nagmarg	43749
49.	Bonar	45714
50.	Viji (Virnar)	13225
51.	Madmati (Upper and Lower)	94802
52.	Erin	84476
53.	Argam	12703
54.	Ajas	41112
55.	Watlar Panar	80883
56.	Wangat	102062
57.	Sindh (Upper and Lower)	234063

S. No.	Name of Watershed	Plan Area (Acres)
58.	Anchar	43821
59.	Dachhigam	65057
	Sub-Total	861667

V LIDDER-SANDRAN CATCHMENT

60.	Khunamuh	62625
61.	Aripal	109762
62.	Lower Lidder	104810
63.	West Lidder	131047
64.	East Lidder	60214
65.	Tuliyan Langinai	29647
66.	Hapatnar	48995
67.	Arapat	111017
68.	Bringi	179513
69.	Sandran	99423
	Sub-Total	937053
	Grand Total	3735423

i.e., 5836.59 Square Miles. (Geographical area)

Percentage area under water (estimated) (ie., lakes, rivers, streams) 6.22%

Therefore, total land area 3502800 acres

Appendix 15 (contd)

S. No.	Sericult. X_7	Apple X_8	Walnut X_9	Almond X_{10}	Scrub X_{11}	Deodar X_{12}	Kail X_{13}	Fir X_{14}	Willow X_{15}
1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	101,000	341,554	-
4	-	-	-	-	-	-	-	81,000	-
5	-	-	-	-	-	-	-	22,800	-
6	-	-	-	-	-	-	-	58,200	-
7	-	-	-	-	-	-	101,000	260,554	-
8	14,800	22,522	41,958	1,907	38,325	112,388	159,533	-	-
9	-	-	-	-	21,600	52,600	38,600	-	-
10	3,200	4,400	-	525	9,220	25,500	26,203	-	-
11	-	-	-	-	-	2,800	16,000	-	-
12	-	3,000	-	-	2,100	-	-	-	-
13	-	1,400	-	125	1,120	-	-	-	-
14	3,200	-	-	400	6,000	22,700	10,203	-	-
15	9,000	10,100	10,418	872	5,105	21,088	66,230	-	-
16	-	-	-	-	1,100	-	38,100	-	-
17	2,100	6,100	-	-	1,000	-	-	-	-
18	6,800	1,600	-	312	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-
20	-	-	-	560	2,200	9,088	12,100	-	-
21	-	2,400	10,418	-	805	12,000	16,030	-	-
22	2,600	8.022	31,540	510	2,400	13,200	28,500	-	13,089
23	-	-	6,500	-	-	-	6,300	-	13,089
24	-	-	6,500	-	-	-	6,300	-	-
25	-	-	-	-	-	-	-	-	13,089
26	2,600	8,022	25,040	510	2,400	13,200	22,200	-	-
27	-	3,022	20,000	-	-	-	-	-	-
28	-	3,200	-	-	800	-	4,200	-	-
29	2,600	1,800	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-
32	-	-	-	510	1,000	-	2,400	-	-
33	-	-	5,040	-	600	13,200	15,600	-	-
34	14,800	22,522	41,958	1,907	38,325	112,388	260,533	341,554	13,089
35	-	-	-	-	-	-	-	-	13,089
36	-	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-	13,089
38	14,800	22,522	41,958	1,907	38,325	112,388	260,533	341,554	13,089

contd....