# Water, power and IWRM (Integrated water resources management) – A comparative study of village water governance in arid and semi-arid Northwest China

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# Abstract

Agriculture based livelihoods in arid and semi-arid areas encompass limited physical resources and evolving relationships between environment, population and the state. Northwest China encounters constant socio-economic changes, changing climate, agriculture and land practices and political relations that impact the social-ecological system. This thesis investigates how policy, environmental changes and local action interact with each other and affect the livelihoods and determine the environment in the Shiyang River Basin.

Focusing on increasingly severe water crisis, environment degradation and endangered livelihoods that define arid and semi-arid environment, this thesis examines local people's perceptions of and interaction with their environment and water-related interventions in the Shiyang River Basin, a typical inland arid area in Northwest China. In 12-months fieldwork, mixed methods were used including semi-structured interviews, questionnaires, group discussions and participant observation. This research explicitly applying a socio-ecological system lens shows that people's perceptions of water crises can be highly divergent, regarding access to and control over local water resources and the roles of internal and external interventions. A wide range of factors result in uneven access to resources and inequitable consequences across space and even within local communities. In the Chinese contexts, personal experiences together with geographical factor, lands area and income levels have significant impacts on villagers' water perceptions. Political trust, social capital and collective action play a key role in the understanding, implementation processes and outcomes of government-enforced water reforms at local levels.

This research is the first known study to use the tools of social analysis to examine water, society and the state interactions and their consequences on governance of the irrigation commons, local livelihoods and sustainability in rural China. It shows the everyday water struggle over water control, access and economic opportunities among different water stakeholders. Although a majority of population still depend on irrigated agriculture for their livelihoods, the future of agriculture in studied basin or in China generally is uncertain as farmers migrate, the population ages and next generations become better educated and migrate to the city. This thesis enables a new perspective on the global water management debate within a context where research has stresses the natural and technocratic approaches and creates new opportunities for more effective and appropriate governance of common pool resources. Interdisciplinary understanding regarding stakeholder perceptions, water resources management and environmental change are enriched. Potential barriers and solutions are transferable to other regions and countries where water crises are accelerating due to population growth, urbanization, industrialization, agriculture and economic development, climate change and other socio-political changes.

# Acknowledgements

My first thinking on the subject of water conservation and governance goes back to my days as a Master student in China. By the education background in agriculture water engineering, I was much involved with research on the field of water saving theories and technologies. It was there I felt strongly that the problem of water conservation does not lie so much in a lack of technologies, but rather in a lack of understanding of the water problems and an enabling mechanism for successful and sustainable implementation. That is when I started thinking about what makes so many government water projects fail and why local people refused to use water-saving technologies despite the heavily government-funded water projects. These cultivated in me a research orientation.

Writing this thesis has been a pleasant, instructive and challenging experience. It taught me things that I expected to learn and many more which had not been anticipated. Some of the unexpected lessons are: 1) how marvelous it can be to have accessible water again, 2) how tricky it could be to get a stubborn, authoritarian politician talking to you, 3) how essential it is to understand the difference between "efficiency" and effectiveness when it comes to water governance - People can "efficiently" doing more things in less time, but it does not guarantee effectiveness- which means doing the right things in the right way; and 4) how crucial it is to be excited and deeply convinced of what you are doing for surviving the long journey.

I always consider myself fortunate to have met Professor Mike Edmunds, my first supervisor, in the field. He has offered me the greatest opportunity to join and conduct my research as a member of the Environmental Change Institute and the School of Geography and the Environment at Oxford. His profound knowledge of and special interests in China's water issues have been a never-ending inspiration. I am also deeply grateful to my co-supervisor Associate Prof. Anna Lora-Wainwright, whose insightful and constructive comments have helped me shape my research and improve my thesis, especially when she was fully occupied and on her maternity leave. Likewise, I owe immense gratitude to Professor David Thomas, my other mentor, whose constant support and guidance have offered me great motivation and direction along the way. Without any of you, this thesis would not have been possible.

The one-year fieldwork in China was greatly enhanced by the support and cooperation of various organizations and individuals. The people in the Shiyang River Basin, who opened their home and heart to me, were patient, friendly and inspiring. I will long treasure the opportunity that I had to live among and learn much from them. All the participants who willingly gave their time and opinions helped to add to my knowledge and understanding of the studied subject.

Last, but most important, I acknowledge the support and perseverance of my parents. It was because of their support that I could pursue my academic interests with a free mind and a source of strength. I also thank my brother, sister-in-law, Wing and other family members and friends in China and UK, for the unconditional love and constant spiritual support, especially during the last months of writing. As I finished this thesis, I had just started to realize this is not the end but a beginning. It is time to explore and embrace together now the new cycle that opens.

# Notification:

This thesis follows the four papers route. Apart from the introduction and conclusion Chapters, each chapter is an academic article either published on or accepted by a scientific journal. The first author is the only writer and main contributor of all the papers, while the supervisors' names were also added due to their contribution in helping with the structure building, arguments shaping, editing and publishing processes.

**“Water is fluid, soft and yielding. Yet it will wear away mountains and earth and nothing can resist it. This shows clearly the principle of softness overcoming hardness”**

**—Tao Te Ching, Lao Tzu, Chinese Philosopher**

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# Acronyms

ADB: Asian Development Bank

BM: Billion cubic Meters

CCP: Chinese Communist Party

CPR: Common Pool Resources

CV: Coefficient of Variation

DI: Drought Index (—the ratio of potential evaporation to precipitation)

FAO: Food and Agriculture Organization

GDP: Gross Domestic Product

GNP: Gross National Development

GPWRB: Gansu Provincial Water Resources Bureau

GW: Ground Water

GWP: Global Water Partnership

IWRM: Integrated Water Resources Management

Mu: Land unit (1mu = 0.067 ha)

PP: Public participation

SES: Social Ecological System

SYB: Shiyang River Basin

SW: Surface Water

UN: United Nations

UNDP: United Nations Development Programme

VCs: Village Councils

WUAs: Water Users' Associations

# Glossary

1. Arid and semi-arid: Environment with an annual precipitation between 200-500 mm or less and high potential evaporation.
2. Water Crisis: water stress caused by physical, social, economic, political and other factors.
3. Water Governance: the involvement of the multiplicity of actors and organizations in the production of policy outcomes and also as the act of coordination, whether through networks or hierarchy.
4. Integrated water resources management: a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.
5. Institution: the set of working rules or organizations, formal or informal that are used to determine who is eligible to make decisions, what actions to be allowed or constrained, what aggregation of rules will be used what procedures must be followed, what information must or must not be provided, and what payoffs will be assigned to individuals dependent on actions.
6. Collective action: the pursuit of a common goal or interests by more than one individual.
7. Social capital: features of social organization such as networks, norms, trust reciprocity and exchanges, common rules and connections in institutions that facilitate coordination and co-operation for mutual benefit.
8. Guanxi: a Chinese term which is variously translated and widely used as social relations, personal connections and particularistic ties.
9. Perception: understanding, knowledge and beliefs held by people in a given context and how people recall things through acquiring, interpreting, selecting and organizing information.
10. Social Ecological Systems: multilevel, complex and adaptive systems, nested in different contexts, provide essential services to society such as supply of food, energy, and water and adapt over time to internal and external disturbances, for example the changing dynamics among resource users, institutions and resources.

# Chapter 1 Introduction

# 1. Introduction

This thesis is a study of water, one resource that could not be more vital to the people and society that it touches; one that includes many different stakeholders with overlapping and even contradicting interests and agendas across a wide variety of sites. It is a study of people's everyday struggle over water and the wide variety of ways in which "the water crisis" can be perceived and approached in the arid and semi-arid regions in the Shiyang River Basin (SRB) of Northwest China.

*Figure 1.1 Oasis is disappearing in the Shiyang River Basin*

Over the years, the "water crisis" has become a theme of attention in a variety of settings in both developed and developing world (Rogers et al., 2010, p.7). Water crisis, water scarcity and water shortage have been popularly and synonymously used in most literature. The term "water shortage" represents a dearth, or absolute physical shortage of water. Places suffering from water shortage have a low level of supply relative to the minimum water needs for basic human needs. It can be measured by annual renewable flows per person. There are two conceptions of water scarcity. One is a natural phenomenon related to a shortage of water and the other is as a geographically and historically situations, a social fact, an imbalance between supply and demand, for example a result of affluence or change of lifestyles. A country faces chronic water

scarcity when its fresh water availability falls below 1000 $m^3$ per year per person (Jiang, 2009). This thesis chose the term "water crisis" to represent the symptoms of water scarcity and shortage. There is "water crisis" when local people cannot get the right amount of water at the right time when it is needed to live a clean, productive and sustainable life. It can be a crisis of physical water shortage or a crisis of governance, or a crisis that is social and political.

"Water crisis" has mostly been examined from the perspective of political and academic communities, whereas very little has explored the social, political nature and diversity of water problems especially from perspectives of local communities from diverse backgrounds (Lee and Zhang, 2004, Liu et al., 2010, Slegers et al., 2005, Chen and Tang, 2005, Pretty and Ward, 2001). There is a dynamic relationship between water, the state and different stakeholders (Ostrom, 1990, Olson, 1965, Agrawal and Ostrom, 2001, Giest and Howlett, 2014). Understanding water crisis requires understanding of localized perspectives and power relations that can help address the ineffective structures of water management (Mosse and Sivan, 2003). In China, water problems have been and continue to be labelled as technical issues (Blanke et al., 2007, Deng et al., 2006, Kang et al., 1996) when in fact they are often governance failures (Pahl-Wostl et al., 2012). It can neither be understood nor resolved without knowledge of the embedded physical, socio-economic, political and cultural environment and complex human dimensions (Berkes et al., 2000b, Lam, 2006, Mehta, 2007). In other words, the water crisis today is not just an issue of physical quality or quantity of supply and demand (UN, 2003, Rogers and Hall, 2003, Rogers et al., 2010) but also a problem of social relations and constructions in different contexts (Mosse and Sivan, 2003, Mollinga et al., 2008, Mehta, 2007, López-Gunn, 2012).

This thesis focuses on understanding the water crisis in the context of IWRM (integrated water resources management) (GWP, 2000) in NW China. It is about defining what the water crisis/solutions are about according to different constructs and different stakeholders' perceived realities. The top-down mandated and heavily invested IWRM reforms could be quite effective in addressing many problems related to centralized water management system such as financial pressures and low efficiency. However, despite the supposedly good intentions and the investment, IWRM reforms at local levels can encounter a variety of difficulties. In examining the relationship

between the IWRM project, the river basin, the state and the diverse stakeholders, this study analyzes why government enforcement of IWRM has achieved less than proposed in the region of study, with unexpected counterproductive impacts (Biswas, 2004, Nickum, 2010, Yu, 2014).

This overall objective of this research is to provide an in-depth understanding of multiple perspectives of water crisis and governance processes and outcomes in the arid and semi-arid communities of SRB. This understanding informs local population and decision makers and enable a comparison with water use and governance processes so that a more effective, equitable and sustainable system of water governance, especially at local level can be achieved. It argues that the IWRM process is a highly social, political process which is shaped and reshaped through localized negotiation, bargaining and manipulation among different stakeholders. It suggests that disparity among different villages and villagers is growing due to local water crisis and reforms. People's water and IWRM perceptions and the performance of IWRM projects share mutual influences. Water users target extra water access and investment funds, locally called "farming of projects" rather than water conservation. The ways of increasing government water control through mandatory IWRM reforms to fix management mistakes caused by bureaucracy and uncoordinated development has engendered new problems without fixing the old ones. This study spans multiple stakeholders, levels and sectors; it is intended to provide findings that are applicable to other parts of China or other countries that are experiencing similar water challenges. Dissemination of this study will convey the little-studied water dynamics under top-down authoritarian regime to the international academic and political communities.

This introduction first introduces the context of the SRB within which water crisis and IWRM reform were examined. Then the research aims and questions are discussed, followed by discussion of conceptual framework and outline of the thesis.

## 1.1. Research aims and questions

This study aims to understand how different stakeholders understand and approach the local water crisis and factors (physical, socio-economic and political) that influence local water governance under mandatory enforcement of IWRM reforms in arid and

semi-arid systems of China. Based on this, it will explore why certain water reforms have failed in some cases but not in others and how improvements can be made in future water governance at local levels in water-scarce regions.

The detailed objectives are:

- To gain an in-depth understanding of how water crisis and IWRM reforms in SRB are understood from the perspectives of different water stakeholders; and illustrate the significance of these differences;
- To identify how these perceived problems and processes are impacting villagers' participation in local water governance with the example of water users' association;
- To assess the roles of different socio-economic and political factors such as age, gender, and power relation, on stakeholders' perceptions and the reform processes;
- To explore the ways in which IWRM reform are understood and managed across a variety of scales by different social groups;
- To suggest possible ways in which water projects can be better devised and water can be better governed for the good of the resource base, environment and the resource-dependent people.

However this research is more than a descriptive case-study and there are four clear research questions:

- What are villagers' perceptions of the water crisis and what are the factors influencing different stakeholders' attitudes and perceptions? (Paper 1)
- Under IWRM reforms, how do villagers and professionals understand public participation and water users' association in terms of the purposes, processes and impacts and why? (Paper 2)
- How and to what extent are IWRM measures implemented, and specifically what are the localized impacts and adaptations in different case study areas? (Paper 3)
- How are local irrigation governance and uses impacted by IWRM reform measures and are these irrigation institutions in different case studies successful and why? (Paper 4).

The answers to these questions are framed in the context of three contemporary debates. The first relates to environmental perceptions and behaviour, more specifically local water perceptions and behaviour. The natural world is always "humanized nature" and water issues are never simply physically determined but are constructed and given meaning by shifting socio-economic and political relationships (Mosse and Sivan,

2003). Many authors have shown a great deal of interest in public perceptions of environmental problems (Van Liere and Dunlap, 1980, Lee and Zhang, 2005, McKay and Keremane, 2006, Slegers, 2008, Oñate and Peco, 2005, Slegers et al., 2005). I intend to reveal the particular ways in which water and society are linked and shape each other under the water-stressed conditions and government-enforced water reforms in the arid and semi-arid NW China.

These answers lie in the socio-political construction of water crisis and the enduring links between water control, power, livelihoods and social-ecological systems. IWRM reforms, as many of its predecessors, are from "the above" and are presented as "well-intentioned" and apolitical. They aim to ensure sustainable development and relieve the ecological stress. However they are fundamentally underpinned by fulfilling the broader political and economic interests across a diversity of scales and actors in the world's largest bureaucratic system. This thesis raises the question of how water issues and management practices are locally, socially and politically constructed. Through collective water uses and management of surface and groundwater every agriculture year especially on highly fragmented fields as in rural China, the people within different local governance systems inevitably produce their own understanding of environment, water resources and related government policies. These attitudes and perspectives are not homogeneous or simple reflections of nature but rather a reflection of local physical, economic, socio-political relations, within which these understandings are produced.

The second debate centres on the CPR (common pool resources) governance process and IWRM in Third world nations as encouraged by national and international organizations. At present this is most evident in the rhetoric of sustainable water resources management and good governance of CPR, into which international institutions, national governments, academic communities and local actors alike have been co-opted. In this study, I examine the ways in which these Western-based discourses and concepts are used by both the powerful, less powerful and powerless groups and expose the inherent dilemmas and contradictions in a traditionally authoritarian society; how they have caused a conflict of interests and how water governance has become a socio-political issue.

Third this research also sheds light on the nature of social capital and collective action in governance of CPR in Chinese societies, where the use of personal relationships to gain interests has been so prevalent and entrenched (Oi, 1991, Yu et al., 2014). Collective action and social capital is at the centre of natural resources management (Adger, 2010, Ishihara and Pascual, 2012, Olson, 1965, Ostrom, 1990). This study examines the water-society and the internal-external relations and interactions that take place within a diversity of groups whose livelihood depends on their water commons.

As well as being descriptive about the water problems in SRB, this study also aims to be analytical and prescriptive. An accurate and in-depth understanding of the perceived nature of the water crisis at local level will enable more appropriate and locally effective solutions. Simultaneously better knowledge of the governance processes and power relations can be used to develop effective governance structures and address the issues of water efficiency, equity and sustainability in the area. This study takes into account not only the official regulation processes but also the effects of local institutions (formal and informal) which regulate the experiences, understanding and responses of people living through water challenges. Findings of this research will help inform government water decisions; will enable comparison with water challenges and governance processes both within the wider region and globally; and will convey barely-known water dynamics in contemporary rural China to the wider academic communities. The critical elements of this work focus on villagers' water perceptions, local IWRM reforms, formal and informal water governance institutions and the multiple roles of social capital such as Guanxi (a Chinese term which is variously translated and widely used as social relations, personal connections and particularistic ties) (Xin and Pearce, 1996, Gold et al., 2002) and collective action (O'Brien, 2002, Olson, 1965). This thesis by supplying a synthesis of local geography, evolving water dynamics and official and local motivations, presents a cohesive examination of the everyday water politics in the arid and semi-arid environment of NW China. It is of wider relevance to study of water governance issues and other CPR in the SRB and other areas within China and internationally, to the development and implementation of IWRM in similar contexts and to enrich theories of CPR governance.

## 1.2. Research location

Any study of environmental issues cannot be appropriately understood without knowledge of contextual information. The geographical characteristics and their impacts on water uses have significant impacts on natural resource base and uses. The physical, historical and social-economic background is also a necessity for understanding the current water and related environmental situations.

*Figure 1.2 The Shiyang River in study area (Source http://www.gs.xinhuanet.com/shiyanghe/index.htm )*

This study is set in the arid and semi-arid regions of the SRB (101°41′～104°16′N，36°29′～39°27′W) in Gansu Province, Northwest China (Figure 1.3 and 1.4). The SRB Basin is one of the most water-scarce regions in China and the world. It covers an area of 41600 $km^2$ surrounded by the Bardain Jaran and Tengger deserts. The basin was selected because of its lack of water resources and severe water-related problems (Tollefson et al., 2014), and thus a typical example of overuse of both surface and groundwater resources. It represents the typical dilemma for human-environment coordination in a manner that nature competes with man for water; upper-stream users compete with downstream users for water-dependent livelihoods; and present generations compete with future generations for groundwater mining.

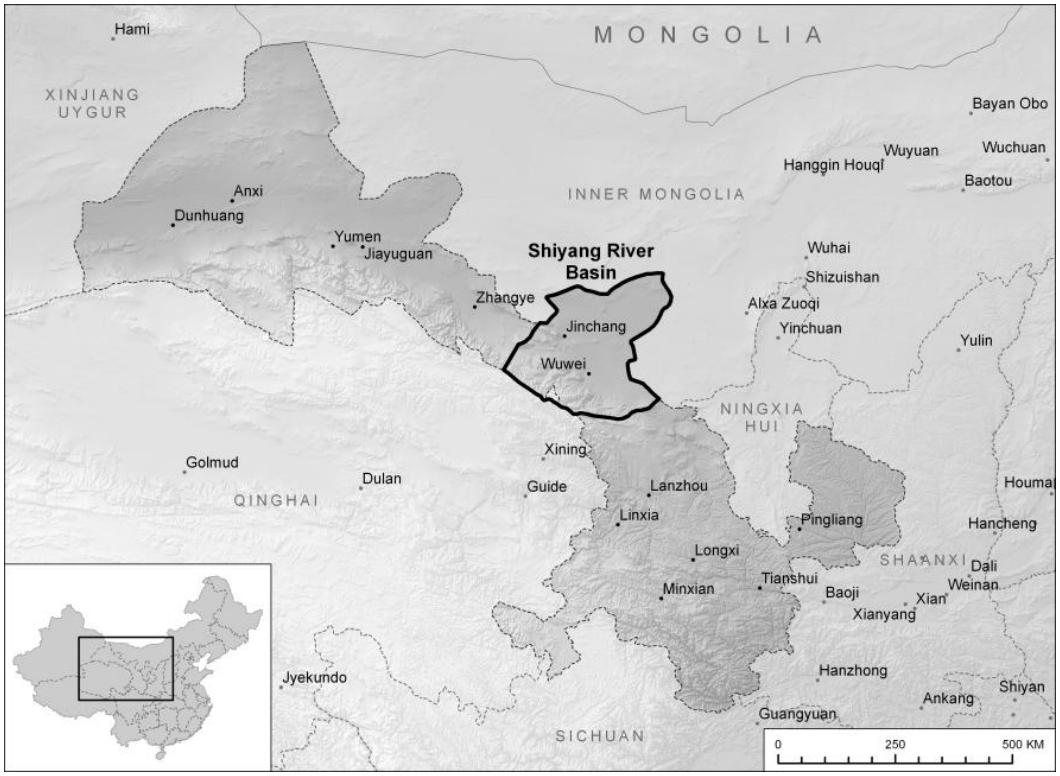



*Figure 1.3 Location of the SRB in China*

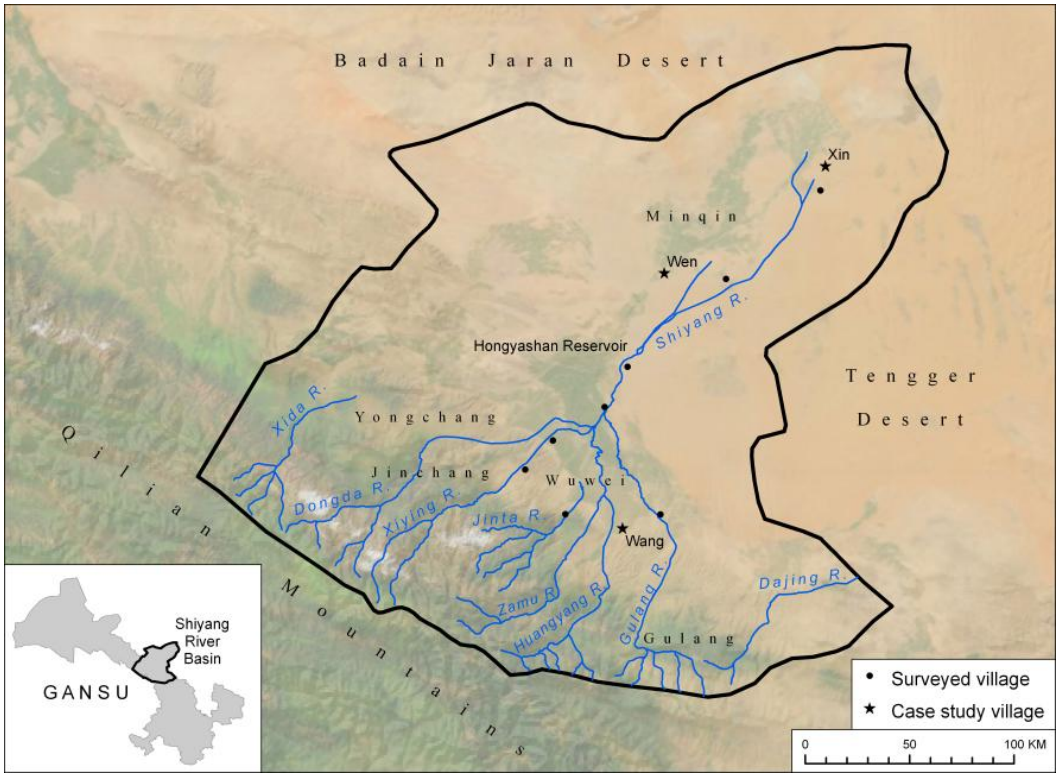



*Figure 1.4 Sketch of the SRB and studied villages (the villages names are false names for anonymity reasons)*

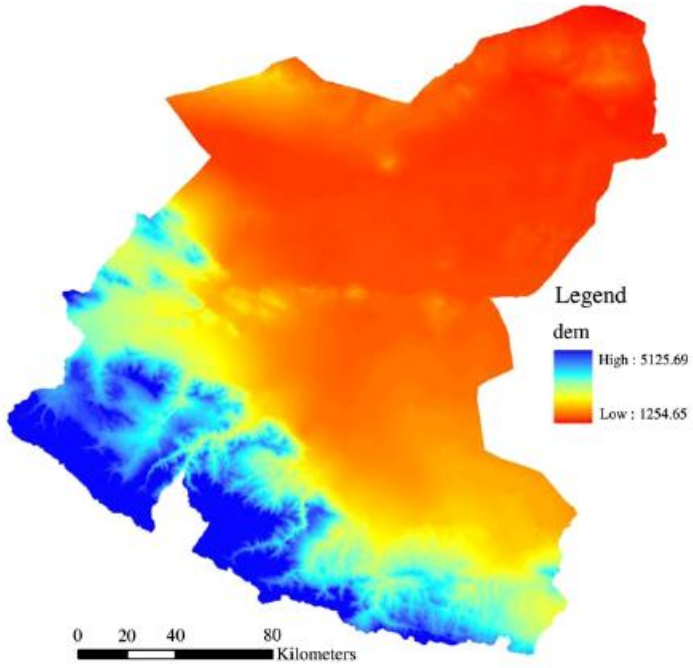



*Figure 1.5 Digital Elevation Model of Shiyang River Basin (Unit: m); Source: (Wang et al., 2012)*

### *1.2.1. Physical*

The basin is an independent closed inland river basin, forming the corridor plains between the southern Qilian Mountains and the northern desert area. The basin terrain is high in the south and low in the north, with a falling gradient from southwest to northeast. It has an arid continental inland climate area characterized by strong solar radiation and long sunshine hours. It has short and very hot summers but long and very cold winters, high evaporation and low erratic rainfall, averaging 282 mm (around 70% concentrating from June to September, while 5% and 10% in April and May during the critical growing period of most agriculture crops) (See Table 1.1). The average temperature in the upper reaches is below 6℃ and the rainfall is 400–600 mm. The average temperature in the middle reaches of the basin is below 8℃ and the rainfall is 150–250 mm. In contrast, the average temperature in the lower reaches of the basin is higher than 8℃ and the rainfall is less than 150 mm (Kang et al., 2004). Influenced by the climate, eco-hydrology, landscape, and other natural conditions, the soil and vegetation types of the basin form an obvious vertical spectrum of soil and vegetation

(Tong et al., 2007).

The Shiyang river starts from the Qilian mountains, and it is composed of eight tributaries from west to east including Xida, Dongda, Xiying, Jinta, Zamu, Huangyang, Gulang and Dajing river (See Figure 1.3.), which join together in Wuwei, then flow into the lower part of the basin in Minqin county and finally disappear in the desert area. Each river has its own reservoir built to make better use of available water. Its eight tributaries are mainly fed by rainfall, snowmelt and glacier melt. The total water availability is 1.66 billion cubic meters (BCM), of which surface runoff is about 1.56 BCM and groundwater (not duplicated with surface water resources) is 0.1 BCM. The overall water consumption by different industries and sectors in 2008 amounted to 2.69 BCM in water supply, with an overexploitation of groundwater of 1.03 BCM. Inter-annual variability in the runoff amount for Xida, Dongda, Xiying, Jinta, Zamu, Huangyang rivers, is relatively small with a coefficient of variation between 16%-25%, while for Dajing and Gulang rivers which account for about 5% of the annual runoff in the SRB basin, the CV is 32% and 52% (GPWRB, Gansu Provincial Water Resources Bureau, 2007). Overall, the inter-annual fluctuation in surface water availability is relatively small.

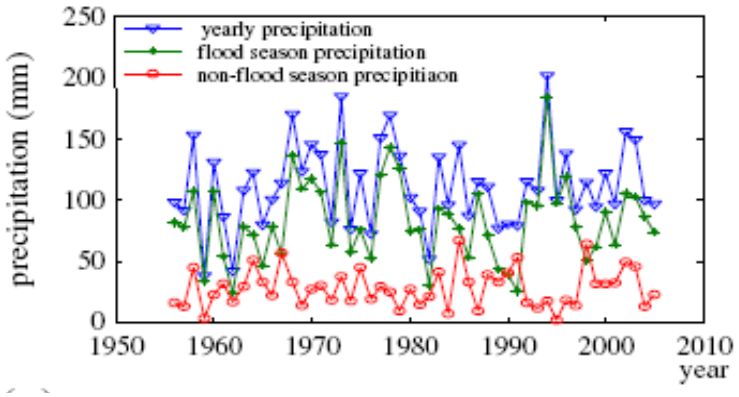



*Figure 1.6 Trends for annual precipitation in lower reaches of SRB (Wang et al., 2012). Normally flood season is from June to September, and non-flood season is from October to next May.*

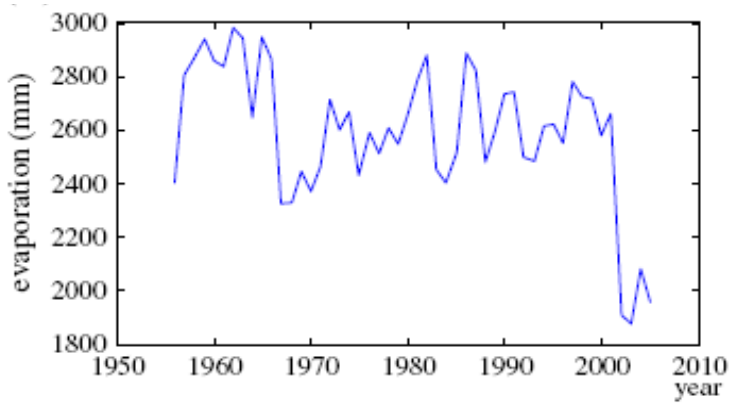



*Figure 1.7 Trends for annual evaporation in lower reaches of SRB (Wang et al., 2012). The minimum anomaly evaporation occurred in 2003.*

*Table 1.1 Multi-year average monthly rainfall and percentage in SRB*

| **Month** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** |
|---|---|---|---|---|---|---|
| **Rainfall (mm)** | **2** | **3.8** | **10.6** | **17.5** | **30.5** | **40** |
| **Percentage (%)** | **0.7** | **1.35** | **3.77** | **6.22** | **10.85** | **14.22** |
| **Month** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| **Rainfall (mm)** | **51** | **62.1** | **40** | **17.5** | **4.7** | **1.6** |
| **Percentage (%)** | **18.14** | **22.08** | **14.22** | **6.22** | **1.67** | **0.56** |
| **Total (mm)** | | | **282.1** | | | |

Source: Author's field work collection, personal contact with water official.

The basin is in the continental temperate zone with arid climate and variable topography, which is divided into three distinct climatic regions. The first is the Qilian Mountains region in the south of the basin, a very frigid, semiarid and humid area, with annual precipitation and potential evaporation at the level of 300–600 mm and 700–1200 mm, respectively, and a drought index (DI—the ratio of potential evaporation to precipitation) of 1–4. The middle part of the basin is the plain region, cool and arid, with an elevation of 1500–2000 m, annual precipitation and potential evaporation at 150–300 mm and 1200–2000 mm, respectively, and DI of 4–15. The northern part of the basin is warmer and more arid, with an elevation of 1300–1500 m, annual precipitation less than 150 mm and potential evaporation about 2000–2600 mm and DI of 15–25 (Huo et al., 2007).

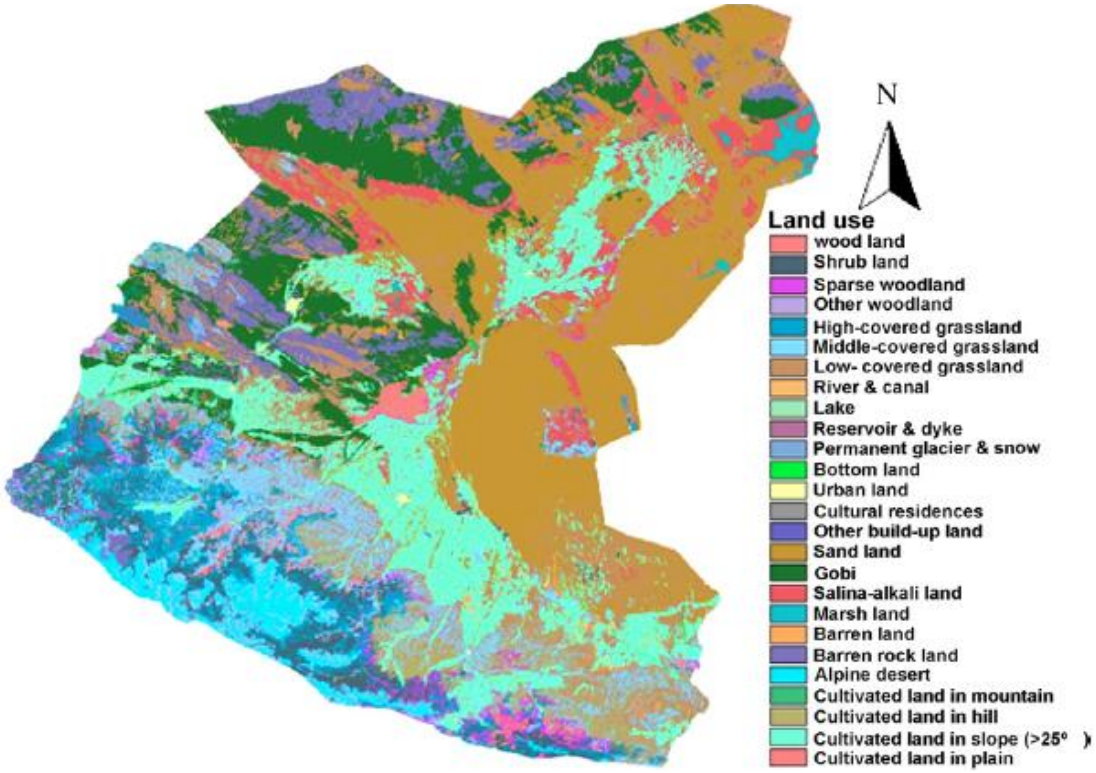



*Figure 1.8 Land use map of the SRB, Source: (Tong et al., 2007).*

The area has been facing severe water problems including overexploitation, falling water tables and degrading water quality. It has experienced a serious loss of natural vegetation, gradual soil salinization and desertification (See Figure 1.8, the lower-reach oasis has been covered with sand land and desert and Figure 1.13). Detailed summary of water problems have been widely discussed (Kang et al., 2004, Huo et al., 2007, Ma et al., 2007, Ma et al., 2005a, Zhang et al., 2012), which include physical water shortage, climate change, increasing water needs from human activities and imbalance between ecological sustainability and economic development. Negative effects such as desertification, deforestation, and soil salinity have been considerable. While much is known about the hydrogeology cycle and processes in the river basin (Edmunds et al., 2006, Gates et al., 2008, Ma et al., 2005a), little has been studied about the social, political and localized nature of water crisis in the area studied.

### *1.2.2. Socio-economic*

The SRB has a large and growing population of about 2.27 in 2003 and 2.5 million in 2010, mostly (>77%) agriculture based. Gross national product (GNP) is 25.8 billion

Yuan (1Yuan=0.1 GBP), with an average annual income per capita of 11551 yuan for urban residents and 4551 yuan for rural residents (Figure 1.9). The population density in the SRB is 55.6 people per square km which far exceeds the international standard for ecological balance (7 people per square km in arid zones and 20 in semi-arid zones). The water availability per capita is 575 $m^3$ which is half of the provincial average of 1134$m^3$, 25% of the national average of 2200 $m^3$ and 6% of the global standard.

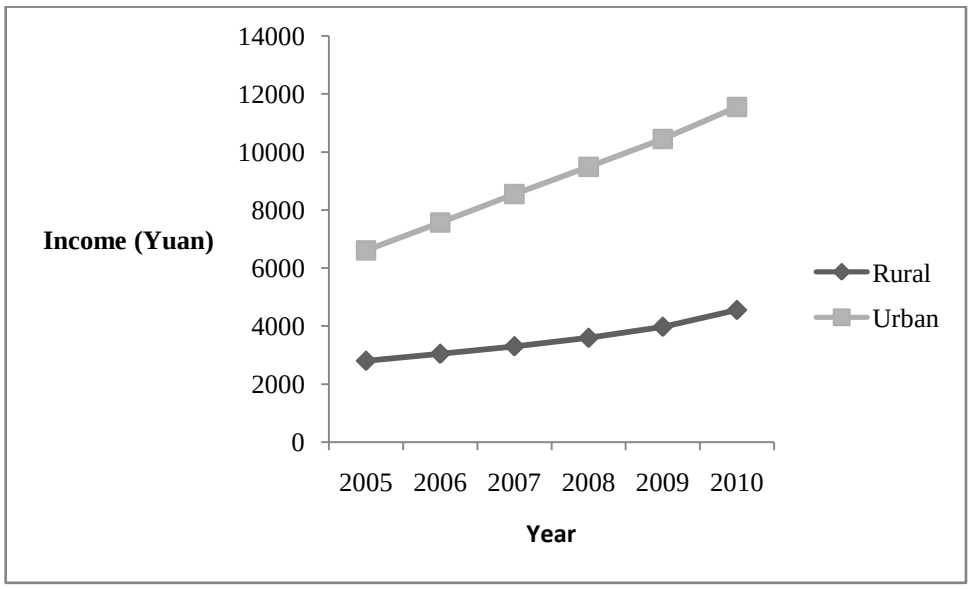



*Figure 1.9 Per capita income change from 2005-2010. Source: Wuwei Statistics Yearbooks 2005-2010*

The area of cultivated land is 3.65 million mu, with 2.25 million mu for grain crops, and it has decreased by 3.38% from 2009. The cultivated agriculture land per capita is 0.13 ha. The main crops include spring wheat, maize, potato, cotton, vegetables and fruit trees. Irrigation accounts for over 84% of overall fresh water withdrawal and flood irrigation remains the dominant way of irrigation for local water users (See Table 1.2). The ratio of cultivation area among grain crops, cash crops and grass had changed from 64：31：5 in 2009, to 62：34：4 in 2010 (GPWRB, 2007).

*a* *b*

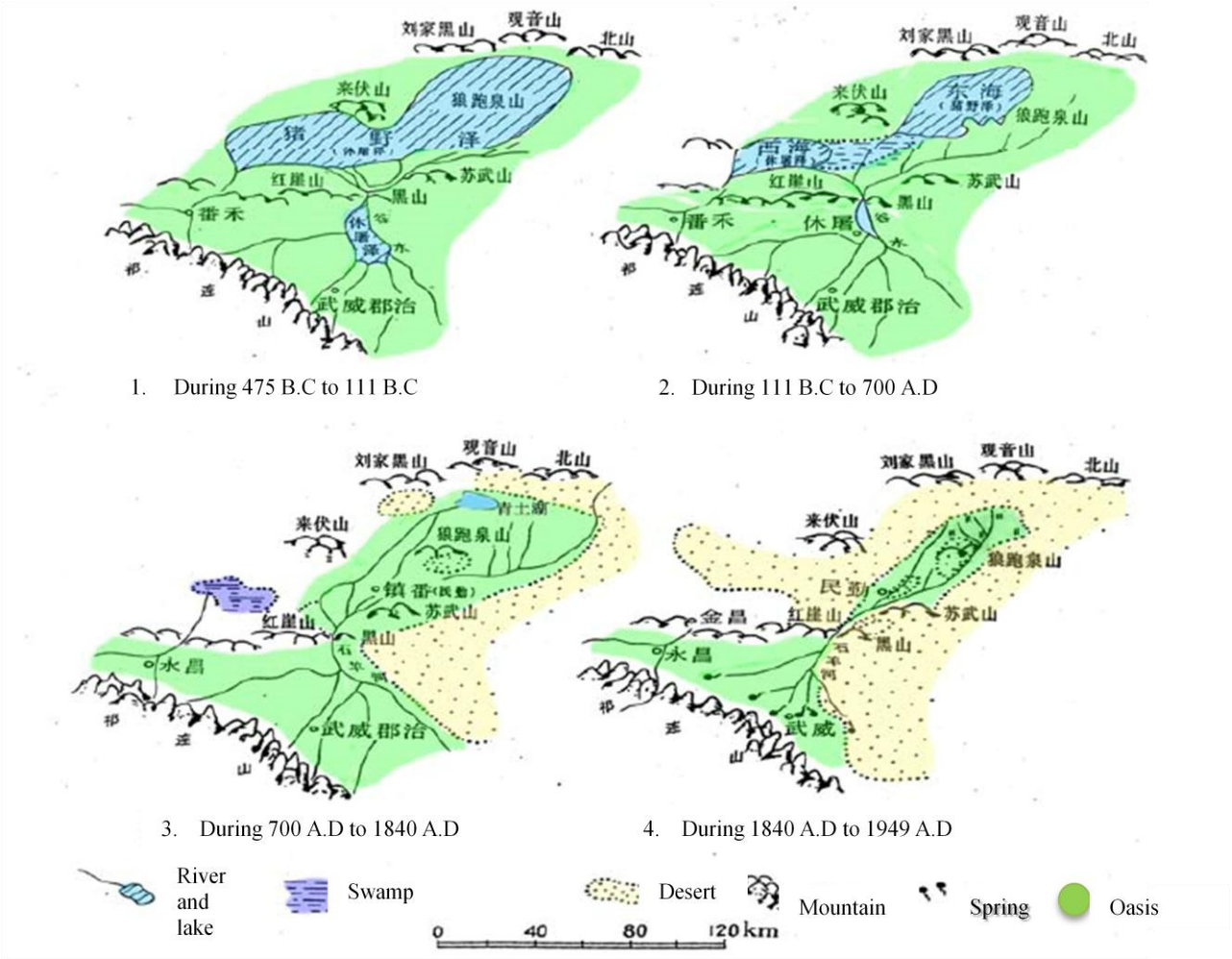
*Figure 1.10 a: local villagers harvesting tomatoes; b: women working on an onion field*

*Table 1.2 Water balance and water use of different sectors in lower Minqin oasis in 2005*

| Component | Quantity ($10^6$ $m^3$/year) | Percentage |
|---|---|---|
| **Water Supply** | 686 | 100 |
| Shiyang River | 37 | 5.4 |
| Yellow River transfer | 39 | 5.6 |
| Groundwater | 610 | 89 |
| **Water Use** | 685.51 | 100 |
| Farm irrigation | 578 | 84.32 |
| Forestry and grass land irrigation | 81 | 11.82 |
| Industry | 9.76 | 1.42 |
| Livestock | 8.76 | 1.28 |
| Rural domestic | 5.07 | 0.74 |
| Urban domestic | 2.92 | 0.42 |

Source: Ministry of Water resources G3 project report, 2007, personal contact.

### *1.2.3. Historical and political*



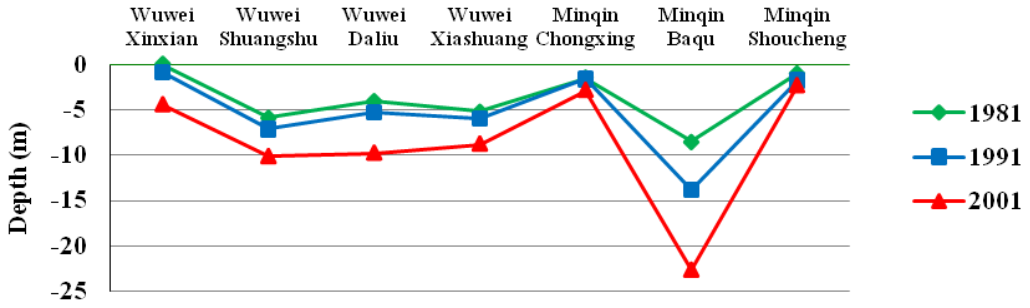




*Figure 1.12 Differences of groundwater level dropping from upper (left) to lower (right) reaches (Source: personal contact)*

Historical and empirical examination is needed in explaining the water resources development(Molle, 2006, Mosse, 2006). Man's interaction with water resources development in the SRB can be traced back to over 4000 years ago. According to Feng

(1963) before the Han Dynasty, there are 4000 $km^2$ of natural water bodies (See Figure1.11a and 11b) and the last water body "Qingtu Lake" dried up in late 1950s (Ma et al., 2007). Large-scale water conservation and water resources development took place in the basin after 1949 following the political changes and growth in the new PRC.

From 1950s to 1980s the government policies had focused on "taking grain production as the key link and target" (Oi, 1991), "Build a granary" (Ma, 2004). The focus of development was land reclamation for grain production in order to meet the increasing needs of human consumption and industry, especially during the "Great Leap Forward" (Thaxton, 2008) and "Learning from Dazhai" (1971-1976) period. Reclamation, water development projects were carried out on unprecedented scales. The direct outcomes were increasing grain plantation, construction of water projects and over-exploitation of both groundwater and surface water resource and deterioration of the local ecosystem. Starting in the 1990s, driven by the need of a market economy and economic reform, SRB was officially targeted as a major grain commodity base. Economically, the government policies and migrants speeded up land exploration and agricultural development and a commodity grain base for Gansu and the state was primarily formed. For example, the SRB supplied 32% of the food, 70% of commodity grain and 99% of the cotton for Gansu Province. Together with increasing crop prices, plantation of both grain and cash crops had been increased dramatically, which led to overexploitation of local natural resources particularly groundwater resources and deprivation of ecological water needs (Li, 1983; Chen, 1984; Chen and Qu, 1992).

In 1959 there were only four reservoirs, and between 1960 and 1972, 18 more reservoirs were built in the SRB. In 1972, there were only about 200km of main and branch canals, but by 1985 the total length had increased to 2849 km and by 1995 up to 6716 km (See Table 1.3). The flow into the Hongyashan reservoir in the lower reaches has decreased by 74%. As a result, groundwater exploitation had been given priority (Ma, 2004) and by 2000, the number of wells had reached 16,500 (See Table 1.3) with a maximum well depth of 320 m with groundwater abstraction of $1.43*10^9 m^3$ per year, far exceeding the estimation of $0.68*10^9 m^3$ per year groundwater recharge (Ma, 2004). The large proportion of the groundwater being used at present is in effect paleowater that is being mined (Edmunds et al., 2006). At present the water level has dropped

widely by between 3 and 5m with a maximum of 35m in some downstream area. About 43.6% of the available grassland in the basin such as in Minqin Oasis (See Figure 1.13) has either disappeared or been degraded. On the other hand, as a result of irrigation with saline, alkaline water, the phenomenon of soil salinization has increased significantly in recent decades; land desertification has accelerated.

*Table 1.3 Water resources development and population change in SRB since 1949*

| Year | 1949 | 1959 | 1972 | 1979 | 1985 | 1995 | 2000 |
|---|---|---|---|---|---|---|---|
| Population($10^6$people) | 0.90 | 1.08 | 1.31 | 1.43 | 1.55 | 2.20 | 2.30 |
| Irrigation area ($10^3$ ha) | 134 | 154.7 | 206.7 | 245.3 | 272 | 302.7 | 304.5 |
| Reservoirs | 0 | 4 | 22 | 22 | 22 | 23 | 24 |
| Reservoir storage ($10^6$ $m^3$) | 0 | 54 | 234 | 271 | 309 | 450 | 478 |
| Canal length (km) | 30 | 82 | 200 | 2046 | 2849 | 6716 | 8725 |
| Channelled surface runoff ($10^9$ $m^3$) | | 0.1 | 0.2 | 1.14 | 1.15 | 1.406 | 1.93 |
| Canal utilization coefficient (%) | 20 | 35 | 45 | 50 | 58 | 65 | 70 |
| Wells number ($10^3$) | 0 | 0 | 0.582 | 11.7 | 121 | 142 | 165 |
| Groundwater pumped ($10^9$ $m^3$) | 0 | 0 | 0.476 | 0.895 | 1.03 | 1.16 | 1.43 |

(Ma et al., 2005a).

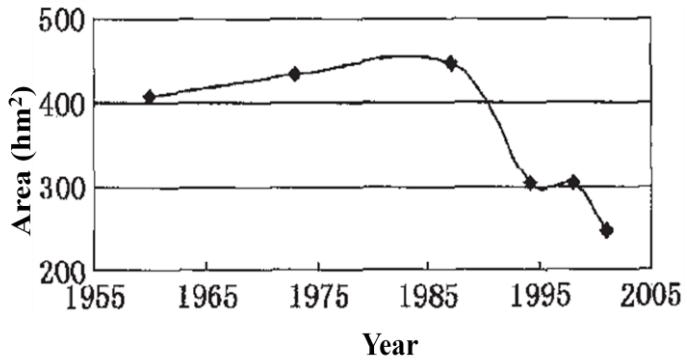



*Figure 1.13 The shrinking of the Minqin Oasis in the downstream since the 1960s, modified from (Ma et al., 2006)*

Entering the 1990s, following the opening up policy (Démurger et al., 2002), the establishment of socialist market economy and market-led pricing of agriculture crops, especially cash crops, a new land reclamation drive was initiated. The newly cultivated lands were used for production of economic-efficient crops including cotton, beets, black melon seeds and fennel (Ma et al, 2006). The desert land especially in the lower

reaches was transformed into high-yield cotton fields as long as there was water (Ma and Wei, 2003). Farmers increased their agriculture land and production based on the economy and the market-led pricing of agriculture crops while the issues of water were not even considered or a factor for their agriculture production, by farmers as well as officials. This created a short-term wealth and support local people's food security (Chao and Chuanglin, 2006), but since this mode was based on exploiting limited water availability, it came at a great environmental cost (Chao and Chuanglin, 2006, Yu et al., 2013).

The idea of pursuing irrigated agriculture in a region with an average annual rainfall of about 200 mm or even less than 50 mm in some area seems difficult to comprehend, however this has a lot to do with the demographic changes and historical and government policies (Yu et al, 2014). For example there were three major government-led immigration waves to the basin in modern times: the first was in the 1950s during the "Great leap forward" (Li and Yang, 2005) when the government moved around 70 thousand people involuntarily from cities such as Shanghai and Henan to the area for labour on state-owned farms and reformation; the second immigration started in the 1980s, in the form of voluntary immigrants, when the government moved over 130 thousand people from poverty-stricken areas to the basin to reclaim wastelands and make better use of local land and water resources; the third wave was following the government's "go-west" slogan in the 1990s (Ma, 2004), which encouraged people to move from the over-crowed east to the sparsely-populated west. All this increased local water pressure and caused increasing overexploitation of water resources.

The SRB is a typical arid inland river basin. Irrigated agriculture has been the basis of the local economy (Ma and Wei, 2003). Over the decades, subsistence and cash crop production has rapidly expanded. It is characteristic of development mode in arid and semi-arid regions. While the local water bureaus focused on surface water management such as building more reservoirs and lining canals, groundwater was largely unregulated. Farmers gathered their capital to drill more and deeper boreholes, expecting to continue to benefit from irrigated agriculture despite falling water tables and deteriorating water quality. Water is still wasted by traditional flood irrigation and lack of effective measures to reduce unnecessary waste. Economic development is

occurring at the cost of destruction of the ecology and environment especially in the arid downstream (Chao and Chuanglin, 2006, Yu et al., 2013).

It is obvious that the agriculture and water development in the SRB is overwhelmingly policy-driven, uncoordinated and over-exploitative. This has formed the vicious circle of over-development, over-exploitation, and land and environment degradation. The expansion of irrigated agriculture and water development particularly during the past few decades has enabled an acceleration of food production and economic growth at local and regional levels. Local population have secured land and water for private use and installed boreholes and used non-renewable groundwater to irrigate the expanded areas. Climate change and variability taking place over the past few decades together with ecosystems increasingly dominated by human activities have added the threat to the local environment. People in such environment face perennial challenges including land degradation, salinization, groundwater overexploitation and desertification.

### *1.2.4. IWRM (Integrated water resources management) and the Shiyang River Basin Key Control Plan*

*Figure 1.14 Government slogan saying "water conservation is a revolution"*

*Figure 1.15 Government slogan saying: "Water - integrated planning, integrated use"*

To alleviate the increasing water crisis in the SRB, China's central and provincial government launched the SRB IWRM plan, also known as the Key Control Plan in 2007. The main objective is through integrated water management to guarantee domestic and ecological water uses, satisfy industrial water uses, reduce agriculture water uses, improve water use efficiency and benefits, and also improve farmers' income and regional socio-economic sustainability and most importantly realize the goal of "never allow Minqin oasis become the second Lop Nur Lake" (A former salt lake which once covered 10,000 $km^2$, has dried up and covered with salt ranging from 30cm to 1m in thickness) as what the previous premier Jiabao Wen ordered (Ma, 2004).

In the upper catchment, the measures are to continuously protect and improve water conservation capability, increase forest coverage, reduce soil erosion and water loss, with emigration of ecological refugees in some of the key conservation areas in the upstream. In the middle and lower reaches, the focus is to increase water saving, water use efficiency, reduce irrigated land area and overall water usage especially groundwater uses, adjust agriculture patterns, construct canal for special purpose of water transportation to downstream area (See table 1.4), and construct a water-saving society. The irrigated areas will be reduced from 4.46 million mu to 3.64 million mu in

2010 and 3.10 million mu in 2020. The water use ratio in the river basin between domestic, ecological, industrial and agricultural will be changed from 3.7:4.5:5.4:86.4 in 2003 to 4.6:6.1:12.0:77.3 in 2010 and 6.6:6.9:16.4:70.1 in 2020. The ratio of plantation between grain and cash crops will be changed from 76:24 in 2003 to 65:35 in 2010 and 50:50 in 2020 (GPWRB, 2007).

According to official document from Gansu Provincial Bureau, the project includes three phases: the first phase is from 2007 to 2010, to increase the runoff to downstream Minqin area (through monitoring water flow to the Caiqi section) from 0.098 BCM to 0.25 BCM (See Table 1.4); to reduce the groundwater overdraft in Minqin Country from 0.52 to 0.089 BCM; to reduce the surface water use in upper-middle reaches from 0.972 to 0.882BCM, and to reduce the groundwater use from 0.75 to 0.42 BM; to regain the groundwater balance of replenishment and exploitation, stop groundwater tables from falling and effectively curb the degradation of ecosystems. The second phase, from 2011 to 2020, runoff to Caiqi monitoring section to downstream is increased from 0.25 to 0.29 BCM, groundwater use in Minqin oasis is reduced from 0.098 to 0.086 BCM, surface water use in upper-middle reaches is reduced from 0.88 to 0.82 BCM with a groundwater use of 0.418 BCM, increasing the groundwater table in Minqin area, restore the wetlands in arid north lake area as discussed earlier, and ecosystem is effectively recovered and IWRM is implemented throughout the basin.

*Table 1.4 Changes of total annual runoff in the Shiyang River Basin*

| **Name** | **1950s** | **1960s** | **1970s** | **1980s** | **1990s** | **2000** | **2010** |
|---|---|---|---|---|---|---|---|
| **Whole basin** | **17.84** | **14.04** | **13.59** | **14.68** | **12.9** | **13.12** | **14.54** |
| **Minqin County** | **5.42** | **4.03** | **3.24** | **2.29** | **1.52** | **1.14** | **2.5** |
| **Percentage** | **30%** | **29%** | **24%** | **16%** | **12%** | **9%** | **17%** |
| **Data source:author's collection** | | | | | | | **Unit $10^8m^3$** |

### *1.2.4.1. Irrigation water allocation*

According to the physical and economic situations in different areas of the basin, irrigated land area per capita ranges from 2 mu to 2.5 mu, with irrigation quota and total amount being reduced accordingly. Considering the differences in natural climatic situations, soil texture, and cropping patterns, the irrigation quota is also diversified: upstream mountainous area 240 cubic meters per mu, Wuwei district 350 cubic meters

per mu, and Minqin area 370 cubic meters per mu (See table 1.5 for net irrigation quota per mu). The irrigation quota in lower reaches Minqin basin is higher than Wuwei district and upstream because of its arid environment and soil types. The high irrigation quota for Wuwei district is largely because of its double cropping while in the relatively humid upstream area, only inadequate irrigation is applied (GPWRB, Gansu Provincial Water Bureau, 2007).

*Table 1.5 Synthesized irrigation quota[1] in the Shiyang river basin (Net)*

| Zones/Year | 2003 | 2010 | 2020 |
|---|---|---|---|
| **Qilian mountainous area** | **328** | **325** | **280** |
| **Wuwei basin** | **390** | **305** | **294** |
| **Minqin basin** | **385** | **333** | **325** |
| **Overall** | **377** | **307** | **290** |

Unit: $m^3$/mu, 1mu=0.067ha; Source: author's field study.

The Shiyang River Basin Water Bureau is in charge of the integrated management and allocation of water in SRB. The annual water allocation plan has allocated overall water amounts to different irrigation districts, cities and counties based on the irrigation quota and number of landholders. Each level makes their own water plan based on allocated water from upper-level government. For groundwater use, water quota is allocated to each borehole with metering devices. The water use target is controlled and each administrative leader is held responsible, meaning that if any of the set water targets are not met, the administrative leader will be removed from his place.

#### *1.2.4.2. Construction of water projects*

Engineering based water projects continue to be given priority in China's water management (Nickum, 2010). According to the key control plan (GPWRB, 2007), 1658 km of major and secondary canals will be constructed. Irrigation facilities for 2.76 million mu of land area will be improved, including 1.86 million of canal irrigation and 0.27 million mu of pipe irrigation, 0.28 million mu of greenhouse construction and 0.35 million mu of drip irrigation. The net irrigation quota will be decreased from 377 $m^3$/mu in 2003 to 307 $m^3$/mu in 2010 and 290 $m^3$/mu in 2020. Irrigation water use

[1] The synthesized irrigation quota is the irrigation amount per mu for every farmer no matter what crops they grow. It is officially designed by water managers based on local weather, soil and water situation and farmers' agriculture patterns.

efficiency will be increased from 0.52 to 0.57 in 2010 and 0.64 to 2020. The official target is to realize drip irrigation and greenhouse agriculture to 11.37% and 8.9% of the total irrigated area in the SRB. In the middle and lower reaches of Liangzhou district and Minqin County, the target is to construct one greenhouse per household based on the demographic data in 2003. The detailed implementation plans are at the jurisdiction of local governments (Goldin et al., 2008) under the principle of congregation in terms of production teams and villages and respect the choices of farmers' will, regarding fund raising, location, quantity and crop selections. The overall guiding objective is to change farmers' traditional water behaviour such as flood irrigation to water conservation and water saving agriculture type and increase their agriculture income.

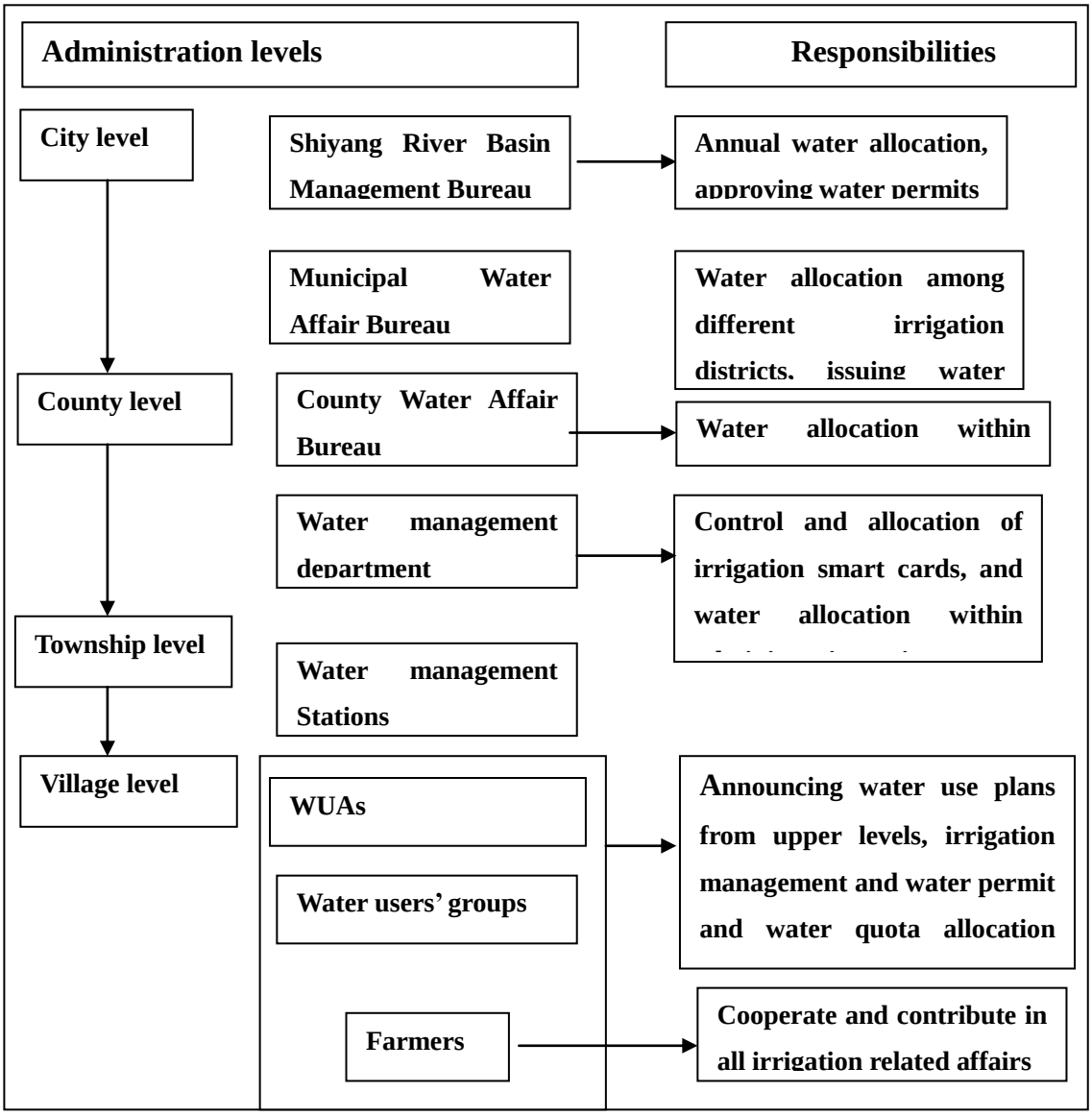



*Figure 1.16b Institutions that controls water in SRB*

## 1.3. Conceptual framework – a thematic literature review

### *1.3.1. Water crisis and water governance*

#### *1.3.1.1. Defining water crisis*

> *"In many cases, water stress is more about politics, economics, behaviour and governance than absolute water scarcity. Better planning is needed, to allocate water where societal need is greatest, and to allow trade-offs between alternative uses."(Ian Goldin, Oxford University Professor of Globalization and development)*

Water crisis can be used and understood in different ways by different actors: for government officials, it may mean a threat to rapid socio-economic growth based on water supply; for environmental organizations, it may mean endangered sustainability of water bodies and environment; and for poor rural residents, it may mean a lack of timely provision of sufficient water for domestic and agriculture uses. Although these diverse objectives may not necessarily be mutually incompatible, to achieve all these concerns adequately and simultaneously is not an easy task, especially for a developing nation which lacks the capital and organizing capability (Mitchell, 1990, Nesheim et al., 2010). There are challenges for local and national government as well as related stakeholders to mediate among different groups and achieve a sustainable and socially acceptable solution (Adger et al., 2003, Sternberg et al., 2009). The inherent danger is that marginalized groups in specific context may be co-opted to work on a project that means something very different from what is expected. It is therefore of great significance to understand what these different stakeholders mean by referring to "water crisis" or successful water governance, if these broad terms of water problems are to be dealt with appropriately and effectively.

In this study, "water crisis" is used loosely to incorporate the physical, economic and socio-political conditions, which reduce rural residents' ability to live a productive life. Therefore, the term "water crisis" is not precisely defined as this would prejudge what different groups understand when they referring to this. It is a term used by stakeholders of SRB to refer to a broad range of water problems, yet one that is frequently oversimplified and taken for granted. In order to understand the ways in which water problems are approached in discourse to achieve certain socio-ecological results, it is

prerequisite to understand what water crisis mean to different social groups across a large spatial scale and across different levels. By investigating these diversified meanings through long-term empirical research, the ways in which both dominant and dominated groups make sense of water crisis and their particular water decisions can be justified.

In this study, instead of accepting that all actors have reached a consensus and are working towards the same objective under current water discourses, the exploration of the variety of understanding of the "water crisis" that endures not only reveal the power-laden nature of water discourse and related reforms and their potential for facilitating government control (Molle et al., 2009), but also to identify complex motivations and objectives as well as its far-reaching impacts in the uses and governance of water across the basin. There exists a class of problems which were "reasonably" dubbed "water crisis". Yet despite the diversified definition, understanding of the term "water crisis", as most other environmental problems, are intricately embedded within social, economic, political and cultural processes (Van Liere and Dunlap, 1980, Williams, 1998, Mosse, 2006, Yu et al., 2014). The dominant concept used for these processes is "power" as the key term required to understand the actions, reactions and interactions among different social groups (Wittfogel, 1981, Mollinga et al., 2008). These terms are used together in the dominant concept of "water governance", a more rigorous theoretical framework for understanding the relationships between water and society and in which different stakeholders are considered as potential partners in the development and governance of water.

#### *1.3.1.2. Water governance*

Water governance is a term that has been increasingly used over the past decade (Tang, 1992, Ostrom, 1994, Rhodes, 1996, Agrawal, 2001, Rogers and Hall, 2003, Ostrom, 2010a). It is defined as the involvement of the multiplicity of actors and organizations in the production of policy outcomes and also as the act of coordination, whether through networks or hierarchy (Rogers and Hall, 2003). In the context of the present study, it becomes imperative to explore what governance mechanisms exist, why and how can improvements in water governance performances be made especially at local level. As has been widely acknowledged, the traditional centralized, bureaucratic,

supply-driven approach which is heavily reliant technocratic solutions have has failed to address the worsening and different water crisis that the world is facing today (Ostrom, 1990, Pahl-Wostl et al., 2008, Lam, 1999). Water problems are neither consistent over time nor homogenous from one country to another, even within a single country (Biswas and Tortajada, 2010).

One of the most fundamental changes in water management over the past decades has been a changing water paradigm (Rogers et al., 2010), from concentration on the "hard path" of massive construction of centralized infrastructures in the forms of dams, reservoirs, pipelines and aqueducts, to a "soft path" with integrated approach (Gleick, 2003, Brooks, 2005). Governance in this new paradigm requires constant changes in roles and responsibilities of key stakeholders; inclusion of traditionally marginalized actors; an intertwining of "bottom" with "top" actors and employment of new and innovative structures to achieve IWRM. However there is little understanding of how different water governance systems impact lives of diverse groups; and how local perceptions, attitudes and interactions reshape water institutions and governance outcomes. This thesis aims to fill in this gap and enrich extant understanding.

### *1.3.2. Political ecology and social-ecological systems (SES)*

> *"All ecological projects (and arguments) are simultaneously political-economic projects (and arguments) and vice versa. Ecological arguments are never socially neutral any more than socio-political arguments are ecologically neutral. Looking more closely at the way ecology and politics interrelate then becomes imperative if we are to get a better handle on how to approach environmental/ecological questions." - (Harvey, 1993 : 25).*

This thesis takes the theoretical approach that the physical environmental issue is embedded in its political-economic context (Aguilera-Klink et al., 2000). Social-ecological systems (SES) (Olsson et al., 2004), also known as "socio-ecological system" (Gallopin, 1991) or "human-environment system" (Turner et al., 2003) are multilevel systems, nested in different contexts, that provide essential services to society such as supply of food, energy, and water (Berkes et al., 2000b). It can be viewed as a complex and adaptive system in which its components, the social system (S) and ecological system (E) make interactions and adaptations over time to internal and external disturbances, for example the changing dynamics among resource users,

institutions and resources. Ecological system here refers to the natural resources and environment while social systems deal with issues about property rights, management mechanisms and institutions, indigenous knowledge and perceptions concerning water resources and environment. Indigenous knowledge and perceptions are used to mean local understanding, knowledge and beliefs held by indigenous people in a given context. Institutions are humanly devise rules, formal or informal those are used to determine who is eligible to make decisions in organizing repetitive activities that will produce outcomes directly affecting involved individuals and others (Ostrom, 1990).
Following the classification used by Scholz et al (2003) and Scholz and Binder (2011), this thesis identifies three forms of interaction: (1) the ecological system influences the social system; (2) human activities affect the ecological system or ecosystem services; (3) the reciprocity between the social system and the ecological system is considered, including feedback loops and learning processes in the social system in response to changes in the ecological system, see Figure 1.17.

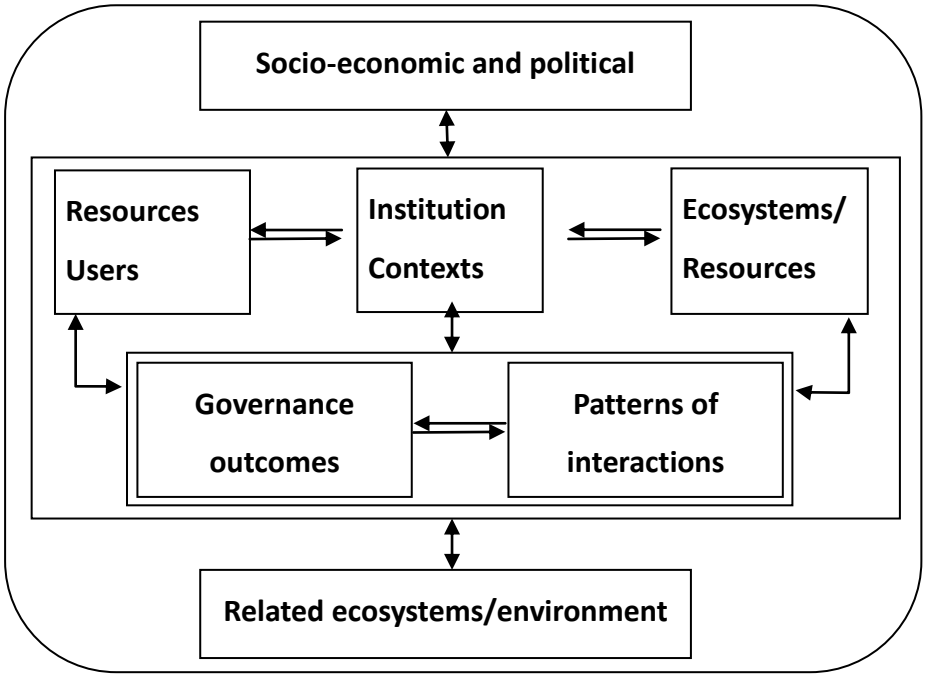



*Figure 1.17 The analyzing framework for the links between social and ecological systems*

The SES theory places humans within nature and focuses on the ways in which interconnections between human and the biophysical contexts produce complex adaptive systems and governance outcomes. There will be social mechanisms behind

management practices based on local context, knowledge and perceptions and social relations/patterns between social and ecological systems and between social systems at different levels. SESs are composed of multiple subsystems and internal variables within these subsystems at multiple levels, each in turn feeds back to affect other subsystems and their components, as well as other larger or smaller SES (Ostrom and Ahn, 2009). External influences may affect the components of the SES and the outcomes of governance (Ostrom, 1990). The external sources include changes of political leaders, institutional rules and policies as well as natural events such as climate change, human activities (Twyman et al., 2004). These systems are nonlinear, meaning that a given cause, often resulting from a complex chain of biophysical and human interactions, can produce a disproportionate effect (Folke, 2006). As such, the nonlinearity of complex system processes makes predicting the outcomes of reorganization difficult from both scientific and decision-making points of view.

Sustainable natural resources management has always been a difficult field. It emphasizes a process of learning by doing rather than the pursuit of a panacea that fits all (Pahl-wostl et al., 2007). Theories of adaptive management (Pahl-Wostl et al., 2008, Berkes et al., 2000a, Olsson et al., 2004, Williams, 2011), follow a principle which is to manage natural resources in a way that is flexible, experimental, and open to modification. This is particularly valid when considering the low resources base and high dependence on local resources of arid and semi-arid regions in northwest China where roles of nature and human society are so intertwined. Failure to recognize this or take this appropriately into addressing local environmental issues would render any solutions incomplete. Therefore, a theoretical linkage and understanding of these systems and their interactions is essential (Pringle and Conway, 2012). However application of political ecology and SES theories to study water governance in a large transitional nation such as China is still only in its infancy with most existing literature remains focusing on the physical aspects of water issues.

Still much work is needed to discuss the social and political relations of this topic and in a systematic fashion. Very little work has been undertaken in the field of study on local institutions and local people's perceptions, which are central to any adequate understanding of the human-environment linkages and interaction. The study of these will reduce conflicts among divergent interests and facilitate participatory, cooperative

and effective policy planning and implementation in water management or environmental management in general. In this study this is addressed first by examining the interplay between social and ecological systems that defines the water crisis and IWRM process and impacts in local environment. It also explores how local settings within which power relations and decision making take place. This study places the complexity and diversity of policy-human-nature relations at the centre of analysis. It seeks to unravel the complex linkages and interactions between human and nature through access, allocation and control over water resources and their implications for environmental sustainability and sustainable livelihoods in water-scarce regions.

### *1.3.3. Roles of environmental perceptions and behaviour*

From local level to global scale, human activity is a major factor in shaping ecosystem dynamics (Ma et al., 2005a, Wolf et al., 2009, Lora-Wainwright, 2010, Conway, 2011). Human perceptions about the environment and resources around, in terms of value, risks, causes and conflicts, influence people's environmental awareness, attitudes and behaviour and the possibility of effective governance, especially at local level (Steinberg and VanDeveer, 2012, Pringle and Conway, 2012). Perception is defined as how people recall things through acquiring, interpreting, selecting and organizing information (Larson and Edsall, 2010). People's environmental perceptions are variable and confounded by psychological and social factors and they are often differ from experts' assessments (Hansen et al., 2003, Rinaudo and Garin, 2005, Lee and Zhang, 2008, Van Liere and Dunlap, 1980). Research has focused extensively on how perceptions vary among people with different social characteristics including social-political and cultural context, personal characteristics and ways of knowing information (Ibsen, 1969, Williams, 1998, Taylor et al., 1988, McKay and Keremane, 2006, Slegers, 2008, Whitmarsh, 2008). However many of the theories and conclusions seem to be controversial (Williams, 1998), and caution is needed not to overextend these results or to attributes the different perceptions of people to a single element or across different temporal and spatial scales (Adger et al., 2005, Jonsson, 2005, Cash et al., 2006).

Research has also found that people's perceptions are based on soft, direct local experiences rather than scientific data (Spence et al., 2011, Whitmarsh, 2008, Williams,

1998, Taylor et al., 1988, Lora-Wainwright, 2013). These experience-based ideologies are entrenched, steadfast and hard to change (Gilbert et al. 1998). People make their decisions based on their perceptions of reality even when scientific evidence shows otherwise (Pretty, 2003, Lora-Wainwright, 2013). They would disregard scientific or official information if it contradicts with popular perceptions of reality (Brunk, 2006). In this thesis, emphasis is placed on understanding and interpreting the perceptions differences and their role in water governance processes and resulting impacts relative to contextual differences while highlighting its practical implications.

Perceptions of water crisis occur when ecosystem systems cannot produce enough supplies, when human actions influence supply and demand, when changes in power and economy affect allocation and access and when human values and interests conflict with the needs of ecosystem. These perceptions vary significantly among different area, climate situations and other factors. For example it has been shown that around the world, rural and urban residents have different perceptions about water (Berenguer et al., 2005). Perceptions and local water policies and decisions are both input and output in the process of water governance. Thus it is essential to understand water perceptions among different socio-economic and political groups. However, it has been found that little of water perceptions studies especially from local water stakeholders are available in both developed and developing regions (Hale dissertation 2013). To the best of the author's knowledge, this study is the first of its kind conducted to examine water perceptions of local residents and their impacts on local water decision making and policy outcomes.

Human activities are considered the main causes of the water problems today in the SRB rather than climatic factors (Wang et al., 2002, Kang et al., 2004, Shen et al., 2005, Ma et al., 2007). However water management and research in China traditionally has been and still is largely technocratic focusing on modelling and technology-aimed solutions (Kang et al., 1996, Ma et al., 2005a, Ma et al., 2007, Ma et al., 2012), while few resources investigating social aspects of water management issues in China are available. The interactions between natural and human-social environment, and the roles/influences that policies have on these relationships were barely touched.

Water crisis a complex interplay between physical situations and human social

relations and the ways in which it is experienced by whom. The perceptions of water crisis can be and actually have been manufactured and even exploited to meet needs and interests of various groups (Graymore et al., 2010, Mehta, 2001, Mehta, 2003). For example, water scarcity can be manufactured in policy circles and in the media. It can be at times purposefully framed to support agendas of different stakeholders including water companies, corrupt officials and water users among others. The lack of social-political analysis and soft path of water governance is partly if not all due to the fact that most of the water leaders and decision-makers in China are still engineering-based and they don't understand or don't think they need to understand the necessity of understanding perceptions and practical needs of different stakeholders.

Research on environmental perceptions has often concentrated on developed nations and a few developing nations such as India (Mosse and Sivan, 2003, Mehta, 2007) and Nepal (De Fraiture et al., 2014, Vlotman and Ballard, 2014, Emami, 2014). Rural China and its population have been rather neglected (Lee and Zhang, 2008). There has been very little work which explicitly address issues of water crisis or governance in conjunction with social processes or from cultural aspects, or which links concerns of ecology and equity. This research provides a unique and timely viewpoint on water governance problems from the perspectives of local population who are most directly and profoundly affected.

### *1.3.4. Commons theory, collective action and social capital*

One of the central debates about water resources management is its embedded nature as "common pool resources (CPR)" (Ostrom, 1990, Wade, 1987). CPR are defined as natural or man-made resources with subtractive benefits (Ostrom, 1990), which means if some use more, less remains for others, for example water in the canals, groundwater, forest and grazing lands. Another characteristic of CPR is the difficulty and high cost of exclusion (Ostrom, 1990). From seminal work of scholars such as Olson (1965) and Hardin (1968), management of CPR such as water faces "tragedy of the commons", "Prisoners' dilemma" and problem of collective action in the form of free-riding and shirking. In other words, without top-down control, coercion or other devices by the government to make individuals act, common interests will not be achieved among self-interested members (Olson and Olson, 1965). Hardin (1968) also stresses that

individuals are locked into a system that compels them to pursue their own best interest in a society in which CPR are limited and ruin of the commons is the destination.

However, failures in management of CPR today are rarely due to such tragedies of the commons (Wade, 1987, Ostrom, 1990, Rogers et al., 2010). A large and growing body of literature has shown that collective self-governance of local communities can and have contributed significantly to the successful management of CPR in ways that cannot be achieve by individuals or by the market or government alone (Pretty, 2003, Ostrom, 1990, Lam, 1999, Tang, 1992, Wade, 1987). Much of the study of CPR has focused primarily on how variations in institutional arrangements have influenced the management outcomes (Steinberg and VanDeveer, 2012). Researchers have explored the need for fit between institutions and the socio-ecological contexts (Ostrom, 1990, Dietz et al., 2003), the relationship between local resources and resource-dependent groups (Groenfeldt, 2010), the ways to mobilize local population to cooperate and contribute (Agrawal and Gupta, 2005, Thomas et al., 2007), the importance of local enforcement of policies (Agrawal, 2012, Yu et al., 2013, Uphoff, 1986), the notification of possible local resistance (Guha, 2000, Mertha, 2008), and the necessity of public participation (Narayan, 1995, Pretty, 2003, Yu et al., 2014).

Communities rather than external professionals or authorities have crucial information about other members' needs, capacities and behaviour (Thomas and Twyman, 2005). Rules should be locally devised and enforced (Steinberg and VanDeveer, 2012). This is particularly the case when local relations support trust, mutual reciprocity and face-to-face communication. Ostrom (1990) argues that local cooperation and institutions at small scales can generate and maintain durable local solutions to CPR problems. She further proposes eight design principles for robust CPR institutions (See Table 1.6). Through comparative analysis of irrigation management in selected villages, local irrigation institutions will be examined employing Ostrom's (1990) design principles to see how local water resources are managed by collective actions and locally devised systems under external interventions and whether these localized systems are successful and why.

*Table 1.6 Design Principles of long-enduring CPR institutions (Ostrom, 1990)*

- **Clearly defined boundaries**
  Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must be the boundaries of the CPR itself.
- **Congruence between appropriate and provision rules and local conditions**
  Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labor, material and/or money.
- **Collective-choice arrangements**
  Most individuals affected by the operational rules can participate in modifying the operational rules.
- **Monitoring**
  Monitoring, who actively audit CPR conditions and appropriator behaviour, are accountable to the appropriators or are the appropriators.
- **Graduated sanctions**
  Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both.
- **Conflict resolution mechanisms**
  Appropriators and the officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.
- **Minimal recognition of rights to organize**
  The rights of appropriators to devise their own institutions are not challenged by external government authorities.
- **Nested enterprises (for CPR that are part of larger systems)**
  Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Social capital and collective action are at the centre of discussions over managing CPR in SES (Rydin and Pennington, 2000, Pretty, 2003, Bodin and Crona, 2008, Yu et al., 2014). Putnam (1995) defines social capital as the feature of social organizations such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit- among heterogeneous groups by virtue of their experience of social interaction and communication. It describes the relations of trust, reciprocity and face-to-face communication and exchange; the roles of networks and the devise and evolution of institutions (Pretty, 2003), which has been interpreted using different models, research methods and empirical data. Its explanatory power in the area of collective action for natural resources management has been widely appreciated (Portes, 2000, Pretty and Buck, 2002, Putnam, 2001, Rydin and Pennington, 2000, Uphoff, 2000, Ostrom and Ahn, 2009, López-Gunn, 2012, Coleman, 1988). Although resource scarcity may induce conflicts and competition, resource-dependent people often

manage to overcome scarcity by resorting to reciprocal solutions through construction and uses of different forms of social capital. It not only explains the real-life experiences of coping with environmental risks within civil society but also explains how local society interacts with the institutions of market and government, particularly in highly resource-dependent societies.

However, the relationship between social capital and collective action or performance of CPR governance in general, is far from clear (Boix and Posner, 1996, Ostrom and Ahn, 2009). First, social capital is not directly measurable or static (Putnam, 2001). In addition to the positive impacts that social capital have on collective action, there are downsides (Adhikari and Goldey, 2010, Yu et al., 2014, Adger, 2010). Moreover, social capital across different levels, horizontally or vertically with external authorities is also crucial in terms of impacting people's environmental perceptions, access to resources, and incentives, which have barely been touched yet. Additionally, perceived inequality and uncertainty caused by a variety of different sources will influence the possibility of cooperative behaviour (Thomas and Twyman, 2005) and distribution and uses of water resources (Trawick, 2008). Therefore, it is critical to understand and bridge the informal and formal institutions and their roles in collective action and governance of CPR. Unlike government-led management, community-based management largely relies on information collected and dispersed locally which often is unavailable to outsiders. In addition, instead of depending on formal organizations to monitor and apply punishment, communities members usually manage to apply conformity at lower costs through social norms, localized incentives and traditional mechanisms including but not confined to mutual trust, reciprocity, reputation and respect among others.

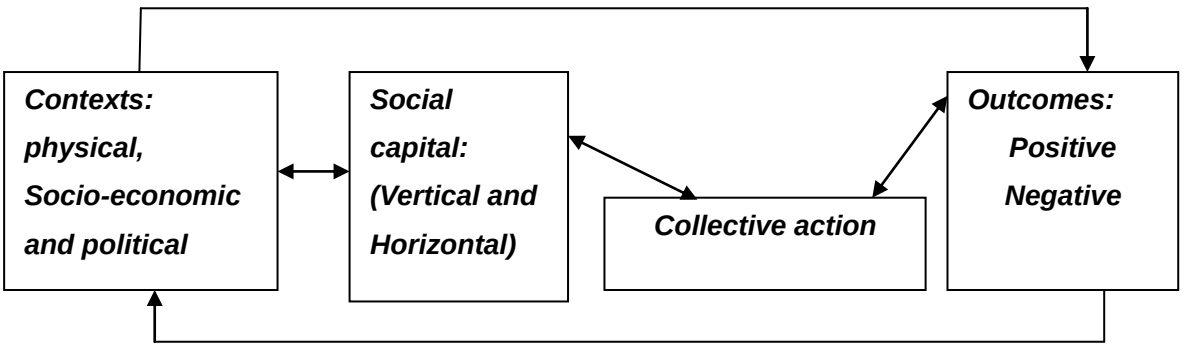



*Figure 1.17b Relations between contexts, social capital, collective action and resulting consequences in China*

In this thesis, it is argued that water governance especially community-based water governance is largely dependent on interpersonal contacts and customary rules especially in a feudal hierarchical society such as China. However community governance is not a substitute but an essential and effective component of successful irrigation institutions. Developing an institutional structure that government, market and local communities mutually enhance each other is challenging but essential. Connecting CPR theories and social capital theory to governance of the irrigation commons in the unique context of rural China, how the water crisis as a physical and socio-political phenomenon is produced and dealt with is examined. For example, how local socio-political system has developed management practices based on indigenous knowledge and perceptions; what the social mechanism behind different management mechanisms and their impacts on water reform processes and outcomes are. This research is an effort to approach this concept critically and examine how interests are defined by different water stakeholders in the rural Chinese context.

### *1.3.5. IWRM*

IWRM emphasizes the human dimension and the growing roles of public participation in water resources governance (Gleick, 2003, Jonch-Clausen, 2004, Van der Zaag, 2005, Giordano and Shah, 2014). It is "a process that promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without comprising the sustainability of vital ecosystems"(GWP, 2000). Its principal purpose is coordinated achievement of economic efficiency, social equity and ecological sustainability. Its central concern is participation and critical roles of local communities in designing and implementing water policies (Hofwegen and Jaspers, 1999). The four guiding principles, also known as the Dublin Principles (GWP, 2000) are: (1) fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment; (2) water has an economic value in all its competing uses and should be recognized as an economic good; (3) water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels; (4) women play a central role in the provision, management and safeguarding of water.

Study of IWRM outcomes remains much general and sometimes controversial (Dukhovny et al., 2004, Jonch-Clausen, 2004, Snellen and Schrevel, 2004). For example, Van der Zaag (2005) among others proposes that IWRM is not an option but essential and that all water management practices should embrace and be aligned with the concept despite any implementation obstacles (Mitchell, 1990, Al Radif, 1999, Jonch-Clausen, 2004, Nesheim et al., 2010). On the other hand, IWRM has been criticized for definition vagueness and difficulty in implementation (Biswas, 2004, Saravanan et al., 2009), provide a long list of limitations including the high costs of participation, dealing with changes in composition of network actors; continued power imbalances and inequity; inadequate capacity; unaddressed conflicts; consideration of the "community" as homogenous; weak, ineffective leadership; lack of visible results; impacts from external events; large gaps in information for decision making; limited perspectives; low levels of trust, fragmented authority; high transaction costs; and the rationalization of geographic with political boundaries, among others. For instance, Biswas (2004) among others argues that one single IWRM paradigm for all countries and regions considering the different physical, cultural, economic and socio-political conditions may not be possible at all. Furthermore, as Molle (2008) argues, there is a pretence that the multiple objectives of IWRM can be maximized simultaneously when in reality there will be trade-offs and actually only a balance can be achieved. Watson et al. (2007) are also critical of the concept in its vagueness and lack of clarity on what is required for implementation, for instance what should be integrated, how and by whom.. More recent efforts supported by external donors in IWRM create opportunities for collaboration, also place limitations on the extent to which practitioners can exploit a multi-stakeholder partnership's collaborative capacity. Actors at the various scales of central and local government, civil society, the private sector and the scientific community have different responsibilities and objectives, placing some organizations in conflict with others. Consequently, these well-intentioned programs can create governance problems such as fragmentation and duplication of responsibility and authority; poor use of or disregard for existing institutions; inconsistency in policies across and between government levels and ultimately gaps in performance and continued power struggles and even further marginalization of special groups.

However, despite the wide popularity and a body of literature studying IWRM, little has been reported regarding evaluation of IWRM processes and impacts using

empirical evidence or from local stakeholders' perspectives, for example what are locally perceived purposes, aims and impacts of IWRM reforms and more importantly what has happened in practice under the alleged IWRM scheme and policies. Lack of information has largely constricted systematic and detailed evaluation of IWRM implementation in practice. It is important for researchers and policy makers to understand how different processes influence performance, that is, outputs and outcomes, while recognizing and working with the complexities of institutional setting.

IWRM is understood and pursued very differently by diverse stakeholders. It is often considered as an end (Giordano and Shah, 2014) that has potential to fulfil organization and political objectives or the will of the reformists rather than a process of empowerment or social change, which even today still seems to be the last thing to which the authorities aspire (Chou, 2009). Therefore, to make sense of the detailed processes and consequences of IWRM or any other reforms in particular settings, people need to understand them as political initiatives, political processes and consequently a site for political and power struggle (Blaikie, 1985, Sultana and Minnesota, 2007, Mollinga et al., 2008, Nesheim et al., 2010).

### *1.3.6. China's water problems*

The water crisis in China has been increasingly constraining its socio-economic development, poverty alleviation, public health and welfare and sustainability (MWR, 2007, Jiang, 2009, Brown and Halweil, 1998, Xie et al., 2009, Cai, 2008). Although China's overall water resources ranks sixth globally, it is one of the most water scarce countries – with the world's largest and growing population, uneven temporal and spatial distribution of water and a per capita water availability of around 2000 cubic meters (less than a quarter of the world average) (Jiang, 2009). The water issue is particularly serious in its arid and semi-arid north which has most of its irrigated lands. For instance, more than half of the land is situated in the arid and semi-arid regions, 26.6% of which has an average annual precipitation of less than 200 mm (Deng et al., 2006). Changing climate, land uses, demographics and socioeconomic and political environment pose unprecedented challenges for governance of water resources, and resources-depend communities whose livelihoods are particularly susceptible to these threats (Xie et al., 2009, Ma et al., 2007).

Irrigation plays a central role in China's agriculture production, food and water security and livelihoods for a majority of its population (Calow et al., 2009). It remains the largest water consumer taking about 70% of its total fresh water use and 17% of the global water use (MWR, 2007). Ensuring food and water security has been one of China's most basic national strategies (Wang et al., 2007). Expansion of irrigation, has contributed to food self-sufficiency, poverty alleviation, and improvement of quality of life for the majority of its population (Nickum, 2010). However the rapid grain production and economic development come at a high price of natural resources base. With increasing water competition between agriculture and non-agriculture sectors, human and environment, present and future generations, irrigation water shortage has become a very serious problem, threatening food and water security inside and outside China (Brown and Halweil, 1998).

The Chinese government is now well aware of its worsening water situation and has committed to transforming its water sectors towards a water-saving society (Huang et al., 2010). Several mechanisms have been adopted including increasing supplies through engineering-based solutions (Barnett et al., 2006, Berkoff, 2003), water pricing mechanisms (Huang et al., 2006, Wang et al., 2009, Webber et al., 2008) and water saving technologies (Deng et al., 2006, Kang et al., 1996), all of which seem to have only achieved less than expected. Until recently, under the influence of international donors such as World Bank and Asian Development Bank, water officials have begun to promote management reforms as a key to address China's water problems (Wang et al., 2005, Nickum, 2010), for example through increasing public participation, decentralization and integrated water management (Huang et al., 2010, Xie et al., 2009, World Bank, 2003).

#### *1.3.6.1. Water development and management in China*

The "human subjugates nature" philosophy dictated much of natural resources management history in China and is prevalent even today, with the aim of controlling and conquering nature and resources for human uses and socio-political development (Choi et al., 2014). The Three Gorges Dam and the South-North Water Transfer project are two modern examples among others (Berkoff, 2003). Organization of local populations in construction of dykes, irrigation channels and reservoirs, also known as

"reliant on the masses" (Nickum, 1981) has always been a central part of government responsibilities. Following the early support from the Soviet Union, water resources projects were carried out in a capital-intensive, centralized tradition of state development and control of large scale infrastructures. Most of the irrigation schemes were developed from 1950s to 1970s. With the collapse of the commune systems and introduction of the Household Responsibility System under Deng Xiaoping, public investment in irrigation water schemes had decreased (Calow et al., 2009). The ownership and maintenance responsibilities among water managers and water users had been ambiguous and deterioration of infrastructures has been prevalent (Nickum, 2010).

Deterioration of irrigation systems had to a large extent driven groundwater development, which was almost non-existent until late 1960s in Northern China but which gained instant popularity for its characteristics such as low investment, easy controllability and high reliability (Lohmar et al., 2003, Wang et al., 2007). The benefits of groundwater development in quick poverty reduction and rapid agriculture intensification had attracted the government's interest as well, in investing in village-based, collectively owned and managed boreholes (Wei et al., 2006). Farmers were encouraged and even subsidized in borehole drilling to shift from traditional grain-based production to commercial crop production and groundwater irrigation. At the time, the focus of both government and local population is on food security and economic gains without environmental concerns (Ma et al., 2005a).

Water resources management in China has always been a political issue. As a traditionally hydraulic society with centralized bureaucracy and authoritarian rules (Wittfogel, 1981), wherever water flows, it is not just a flow of physical material but also a flow of power. Water control which forms part of basis of the Chinese Communist Party's (CCP) governing legitimacy has mainly been responsibility of government. The government owns and controls water resources in a planned, centralized top-down manner, with the political entities making decisions on behalf of people. It is administered by a nested hierarchical administrative system, a combination of river basin administration and administrative organizations. MWR, under the State Council, has the primary responsibility for water resources management, including ultimate responsibility for the preparation of water plans and the management of

abstraction permits that balance demand and supply (Calow et al., 2009, Nickum, 2010). River basin institutions and commissions are then authorized by MWR to manage water resources (surface and groundwater) in their respective basins.

According to the 2002 new Water Law, river basin organizations are in charge of water management and supervision under their jurisdiction and issues that go beyond will be administered by the water authority at next higher level (Liu and Speed, 2009). The river basin commission is the overall resource regulator/planner. It is responsible for water administration including river basin planning, flood control, water allocation, water resources protection, soil conservation, issuing water permits and construction of water projects funded by central government, on behalf of the MWR (Calow et al., 2009). The provincial water bureau plays a dual role: water regulator/planner and water operator/planner. Their duties include planning, survey, design, construction, operation and management of irrigation, drainage, flood control works and rural hydropower. The water resources bureau at the prefecture and county level is directly responsible for constructing and maintaining irrigation infrastructure, associated irrigation and flood control facilities and medium-sized reservoirs. The irrigation stations at township level share responsibility for constructing and maintaining branch and lateral canals, ancillary works and small reservoirs, and collecting water fees. The staff in the prefecture and county bureaus and township irrigation stations, are organized into irrigation district management authorities; field canals are generally managed by village members. Different irrigation areas differentiate financial management rules. Mostly the salaries of these staff come from the water fees collected, with sometimes some State subsidizes for the irrigation districts on facility maintenance.

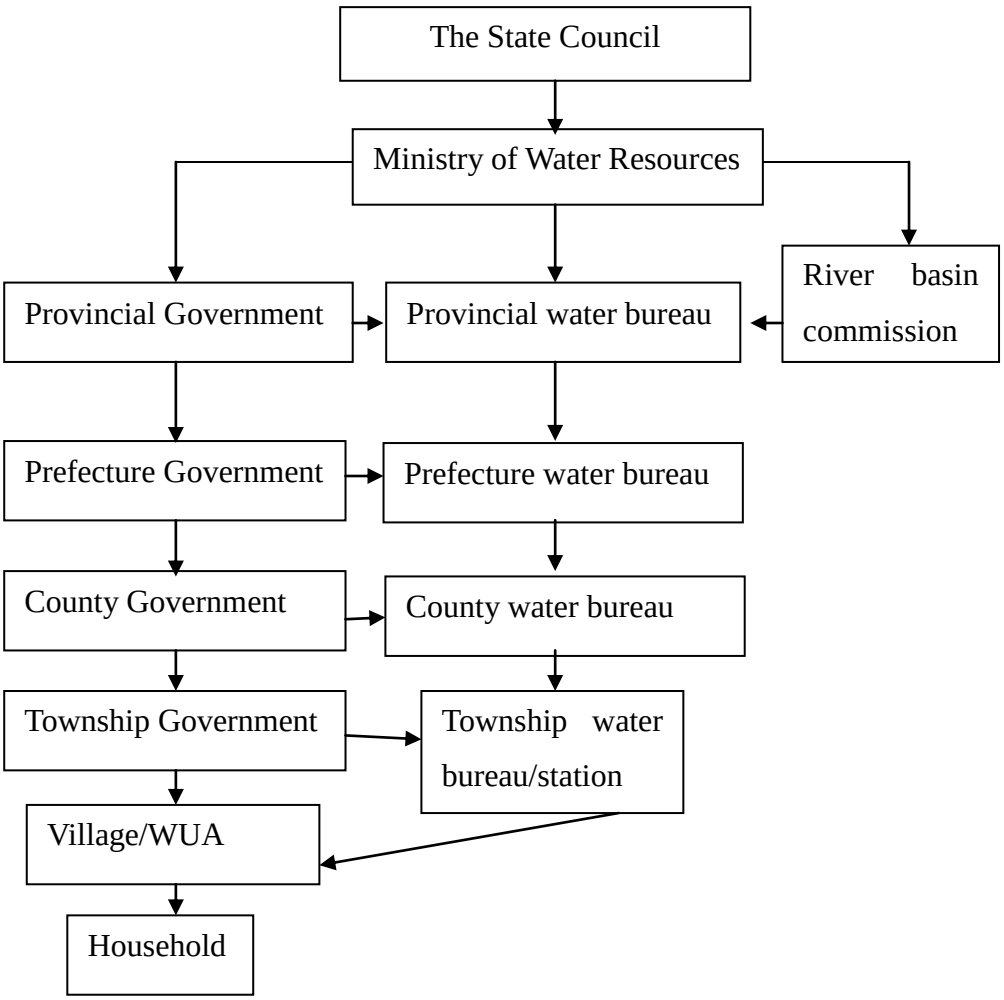



*Figure 1.18 The governance structure (vertical and horizontal) of water resources in China, adapted from (Lohmar et al., 2003)*

Water planning is based on basin and regional allocation plans, through which water is allocated between administrative regions. Water in a trans-provincial river is allocated between provinces or autonomous regions by River Basin commissions according to the overall basin plan, with provincial/regional plans then allocating water between prefectures, and prefecture level plans allocating water between counties. Process exists in determining the actual volume available for abstraction (or consumption) during any given year according to available and/or predicted supply. The Annual Regulation Plans may be adjusted during the year to bring the plan in line with actual water conditions. Hence agricultural users are required to adjust their irrigation schedules according to annual available supply. Access to water resources by an individual or unit is regulated by a water abstraction permit system, and in accordance with approved water resources allocation plans and quotas. The 2002 Law makes

specific regulations of groundwater overdraft, and identifies the circumstances under which groundwater withdrawals must be forbidden or restricted to ensure sustainability. Water certificate are granted to individual farmers, identifying their share of available water under a WUA/village entitlement. This is coupled with a water ticket system under which farmers pre-pay for the water quota based on their certificate volume and seasonal availability they require in a particular year, season or watering. Water users are required to submit an Annual Water Use Plan to their administering authority. This is considered (together with actual water availability) in preparing the Annual Regulation Plan. In other words, the granted water certificates are rather informal and the water rights are rather changeable and are not legally defensible rights.

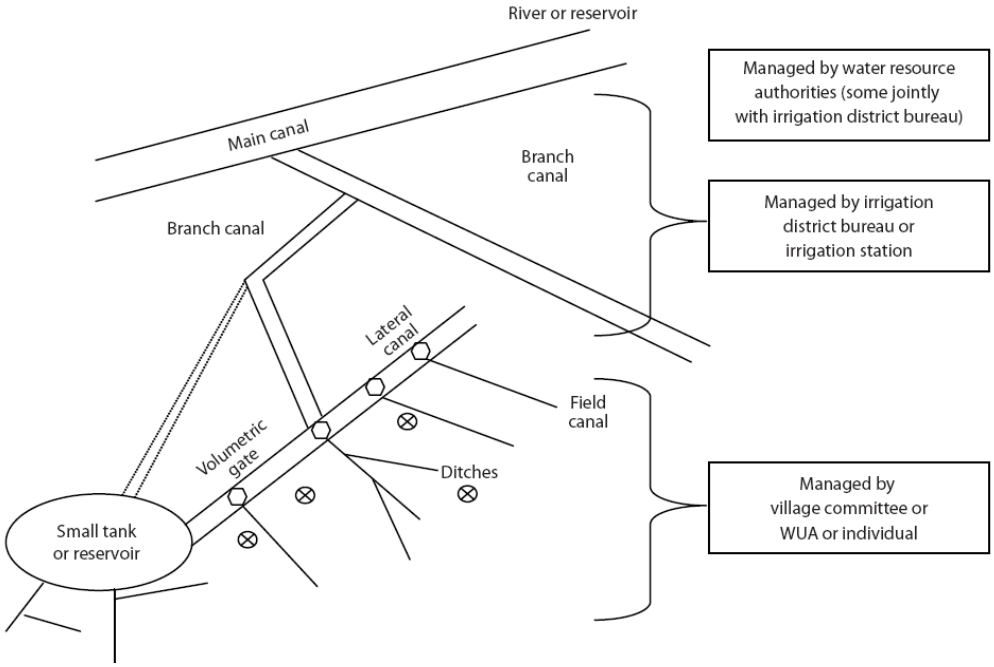



*Figure 1.19 Conceptual model of irrigation system and management in China*

The author believe the system has been suffering from (1) A highly top-down, bureaucratic irrigation management systems with too many levels and sectors; (2) Inadequate water pricing which is too low to fulfil cost-recovery or improve operation and maintenance; (3) Lack of an effective, clear and well-defined and protected water rights system; (4) Little water users' participation and ownership, which has considerably impacted water use efficiency and system performance. It is against this background that water management reforms on supply-driven solutions to IWRM are

carried out. In this thesis the focus is on water management down towards villages.

#### *1.3.6.2. IWRM in China*

IWRM has been extensively accepted and applied as a guiding approach in all fields of China's water resources management (Chen and Chen, 2005, Reynolds, 2008, Shi et al., 2007, Fang et al., 2007, Zhang et al., 2010, Monninkhoff, 2010, Geng, 2010, Wan and Zhang, 2009, Du and Xu, 2007). Water leaders and decision makers, many of whom have studied or conducted research overseas are well aware of the changing water paradigm and are often active in propelling changes towards IWRM especially with supporting efforts from international donors and organizations. For example, China's new Water Law in 2002 incorporated the idea of the IWRM regime. The 11$^{th}$ Five-Year Plan (2006-2010), set a number of water policy goals including water rights and trading, integrated management, and coordination among different sectors. However to date, the water problems have not been effectively addressed. Both studies and practice of water governance processes in China have rarely incorporated consideration of the social, political dimensions of water management. This makes detailed understanding of the nature and impacts of IWRM in specific contexts critical.

The usual approach of water management reforms in China is to understand the Westernized concepts and theories and then apply them to the Chinese context. Similarly IWRM in China has been implemented by bureaucratic government agencies in a centralized, top-down manner (Nickum, 2010), as the ways of water management discussed above. Extant study of IWRM has focused on technical rather than human or social aspects. However without modifications based on fully understanding of the contexts and the impacted stakeholders, these theories and concepts more often than not are inapplicable to China (Nickum, 2010). Moreover, this can engender threats to local livelihoods and social stability and induce public distrust and even resistance (Scott, 1987, Guha, 2000).

Moreover, results of IWRM implementation in China are rather mixed. On one hand, through a Global Water Partnership survey of 108 countries (See the website), China was one of the 11 developing nations that had been making good progress towards IWRM. Moreover, China has been identified as one of the successful leaders in

implementing IWRM reforms in Asia (Bandaragoda, 2006). On the other hand others assert that IWRM reforms in China are either difficult to realize or pay only lip-service in their policies. Reynolds (2008) for example argues that IWRM is not a viable option unless IWRM is adapted to China's political contexts and has proved to be an implementation failure. Similarly, Biswas (2008) also suggests that IWRM is not feasible for a large country as China due to the complexity and difficulty of integration.

This research stresses that successful implementation requires more than existence of IWRM principles or policies but how and to what extent IWRM has been understood, implemented by whom or under what circumstances. IWRM like other water policies are transformed through negotiation and renegotiation throughout the implementation processes at all levels (Rap, 2006). Unlike most extant IWRM literature which focuses on larger scales at basin or national levels, in-depth detailed empirical studies at village and community levels in different conditions within an authoritarian socialist regime is provided. These experiences can be transferable to water management and IWRM reforms in other regions where water crises and related environmental stress are accelerating due to pressures of development, climate change and other socio-political changes.

## 1.4. Research methods

The mixed method approach allows the author to combine the power of a generalized understanding regarding variation across a large number of cases from quantitative analysis to qualitative analysis with deeper understanding of social ecological processes. This research was conducted in three stages. Firstly, I collected quantitative data to gain basic knowledge of the water problems in the region and how different water users perceive them. Secondly, I conducted qualitative research including semi-structured interviews, participant observation and group discussion of different water users understandings and how they adapt to the increasing water challenges from both internal and external sources. Finally, workshops with key informants were carried out to discuss and validate both quantitative and qualitative results. The statements in this study were formulated and cross-checked by the author after many primary observations, participation and informal discussions with a wide variety of stakeholders.

### *1.4.1. Data sources*

Research methods studying governance of the common pool resources such as water has two categories. One focuses on the study of a large number of cases (large N) and quantitative statistical analysis. For reasons of resources, however, these are only possible under highly controlled contexts and only for a limited set of (participatory) mechanisms (Mahoney, 2007). The second focuses on empirical research through conducting single or several case studies (small N). This method allows a qualitative, in-depth understanding of the governance processes, but its obvious disadvantage lies in the lack of generalizability in the face of a multitude of different procedures as well as societal and environmental contexts. While acknowledging and taking advantage of both methods, this research uses mixed methods based on the analysis of large number quantitative analysis and a small number of in-depth case studies.

Data sources include: secondary data (literature review and government policy documents, reports, written accounts, financial records, archives and program/projects files); questionnaire surveys, semi-structured interviews, group discussion, field observation (participation in local meetings, agriculture activities and daily lives) and local validation of results (informal conversations, workshops and discussions). Different data sources from multiple methods were used for triangulation and validity, so that a synthesized and rigorous analysis is made (Yin, 2008). The variety of methods and continuity of field research has proven to be adequate to grasp the complex aspects of research objectives and questions. By engaging in the complex governance systems in a heavily regulated area for a long time, I am able to better understand the dynamics and contextual factors that influence these processes and stakeholders.

### *1.4.2. Questionnaire survey*

The comprehensive questionnaire was designed and pre-tested in order to make necessary changed regarding variation in situations across different regions. After necessary amendments such as the clarity of the questions, the length of time for completion, relevance of questions and language differences between English and Chinese, the final version of the questionnaire (one for 225 villagers and one for 41 professionals) was developed. The questionnaires consist of several modules include

basic information of the participants, water situations, public participation and IWRM and local irrigation water governance. The communities from which the research participants were drawn were chosen to provide both a representative and in-depth social-spatial sample of the residents in the SRB. Questionnaire surveys were carried out in 11 selected sample villages in upper, middle and lower reaches of the basin to increase the variation and representativeness. Only three representative villages Wang, Wen and Xin village were used for study for practicality and representativeness. Another reason is the author stayed in these three most representative villages for the longest period of time, with rich and diverse sources of data for analysis and corroboration. Xin village were recommended by county water officials and Wang were chosen because of their previous history of being studied by he author and other researchers. Wen village was selected for their reported success in water management performances. The villages surveyed are traditional villages. Irrigated agriculture is the major livelihood option for most of the villagers. In 10 of the 11 villages, WUAs have been set up to work as the legitimized water management organization at lowest village levels. Three representative villages were selected for detailed analysis considering practicality and efficiency. There is a significant variance among these organizations with respect to the appointment of WUA leaders and committee members, frequency of meetings, mobilization of labour, funding, water charges, and working rules of water management and other irrigation related activities. Production teams also known as water users' groups are the minimum unit of villagers' organization above household.

Within each village multiple criteria were used to select participants including stratification, snowballing and purposeful selection. Firstly, questionnaires with team leaders and landlords were carried out in each village during the early visits to grasp the general information and potential key informants, and then snowball sampling method was used with consideration of representing the heterogeneity of village population such as age, gender, socio-economic status.

In total, 41 water professionals who work and/or research in SRB were surveyed and interviewed. See below for list of interviewed professional stakeholder groups:

*Table 1.7 Details of interviewed professional*

| Name of professional groups | Level |
|---|---|
| 15 Researchers including University Professors, post-docs, PhD students, Maters students | University and research center in SRB or doing research on SRB include:<br>China Agriculture University<br>Lanzhou University<br>Northwest Agriculture and Forestry University<br>Gansu Agriculture University |
| 11 Water managers | 1 at Provincial level, 3 at City level, 4 at County level, 3 at Township level and below |
| 4 Officials and decision makers | 1 at Provincial level, 3 at city level |
| 11 Practitioners | 3 at City level, 4 at County level, 4 at Township level and below |

### *1.4.3. Semi-structured interview*

Semi-structured interviews are the most commonly used way of obtaining primary qualitative data (Silverman, 2009; Denzin and Lincoln, 1994). Interviews serve as an important part of my research approach of unravelling how water problems and IWRM were approached, recognizing the importance of a variety of attitudes and values to the research aims and objectives. It was used to access richer information of interviewees' own understanding, experiences and opinions with a level of depth and complexity that is not available to other approaches. Interviews were carried out during the 12 months of field work from Sep 2011 to Sep 2012. In total, 105 interviews (35 in Wang village; 30 in Wen village; 15 in Xin village; 25 professionals including officials, policy and decision-makers and water practitioners at township, county, provincial levels) were selected for analysis. All the village names were fake names for consideration of anonymity.

A combination of snowball sampling and purposeful selection was employed to identify interviewees. Most of the interviewees were also involved in questionnaire surveys so that their information can be corroborated. For some key informants,

repeated long interviews were also used. All interviews were conducted in Mandarin and most of them were recorded and complemented with thorough field notes and diary. Normally interviews last for one to two hours, at interviewees' home, fields or work places. (See Appendix).

### *1.4.4. Group discussion*

Focus group discussion is adopted for its characteristics such as cost-effectiveness, flexibility and being able to grasp useful insights of different stakeholders' perspectives and internal interactions among group participants, which are not available through individual interviews (Denzin and Lincoln, 1994; Morgan, 1998). It provides a useful tool by which the experiences of rural residents from a variety of different backgrounds can be drawn on and enables the exploration of the power relations and networks within and among different communities. Our focus groups were separated into male, female and mixed groups ranging from 5 to 9 people per group. In all, 14 group discussions (5 in Wang village: 1 female group, 2 male groups and 2 mixed groups; 7 in Wen village: 1 female group, 3 male groups and 3 mixed groups; 2 in Xin village: 1 male group and 1 mixed group) were carried out with guiding questions.

The composition of focus group has great impact on the data. For example group mix such as age, gender, socio-economic status of participants can have significant impact on how the group react to the discussion topics and how they interact with each other. Thus, within each village, male groups, female groups and mixed groups were used to obtain the gender and power relations. Female groups were purposely selected within each production team, including those who participate in water users' group meetings and those who normally stay at home, those who are relatively richer and those who are poorer, those who are elder and more experienced and those who are younger. Male groups were separated into two kinds, the ones with only team leaders and the ones with team leaders, village leaders and ordinary villagers. Mixed groups were also selected within each production team so that it is easier to recruit and participants have shared experiences and enjoy familiarity and comfort which facilitate cross-gender discussions.

### *1.4.5. Field observation*

During field study, I also engaged in village meetings and other occasions. This enabled impressions and understanding of different phenomenon to be gathered through direct contacts and life experiences locally (Denzin and Lincoln, 1994) rather than setting out to test established hypotheses about them (Atkinson and Hammersley, 1994). Some of these meetings were rather formal and not open to the public while others were quite casual including local discussions on topics such as irrigation timing, charges, allocation and labour distribution among others. I also regularly participated in local agriculture activities including weeding, irrigation and harvesting; community meetings and other events. Observational data gathering continued until theoretical saturation (Glaser and Strauss, 1967) had been reached and new information consistently replicates early findings. By observation and participation in these events, I managed to gain deeper insights into the various ways in which different people were approaching water issues and reform projects and the broader contexts within which they were framed.

### *1.4.6. Secondary materials*

To enrich and verify primary data, various secondary materials were used including published literature, government policies, documents, reports, archives and local records such as water use report, water fee records, land area and crops patterns, and household based water certificates. These materials had been understood and used within contexts of their different producers and production conditions (Denzin and Lincoln, 1994). As Fischer and Forester (Forester, 1993 p. 2) suggest, bureaucratic policy making is a constant and discursive struggle over the criteria of social classification, the conceptual framing of the problems, and the definition of ideas that guide the ways people create shared meanings which motivate them to act. Accordingly, analysis based on a thorough literature review and discourse analysis from diversified sources offer a particularly helpful window to frame and understand water issues and embedded socio-economic and political interests and the ideas and language used by different stakeholders. This can help gain insights into the local, regional as well as broader context within which huge water projects, such as IWRM in SRB, were driven and implemented in practice.

### *1.4.7. Data analysis*

Both quantitative data, such as from large numbers of questionnaires and qualitative data, for example through interviews, discussions, observation and fieldwork notes, were used to analyze the subjects and to complement each other. Based on an exhaustive literature review and the author's fieldwork together with previous work and research experiences, the data analysis revolves around four important themes, which are also formed into four different academic papers, including people's understanding and perceptions of water crisis; people's experiences and perceptions of WUAs as well as their performances; the implementation and impacts of IWRM from different perspectives; and the evaluation of local water governance under imposed IWRM water reform through Ostrom's design principles.

The coding process started by reading through the texts line by line with research questions in mind. Every meaningful bit of text is labelled and through axial coding stand-alone concepts was categorized with further elaboration for more specific dimensions. Related Text and repeating ideas that is related is grouped and the rest is disregarded. The process stops until as many of relevant text selections as possible has been grouped together. The initial themes found were organized and developed into more abstract and higher levels to theoretical constructs, and the process was guided by key elements of Ostrom's theoretical framework (See below Figure 1.20). This framework comprises the thematic codes of analysis that is used to identify patterns among different themes. Within each theme, repeating ideas and categories were then grouped together into larger and coherent groups and the coding process was done repeatedly.

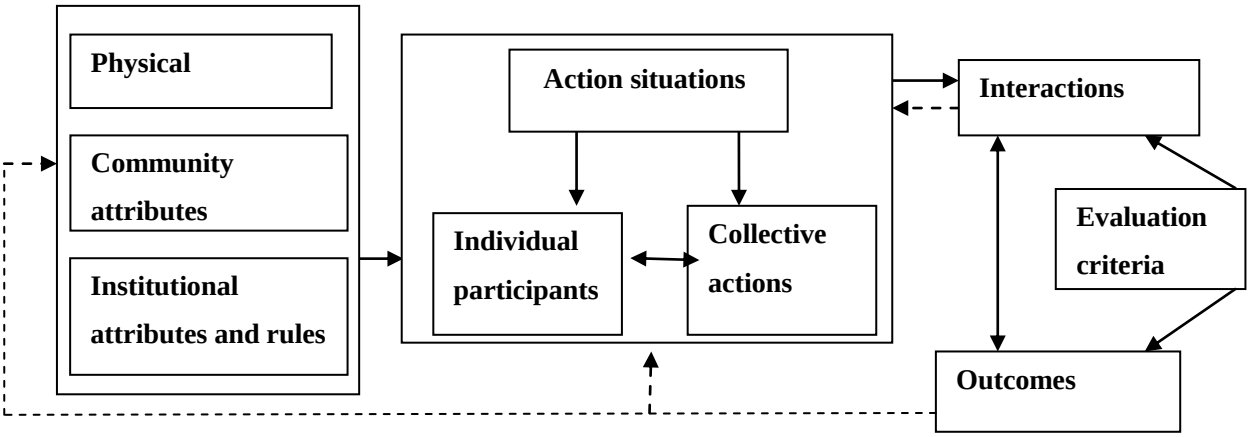



*Figure 1.20 Analytical framework, Source: Adapted from Ostrom (2010b).*

There are four hypotheses regarding the four main themes and research questions:
Hypothesis 1: different people have different perception and understanding of "water crisis", for example the nature and causes of water crisis. In addition, there are a variety of impacting factors shaping people's perceptions, which may not be directly related to their physical, socio-economic characters as most literature suggest.
Hypothesis 2: similar to understand of water crisis, local people have very different perceptions towards WUAs and public participation in local water governance, which directly resulted in either success or failure in implementing WUAs at local levels.
Hypothesis 3: Implementation and impacts of IWRM reforms vary significantly rather than being monolithic.
Hypothesis 4: evaluation of local water governance under increasing external water reforms such as IWRM is local, contextual and Ostrom's design principles which are successful in many contexts may not apply in the Chinese context.

### *1.4.8. Position of the researcher and limitations*

Although the methodological choices of this thesis may not be sufficient for ascertaining "truth" about impacts or challenges of water issues and reforms in the study area, it is well-suited to unravel the theoretical proposals and practical processes in the case of SRB. To study water governance in an area that water issues are extremely sensitive, it is quite difficult to distinguish whether the informants were telling the truth or not. It is possible that the formal meetings that the author was taken to or in which she was allowed to participate were purposely selected in order to make a positive impression. Were the interviewed participants speaking frankly with me or hiding their genuine thoughts? The author would argue that these uncertainties have actually worked to my advantage as the complexities *per se* allow me direct access and insights into the sensitivity and significance of contexts and socio-political fabrication of water related issues, which is not easily accessible to other methodological approaches. Instead of focusing on what the "truth" is, it is stresses that the question of whose "truth" it is and why different stakeholders hold different "truths", or why same stakeholders perceive different truths under different circumstances.

Did my presence or lack of presence make a difference in terms of the content or formats of the meetings? My position as an educated, single female researcher in her

late 20s from a Western university in a remote, isolated and highly agriculture-based area undoubtedly influenced my own perceptions and analyses, as well as local people's perceptions of me. My presence in the studied villages and communities was never a secret. Overtime, my presence in local meetings and agriculture activities became a routine and it was my absence in these events that became notable and people started to ask why I had not participated recently. I can also clearly sense that informants were less guarded and more relaxed and open over casual conversations and interviews. My gender also played an interesting role during my field study. My marital status of being a single female in late 20s was also an issue of interest to local people. By long-term communication, reciprocal exchange of information and adopting local habits, I managed to build a reliable relationship with my participants.

Unavoidably, this study has its fair share of limitations which cannot be ignored. The researcher surveyed 11 different villages throughout the river basin and relied on two representative villages. A larger sample size would be more representative of the water perception and action of villagers. However, it must be said that although only two villages, and in one chapter, three villages were used, the data collected was detailed and helped reveal local water perceptions and governance. The villages chosen were also typical and representative. There was a gender imbalance as most interviews and discussions were done in participants' house and when both male and female members were present, it was always the male member of the house to participate. Further efforts to strike a balance in gender might be a better way to understand the subject. In addition, due to a lack of longitudinal data set, it is difficult to track people's perception changes over time, for example before and after the reforms, there is no information on people's water perceptions, adaptation strategies and social understanding of WUAs in previous years. In order to get a more detailed understanding, the author conducted fieldwork with multiple methods over a long period of time. Moreover, the analysis of IWRM implementation focused on people's perceptions, experiences and understanding rather than the outcomes. Ideally the author would like to evaluate the sustainability and effectiveness of the implemented policies. However, IWRM policies have been implemented only over the last few yers, so it is difficult to access the success of these strategies in terms of water level, quality, and long-term change in livelihoods and economic and ecological benefits. Finally, water crisis was researched indirectly, not through the actual water availability or

quality. Neither public nor officials keeps good records, at least sharable records of water consumption. In order to minimize these challenges, repeated and long-term interviews, discussions and participation were used to indirectly verify the data.

## 1.5. Thesis structure

This thesis is composed of an introduction chapter, four main chapters/academic articles that have been published or under review by relevant peer-reviewed journals, and a discussion chapter and a conclusion chapter. Chapter two provides the basis for broader discussion about water crisis in the river basin by considering the key insights of villagers regarding the forms, causes and solutions of local water crisis as well as the impacting factors for these perspectives. Engaging with extant literature on environmental perceptions especially water perceptions, it enriches current debates. It shows that while most villagers are aware of local water crises, they are very uncertain of the causes. Their perceptions of local water crises are considerably heterogeneous not only between two villages but also among different villagers. Affected by diverse factors in very different ways, local villagers identify decreasing water access, control and affordability as major aspects of water crisis. It has been found that water crises are locally and socially constructed rather than physical determined and personal experiences together with physical, social-political and economic factors have more significant influence on villagers' water perceptions than ordinary demographic attributes such as gender or education. It is suggested that public consultation is crucial to understand and address water crises in more localized and effective ways.

Based on understanding of stakeholders' water perceptions, Chapter three explores stakeholders' participation in local irrigation management activities through water users' associations (WUAs). By examining two typical WUAs, regarding their aims, nature and roles in increasing public participation and in local irrigation management, it shows that there are significant discrepancies among various water stakeholders towards WUAs and public participation in terms of their understanding, motives and experiences. These discrepancies can be explained by a variety of factors, especially geographical location, local contexts, personal experiences, knowledge gaps and incentives and value systems. For officials, WUAs and participation are mechanisms to involve and mobilize people in executing government water policies, while for local

villagers, these mechanisms are supposed to represent and protect their rights and benefits. This paper suggests that local WUAs practices serve to reshape people's perceptions of both participation and WUAs, which in return influence WUA implementation and local irrigation management. Local governments especially at township and county levels, still have a tight water control which precludes meaningful bottom-up participation. It concludes that effective implementation of WUAs and public participation has to be context specific based on accurate understanding and shared motives of WUAs among different water stakeholders rather than a universal symbolic name.

Chapter Four investigates IWRM policies and the impacts at local village levels from villagers' own experiences and perspectives with a special focus on the influencing roles of political trust in IWRM processes. Supported by empirical data gathered in the field, it shows that neither villagers' understanding nor the implementation of IWRM is monolithic. Political trust plays a crucial role in shaping villagers' attitudes and responses towards IWRM implementation. Local villagers trust central and higher level government and believe the IWRM policies to be well-intentioned, but distrust its local agents who villagers believe, distort these policies into local policies (tu zheng ce) for their own interests and purposes. The normative IWRM rules and proposed benefits appear to be well accepted by almost all involved, but the exact mechanisms for doing so appear problematic. IWRM process and outcomes are constantly shaped and reshaped by bargaining, selective implementation and covert resistance in dynamic local contexts. Successful implementation cannot be guaranteed by the existence of these well-intentioned IWRM policies, and certainly cannot be defined by whether the officially set targets are hit or not. Misunderstanding, distrust, uncertainty and unfairness lead villagers to work the system to their minimum disadvantage or maximum advantage at economic and socio-political costs.

Combining the three themes discussed earlier, Chapter Five focuses on evaluation of the two key patterns of irrigation institutions – contracting and collective management in two typical villages under IWRM reforms. Existing irrigation institutions were examined based on theoretical framework proposed by Ostrom (1990). It demonstrates that the design principles are not sufficient enough to determine whether local irrigation institutions are successful in the Chinese socialist context, where the use of social

capital such as personal relationships to pursue one's interests is so prevalent. Local institutional arrangements vary significantly, based on local contexts considering their own norms, beliefs and social capital, which has not been adequately taken into account in either the process of water policy development or implementation. Better rule enforcements were found in the collective management than private contracting. For the first time, it reveals the negative consequences of social capital – collective corruption and resource exploitation which are better planned and more difficult to detect and far more dangerous. Social capital, in conjunction with particular social contexts can account not only for the water users' actions but also for the development of local irrigation institutions. A pragmatic, contextualized, cooperative partnership that is neither top-down nor bottom-up is suggested.

# Chapter 2 - Paper 1

**“There is no truth. There is only perception.”**

**— Gustave Flaubert, French writer**

# 2. Villagers' perceptions of water crises and the influencing factors of local perceptions: a case study in the Shiyang River Basin, Northwest China

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## Abstract

The integration of people's perceptions concerning water into policy and planning is essential for successful water resources management, however little is known about this topic. To redress this problem, interviews were undertaken with a total of 119 villagers in two different villages in the upper and lower reaches of the Shiyang River Basin, northwest China employing qualitative and quantitative research methods. This paper demonstrates a deeper and clearer understanding of local people's perceptions of water crises and their causes in arid and semi-arid regions. Results demonstrate that: (1) while most villagers are aware of local water crises, they are uncertain of the causes; (2) perceptions of local water crises are considerably heterogeneous both between the two villages and among different villagers (3) villagers' perceptions of different aspects of water crises including water access, control and affordability are affected by diverse factors in very different ways. Personal experiences together with physical, social-political and economic factors (location $R^2$=0.591, P=0.000; land area $R^2$=-0.327, p=0.01; income levels $R^2$=-0.26, p=0.01) have a more significant influence on villagers' water perceptions than ordinary demographic attributes. (4) Most of all, water crises are locally and socially constructed rather than physically determined. The conclusions are invaluable for water researchers and decision makers to better understand and solve water crises in more localized and effective ways.

**Key words:** Villagers' water perceptions; personal experiences; socio-political factors; water crises; transdisciplinary water research; Shiyang River Basin; Northwest China

## 2.1. Introduction

Water crises have been one of the most pressing challenges that people have been and continue to be facing, especially in developing countries and in densely populated arid and semi-arid regions where rapid population growth and associated rising water demands will occur over the next few decades(Ostrom et al., 2011, Rijsberman, 2006). However, as has been increasingly acknowledged, water crises today have been caused by a combination of diverse factors including physical shortage and inappropriate management (Lu et al., 2000). Therefore, water management can no longer be just about increasing water supplies through traditional hard paths of infrastructure construction or exploitation of new water sources(Gleick, 2003, Gleick, 2000, Stanghellini, 2010, Rosegrant and Cai, 2002, Coward, 1980), but about how to more effectively manage available water resources and improve performance of existing systems (Ostrom et al., 2011, Rogers and Hall, 2003), especially irrigation systems since agriculture remains the largest water consumer and accounts for 70% of global water withdrawals and even more than 90% in developing countries (FAO, 2010).

Understanding villagers' perceptions is a prerequisite for effective water management considering that public perceptions will have significant influence in shaping or reshaping people's behaviours and responses (Zube and Sell, 1986, McMillan et al., 1997, Lee and Zhang, 2008, Ogunjinmi et al., 2012). Firstly, as Carvalho et al (2002) describe, 'outsiders cannot necessarily identify local needs and priorities or figure out how best to meet them'. External assistance is not sufficient for ensuring appropriate resource management, without greater involvement and cooperation of local people especially farmers. Local communities' direct and long-term experiences, and detailed understanding of their environment is invaluable (FAO, 2000, Ostrom, 1990, Zube and Sell, 1986).Secondly, – Understanding local perceptions facilitates identification of the process by which local villagers either individually or collectively respond to water problems and external interventions in their environment. A clear understanding of local people and extant working rules either formal or customary, is invaluable in enhancing efforts to deal with the 'tragedy of the commons'(Ostrom, 1990).Third, – comprehending resource users' perceptions helps identify reasons for different stakeholders to co-operate or resist during the implementation of certain policy

interventions and provide suggestions on appropriate planning and interventions in the future. Without grasping these perceptions, water professionals, officials and even practitioners may misapprehend local villagers as ignorant and conservative; may neglect the importance of local contexts in addressing these problems, or may even implement programs which are locally inappropriate and thus highly unlikely to work or be enforced as planned (Scott, 1999).

Studies about factors impacting people's perceptions and attitudes towards environmental issues have shown that several variables have been directly related to social and demographic variables including age, gender, income levels, education, residence, occupation and social class (Van Liere and Dunlap, 1980, McMillan et al., 1997). For example, a negative relationship has been found between age and environmental perceptions, showing that younger people tend to have better environmental awareness and more specifically pro-environmental attitudes than older ones (Lee and Zhang, 2004). Residence or locations also have been considered as key factors in explaining differences in people's environmental concerns and attitudes (Larson et al., 2013, Slegers, 2008). For instance, studies indicate that urban residents show better environmental awareness than rural people (Tremblay Jr and Dunlap, 1977, Berenguer et al., 2005, Van Liere and Dunlap, 1980). Research also has shown that gender is an important factor in explaining differences in people's environmental attitudes. Ogunjinmi et al (2012) argue that gender plays a critical role in affecting local communities' environmental attitudes. It has also been found that higher income levels are related to higher levels of environmental awareness and part of the explanation of the roles of higher income levels is that with higher income people will have higher levels of education and thus better environmental awareness. According to McMillan et al(1997), higher education levels will broaden people's horizons and encourage more open-minded perspectives. Van Liere and Dunlap (1980) and Ogunjinmi et al (2012) further assert that education is the variable that is consistently associated with people's environmental attitudes. However, there has been no consensus reached so far on factors influencing people's environmental attitudes since different researchers choose different data collection and analysis methods in very different contexts.

However, despite a large body of extant literature discussing challenges and solutions to improve irrigation system performances from a professional perspective, many of

which have already shown ample evidence of the significant roles of local water stakeholders in water uses and management (Ostrom, 1990, Vermillion, 1997, Uphoff, 2000, Jonsson, 2005, Bandyopadhyay et al., 2010), little is known of local water perceptions (Lee and Zhang, 2004, Zube and Sell, 1986). Much less has been reported using rich empirical evidence. To the author's best knowledge, such information remains unavailable in China where water management has been overwhelmingly top-down and technocratic while critical questions such as how local villagers perceive local water crises have barely been asked (Barnett et al., 2006).

This paper aims to understand local water crises from a different angle and explore the relationship between different factors and their influences on people's water perceptions based on comparative case studies in northwest China. In the following sections, three aspects of villagers' water perceptions will be discussed 1) perceptions of existence of physical water shortage and influencing factors; 2) perceptions of different aspects of water crises and potential explanatory factors; 3) perceptions of the causes of local water crises and the effects of different factors on villagers' perceptions. Although locally based, the study will provide valuable insights on how water users in rural communities of arid and semi-arid regions perceive their water crises and what factors influence their perceptions. Moreover this research will provide some practical lessons concerning future water study and management in other countries and areas facing similar water issues.

The significance of this study and its impact on other countries and regions lies in several aspects. Firstly gather opinions and concerns and understanding of the water problems as well as solutions is fundamental to formulating good water policies that will be embraced by all. Policies that incorporate the concerns of the most affected population are more applicable and effective. This applies to not only the study area or China but the rest of the world. Secondly, regardless of the specific context, the conclusions and findings of this study, for example, water policy implementation is not about having the perfect policies or enforces it upon the public works for many other different contexts too. Thirdly, the mixed- research methods which have barely been used in water studies, show a very effective way to understand and resolve local water problems in both developing and developed world. This could apply to other cases in future water studies. Fourthly, the intensification of China's water crisis could

significantly impact on its international partners. A better understanding of current water problems as well as solutions will help alleviate China's water risk as well as the rest of the worlds'.

## 2.2. Study area

The Shiyang River Basin (101°41′～104°16′N， 36°29′～39°27′W) lies in Gansu Province, northwest China, surrounded by the Badain Jaran and Tengger deserts (See Figure 2.1). It covers an area of 41600 $km^2$, with a population of 2.27 million in 2003 (), 2007, Gansu Provincial Water Resources Bureau). Among China's inland river basins, the Shiyang River Basin has the largest population, the most developed economy, and the highest level of water resource development, water scarcity and environment vulnerability (Ma et al., 2005a).

The Shiyang River starts from the upper reaches in the Qilian Mountains and disappears in the desert areas to the north (See Figure 2.1), with eight tributaries and an average annual runoff of 15.75×108 m3. It is replenished by snow, glacier melt and seasonal rainfall mainly concentrating from June to September. The area is divided into three climatic zones: southern mountain area, with an elevation of 2000-5000 meters above sea level, average annual rainfall of 340-650 mm and evaporation of 720-1200mm; middle arid and semi-arid region, with an elevation of 1500-2000 meters, average annual rainfall of 160-340mm and evaporation of 2000-2200 mm; and northern arid zones surrounded by deserts, with an elevation of 1300-1500 meters, less than 150 mm of annual rainfall and 2200-2640 mm of evaporation (See Table 2.1).

*Table 2.1 Climate characteristics in different zones in the Shiyang River Basin*

| | **T (℃)** | **R（mm）** | **E（mm）** | **RD (days)** | **RH (%)** | **SH (hours)** |
|---|---|---|---|---|---|---|
| Southern Mountainous area | 0-5 | 340-650 | 720-1200 | >80 | 46-48 | 2553-2700 |
| Middle arid and semi-arid regions | 5-8 | 160-340 | 2000-2200 | 50-80 | 45 | 2700-3000 |
| Northern arid desert zones | >8 | <150 | 2200-2640 | <50 | 30-45 | >3000 |

Notes: T means average annual temperature; R means average annual rainfall; E means average annual evaporation; RD means relative humidity; RH means relative

Humidity; SH means annual sunshine hours. Source: adapted from Kang et al, 2004.

Source: adapted from Huo et al, 2007.

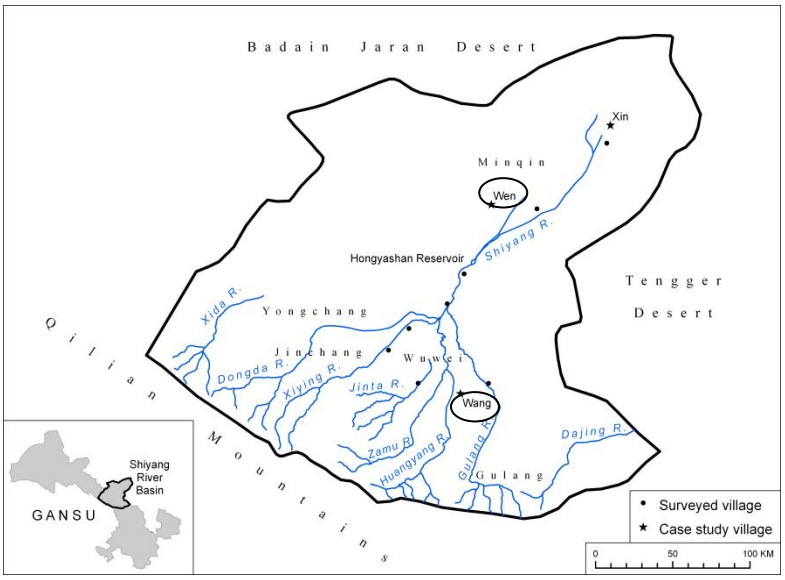


*Figure 2.1 Location of the Shiyang river basin and studied villages (Wang and Wen)*

The Shiyang River Basin has a long and rich history of water resources exploitation and development since ancient times. A majority (>77%) of the population are still involved in farming, deriving all or a substantial part of their livelihoods from irrigated agriculture (), 2007). It has traditionally been one of the most important state commercial grain bases in both Gansu Province and China (Ding, 2007). Over the past few decades, water stress has been increased considerably throughout the basin (), 2007). Numerous channels, dams and reservoirs have been built in the upper and middle reaches to deal with increasing water demands from population growth, land expansion, agriculture and economic development. As a result river inflow to the lower reach continues to drop (Lee and Zhang, 2004) and has decreased significantly by 74% over the past four decades (Kang et al., 2004) (See Figure 2.2). People began to exploit groundwater resources throughout the basin on a large scale, particularly in lower Minqin county (Edmunds et al., 2006), where over 11000 wells had been dug up until 2000 (Liu and Wan, 2010), with groundwater exploitation increased from less than $0.19\times10^9 m^3$ per year in the 1950s to $1.1\times10^9 m^3$ in the 1990s (Ji et al., 2006).Groundwater tables keep falling at a rate of up to 1meter per year and have dropped from 8.5m below the surface in 1984 to 14.9m by the mid-1990s (Ma and Wei,

2003) (See Figure 2.3).Overexploitation, falling water tables (See Figure 2.3) and degrading water quality have been increasingly prevalent and worsening.

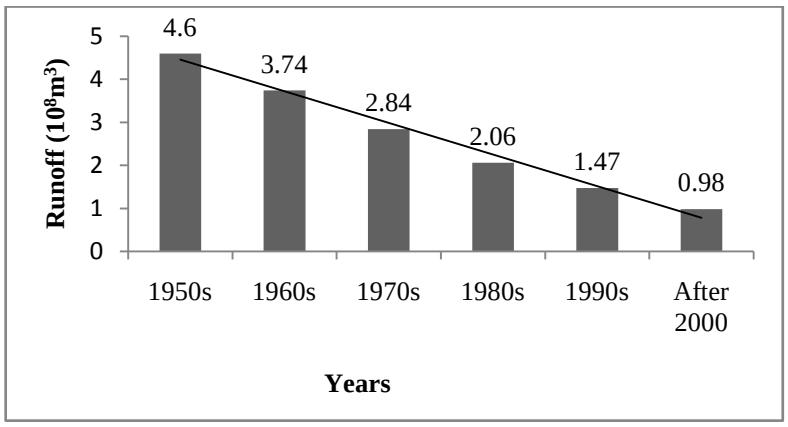


*Figure 2.2 Annual runoff to Hongyashan Reservoir in the Lower reaches (Unit: $10^8$ $m^3$)*

Source: personal contact from author's fieldwork.

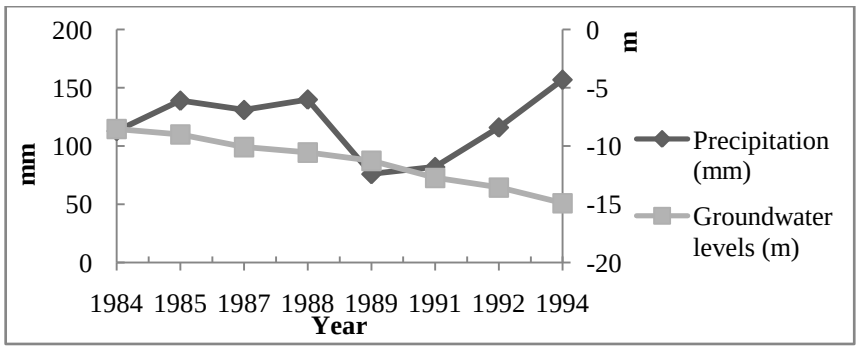


*Figure 2.3 Changes in groundwater levels (m) and precipitation (mm) in Minqin County, adjusted from Ma and Wei (2003)*

The basin has been facing increasingly severe water stress and related environmental problems (Kang et al., 2004) which are caused by a large and growing population, climate change, resource limits, and inappropriate water management to human activities and improper agriculture practices (Yu et al., 2013). Local people's livelihoods, social and economic development and ecosystem balance have been continuously threatened (Ma et al., 2007, Ji et al., 2006). For example, in Minqin County, over 90% of the area suffers from desertification[2] and many farmers have been

[2] **Desertification** here is a type of land degradation in which a relatively dry land region becomes increasingly arid, typically losing its bodies of water as well as vegetation and wildlife. It is mainly caused by human activities.

forced to leave their communities and face great difficulties in securing their livelihoods (Wei et al., 2006, Aarnoudse et al., 2012).

To face the worsening water situations, especially in the lower reaches, water reforms towards integrated water resources management (IWRM) in the basin which were initiated and funded by the Chinese government and many international donors have been carried out by provincial and local governments throughout the basin since 2007 (GPWRB, Gansu Provincial Water Resource Bureau, 2007). A series of policies were implemented including construction and rehabilitation of irrigation infrastructures, shutting down pumping wells, cutting down irrigated land areas, readjusting agriculture patterns to less water consumptive and more profitable patterns such as greenhouses and growing cash crops, introducing water rights and mandatory limit on farmers' irrigation uses, increasing irrigation water prices and reallocating more surface water to lower reaches concerning its ecological vulnerability and extremely severe water circumstances. All these attributes make the Shiyang River Basin a classic case study.

## 2.3. Research methods

In contrast to most previous water studies of China, local water crises were studied from villagers' perspective employing qualitative and quantitative methods. Qualitative methods including semi-structured interviews, informal conversations, group discussions and participant observation were chosen to accurately record details in informants' water perspectives complemented by secondary data collection and textual analysis of relevant literature, regulations, documents and policies. Key informants include village council members, community leaders, local villagers, water practitioners, managers and officials at village, township, county, city and provincial levels. Interviewees were recruited using a stratified snowballing method to adequately cover the heterogeneity and composition of the community including social, political, economic, gender, age groups of the villages. Key participants including all village leaders, all team leaders and landlords were recruited first. Then the snowballing process started from key informants, with each participant's socio-economic, political, and age and gender elements being taken into account. This aims to avoid biases in sampling, for example to avoid to just sampling the better-off groups or the ones that have good relations with key informants. Each interview ranged from 15 minutes to

two hours. Each group discussion usually took 2 to 3 hours. Questionnaire surveys together with secondary data collection enabled further insight and triangulation of data. Over 80 interviews and 119 questionnaires were conducted in two sample villages (51 in Wang village and 68 in Wen village) from September 2011 to September 2012 till the data reached theoretical saturation (Glaser and Strauss, 1967). Quantitative data was analyzed using descriptive statistics and Pearson correlation through SPSS 21.

Qualitative data analysis was based on coding and content analysis to identify themes and interpretations. The audio recordings from interviews and discussions were transcribed verbatim in Chinese. All the transcripts from differences sources were then read thoroughly and repeatedly to gain a general sense of the information and then classified according to different research questions and themes. The coding process started by reading through the texts line by line with research themes in mind. The initial repeated ideas found were organized and developed into a more abstract and higher levels, the process was guided by key elements of Ostrom's theoretical framework (See Figure 1.20). Every meaningful bit of text is labelled and through axial coding stand-alone concepts was categorized with further elaboration for more specific dimensions. Different themes and related texts were selected for further analysis of repeating ideas, guided by the theoretical constructs. Within each theme, repeating ideas were then grouped together and the coding process is done repeatedly. Identification and organization of themes and codes of collected data from fieldwork was made. Grounded in the extant literature, the analysis is an iterative and continual process of reflection and going back and forth between different steps.

Two sample villages, Wang village in the upper reach and Wen village in the lower reach of the basin, were selected based on several principles, including geographical location, agricultural patterns, water situations, village size and local irrigation management (See Table 2.2). In both villages, most people have been long-term inhabitants with an average residence time of 34 years. Agriculture production is still the most important source of livelihoods for the majority of villagers. Irrigation plays a central role in agriculture and food production, locals' income and livelihoods. The above mentioned water reforms towards IWRM such as management decentralization, enforcing water rights, compulsory irrigation quota limits and increasing water prices have been carried out in both villages starting from 2007, see Table 2.2 for details.

*Table 2.2 Basic information of studied villages*

| Village profile | | |
|---|---|---|
| **Village name** | **Wang** | **Wen** |
| **Population** | **1845** | **1834** |
| **Average annual precipitation (mm)** | **164** | **110** |
| **Average annual evaporation (mm)** | **2000** | **2644** |
| **Distance to nearest city/town (km)** | **27** | **10** |
| **Average annual income per capita (Yuan)** | **6960** | **5411** |
| **Land area per capita in mu (Actual/Official)** | **5.85/2** | **2.7/2.5** |
| **Official water quota per capita ($m^3$)** | **430** | **410** |
| **Irrigation sources** | **Groundwater** | **Groundwater and surface water** |
| **Sample size** | **51** | **68** |

Source: Author's field study

Wang village has a population of 1845 in 12 location-based communities. With a distance of about 30km away from the nearest city, it is more difficult for most local residents to seek off-farm job opportunities so most people are still mainly agriculture based. The average land holding per farmer is much more than the official irrigated land limit is set at 2 mu per person. The main crop types are seed corn and wheat. Irrigation is indispensable for local agriculture production with a very low annual rainfall and a high evaporation (See Table 2.2). Groundwater is the only irrigation source for local farmers. The annual income per person on average is 6960Yuan in 2011 (exchanging rate at 1GBP =10 Yuan).

Wen village has a population of 1834 people divided into 10 production teams. It is relatively close to the nearest county and some villagers pursue part-time off-farm employment. Irrigation is dependent on both groundwater and surface water resources. Actually increasing surface water supplies from upper reaches started over the past few years through government interventions assuming that if more surface water is transferred to the lower reaches, groundwater overexploitation in lower river basin will be reduced. Per capita landholding in Wen village is comparable to the official limit of 2.5 mu per person. Unlike the uniformity of crop types in Wang village, in Wen village people have more freedom in crop selection. They usually grow a combination of wheat, corn, sunflower seeds, cotton and alfalfa. The average annual income for Wen villagers in 2011 was around 5000 Yuan (1 GBP=10 Yuan) (See Table 2.2).

Demographic characteristics of respondents are categorized in Table 2.3. As shown, the age of respondents was more or less evenly distributed, with a clustering between the age 31-50 years (58.8% in Wang and 60.6% in Wen). The average age is 46 years old. Most informants have primary or secondary school education. It is also important to note that there are more male respondents because most of the surveys were carried out at household level and when both male and female members were present, normally it was the male member who chose to fill out the questionnaires and respond on behalf of the family.

*Table 2.3 Descriptive statistics of respondents*

| | Age (years) | Education (level 1-7) | Family Numbers | Children Number | Land area | Income levels (level 1-7) |
|---|---|---|---|---|---|---|
| **N Valid** | **119** | **119** | **119** | **119** | **119** | **119** |
| **Mean** | **45.88** | **2.73** | **4.76** | **2.14** | **17.80** | **3.75** |
| **Range** | **52** | **5** | **9** | **5** | **48** | **6** |
| **Minimum** | **24** | **1** | **1** | **0** | **2** | **1** |
| **Maximum** | **76** | **6** | **10** | **5** | **50** | **7** |

Note: coding- **Education**: 1=no education,2= primary school, 3= secondary school, 4= high school, 5=vocational education; 6=college and above);**Income levels per household**: 1=<5000 Yuan,2= 5000-10000 Yuan, 3= 10000-20000Yuan, 4=20000-30000Yuan, 5=30000-40000Yuan, 6=40000-50000Yuan, 7=>50000 Yuan, exchanging rate at 1 Pound=10 Yuan;**Land area** in mu, 1 mu= 0.067 ha.

## 2.4. Results

### *2.4.1. Local perceptions of water shortage*

#### *2.4.1.1. Perception differences between two selected villages*

Water shortage at local levels as a special element of local water crises was evaluated by villagers based on a pre-set five point scale, where 1 means no physical water shortage at all and 5 means extreme water shortage situations. Results from Figure 2.4 show that most (57%) of the 119 respondents consider water shortage in their area as high (water shortage mark with 4 points and above) while 43% consider it as medium/low (water shortage mark with 3 points and below). These results show that most villagers are

aware of local water shortage situations.

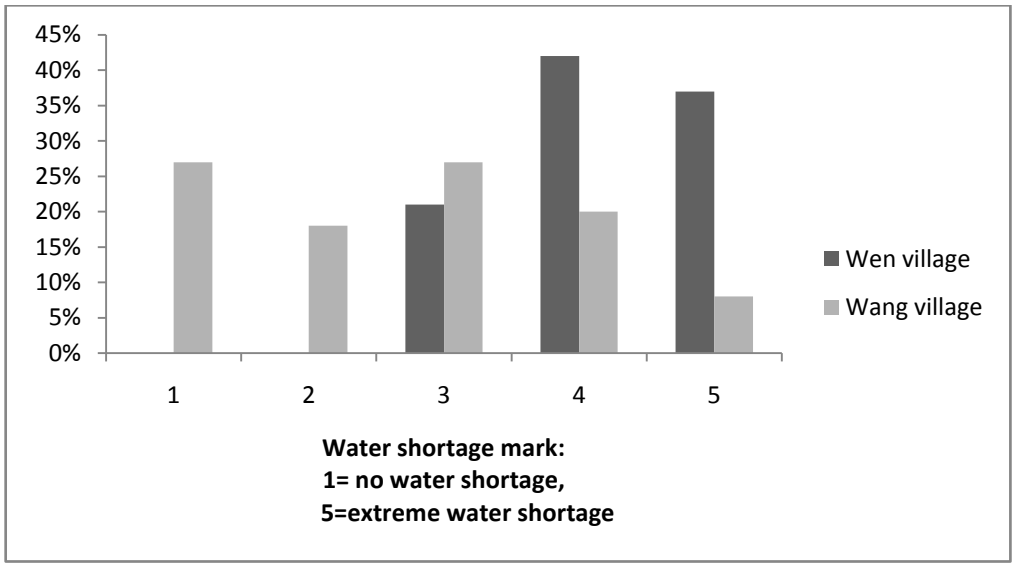


*Figure 2.4 Distribution of water shortage marks in Wen and Wang village*

It also shows that respondents' perceptions of water shortage may significantly differ from one village to another. For instance in Wen village, the water shortage mark ranges from 3 to 5 points (See Figure. 2.4), with an average mark of 4.2 and a standard deviation of 0.745 (see Table 2.4). In contrast, the water scarcity mark in Wang village is more diverse ranging from 1 to 5 with an average mark of 2.6 and standard deviation of 1.296 (Table.4). While 79% of people in Wen village perceive there is high level of water scarcity locally only 27% of respondents in Wang village think their physical water scarcity is high ($Chi^2$=32.13, P= .000), which further implies that people from Wen village perceive that water shortage is more serious than in Wang village. The contrast of villagers' water perceptions between Wang and Wen village has been shown in Figure2.4 is also consistent with the objective situations in both villages as the data presented in Table 2.2.

*Table 2.4 Descriptive Statistics of water shortage mark in Wang village and Wen village*

| Village | N | Range | Min | Max | Mean | Std. Deviation |
|---|---|---|---|---|---|---|
| **Wang** | **51** | **4** | **1** | **5** | **2.63** | **1.296** |
| **Wen** | **68** | **2** | **3** | **5** | **4.16** | **.745** |

Note: 1- no water shortage; 5- extreme water shortage

### *2.4.1.2. Impacting factors for perception differences at village levels*

Physical factors such as geographic locations, can impact human perceptions of environment (Tremblay Jr and Dunlap, 1977, Zube and Sell, 1986, McMillan et al., 1997). Similarly, a correlation has been found between locations (using village code, 0-Wang village, 1- Wen village) and people's water perceptions (using water shortage mark on a scale of 1 to 5, one means no water shortage at all, 5 means extreme water shortage) (Also see Table 2.5a) in this paper, showing that people's understanding of water crises is highly localized. The null hypothesis is that living in which village and people's perception of water crisis are independent. According to the results, village code or belonging to different villages were directly associated with people's water shortage marks. For example people in Wen village at lower reach who experience higher evaporation, lower rainfall and many related ecological problems are more afflicted by water stress so that they may consider water shortage more serious. This is consistent with previous studies showing that people's environmental views can be related to their surroundings and experiences (Spence et al., 2011, Whitmarsh, 2008).

*Table 2.5a Correlations between village and water shortage*

| | | Village code | Water shortage mark: 1-no water shortage 5-extreme water shortage |
|---|---|---|---|
| **Village code** | **Correlation** | **1** | **.601**** |
| | **Sig. (2-tailed)** | | **.000** |
| **Water shortage mark: 1-no water shortage, 5-extreme shortage** | **Correlation** | **.601**** | **1** |
| | **Sig. (2-tailed)** | **.000** | |
| | **N** | **119** | **119** |

**. Correlation is significant at the 0.01 level (2-tailed).

Other potential factors that may have caused the perception disparities between the two villages include village related livelihoods diversification, dependence on agriculture production, different agriculture patterns, crop types and irrigation needs. Data analysis shows both villages have similar livelihood diversification with most families having three different income sources including agriculture production, livestock raising and part/full-time on-farm or off-farm employment. There is no correlation between how many types of livelihoods people have and their water shortage marks (See Table 2.5b). Regarding dependence on agriculture, all respondents are agriculture-based and in both

villages, most still depend on agriculture for a majority of their family income, which lessens the possibility of a correlation between stakeholders' dependence on agriculture and people's perceived water shortage marks.

*Table 2.6b Income sources* water shortage relation*

| | | **Water shortage mark 1 to 5** | | | | | **Total** |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| **Income sources** | 1 | 0 | 0 | 1 | 0 | 1 | 2 |
| | 2 | 2 | 5 | 8 | 14 | 11 | 40 |
| | 3 | 9 | 3 | 13 | 19 | 14 | 58 |
| | 4 | 3 | 0 | 6 | 5 | 3 | 17 |
| | 5 | 0 | 1 | 0 | 1 | 0 | 2 |
| | | 14 | 9 | 28 | 39 | 29 | 119 |

It is also logical to expect that farmers' perceptions of water shortage will depend on their perceived irrigation needs and actual water availability. This means that people who grow more water-intensive crops with higher irrigation needs may perceive water shortage as more serious. However, results show the opposite. People in Wang village uniformly grow seed corn which is more water intensive than most crops grown in Wen village, such as cotton and sunflower seed and yet they consider local water shortage less seriously than Wen villagers. This may be because locals perceived that water availability in their area was better.

Local socio-political contexts also have a profound impact on people's perceptions of water shortage situations. For instance, irrigation management in Wang village is contracted to group leaders, whose large majority of payment is based on the principle of 'using more water, charging more fees and getting more profit' so that contractors will always try to get more irrigation access for locals. In Wang village, the village council leaders, local government and water managers seem to share a closer relationship with mutual interests, which make acquisition of water access easier than in Wen village located in the lower reaches, where such networks are loose and water control is stricter. Obviously these context-based experiences lead many people to argue that the water problems that they are facing are not about water shortage, but

networking and paying more for their water uses, whereas most people in Wen village facing difficult experiences in getting irrigation access consider water shortage issues more serious. These findings are in line with discussions in literature showing that experiences and power related contexts are associated with people's environmental knowledge and attitudes(Williams, 1998, Bögeholz, 2006, Maraglino et al., 2010).

#### *2.4.1.3. Perception differences within villages*

Data analysis also demonstrates considerable heterogeneity in perceptions of water shortage among villagers within the same village and water users groups showing that each individual has his or her own perceptions of environmental problems such as drought, desertification and flood (Maraglino et al., 2010). Among 51 respondents in Wang village, around one third marked one point for their water shortage which indicated that there was no physical water scarcity in their area at all, whereas about one third perceived that their water scarcity is extreme or very serious (Figure 2.4). Similarly, 37% of the 68 respondents from Wen village expressed that their water shortage situation is extreme, while 21% believed it is only medium.

#### *2.4.1.4. Impacting factors for perception differences within villages*

In contrast to most extant studies, impacts of demographic factors (gender, age and education levels) on villagers' perceptions of water shortage are rather weak or not significant at all in this study through statistical analysis. For instance, people who are more educated may not necessarily be more water shortage conscious. One explanation for the inefficacy of education in shaping villagers' water consciousness may be that most of the respondents were between age 40 to 50 and had received their education in 1980s and 90s, when water issues in China were generally not considered as a problem nor included in education programs. Almost no respondents could remember any educational experiences related to water shortage. Some people still refer to water as an inexhaustible resource based on their previous education and experiences. The old ideology seems always entrenched and difficult to change (Larson and Edsall, 2010).These evidence further indicates that current education forms such as public hearings, distributing pamphlets or public campaign slogans, have failed to foster positive water attitudes (Eagly and Kulesa, 1997, Kearney and Bradley, 2011). Strengthening people's awareness requires not only increased education or

informational interventions but also the content and effective forms of education (Eilam and Trop, 2012).

To evaluate whether there is a correlation between different variables, statistical tests were employed using SPSS version 21. First due to the types of data for analysis, the Spearman correlation coefficient was used to see if there is a correlation between water shortage mark (on a scale from 1 to 5) and land area. Interestingly, a negative correlation between participants' water shortage mark and current land area ($R^2$=-0.327, p=0.01) has been found, which indicates that respondents with bigger land holding find water shortage is less serious than relatively smaller landholders. Similarly there is also a very significant correlation between people's water shortage marks and their income levels ($R^2$=-0.26, p=0.01). When aggregating these relationships, we find that larger land-holders, with higher income levels tend to believe their water scarcity issues are less serious than poorer villagers and smaller landholders. Considering that economic wellbeing and social capital are closely associated (Ostrom, 2002, Krishna, 2002), people with higher income levels and more social capital may get irrigation access more easily which may lead them to consider local water shortage as less serious. However for those with relatively smaller pieces of land, lower income and less capital, water shortage situations are perceived as more serious.

Personal experiences, water needs and villagers' own definition of what shortage levels as low, medium or high will also have a profound effect on their perceptions of water shortage. In other words, water shortage or the intensity of water shortage can mean different things to different people. For example, what qualifies as "water scarce" depends on how different people define their water needs and availability. One villager who is also a large land-holder expressed that he cannot irrigate all of his lands as before the reform so that the water shortage is very serious. While his neighbour from another water group which owns more pumping wells and has access to more irrigation access, thought the water problem as less serious. This again corroborates the great water perception disparity among different water users because even in the same community or water user groups, people can have very different water use and management experiences. This is also consistent with extant results showing that people's former experiences can have a great impact on their environmental attitudes and behaviours (Whitmarsh, 2008, Williams, 1998, Taylor et al., 1988).

### *2.4.2. Perceived aspects of local water crises*

*"If you control water, you control us" (Interview, local farmer, male 49, Wen village, June, 2012, N6).*

Villagers were asked with open-ended questions to describe the forms of water crises of their areas. As shown in Figure 2.5, most respondents (81% in Wen village and 76% in Wang village) believe water crises to be 'the constraint for local livelihoods and income'. According to the results of interviews with villagers, local water crises can be categorized into three main groups from their perspectives: (1) unreliable and declining irrigation access/control; (2) insufficient irrigation and (3) increasing irrigation expenses. Their understandings of local water crises are not only physical but also socio-political. For instance, many respondents in Wang village do not believe water is scarce in their communities, but assert that they are facing increasing water crises such as failure to get appropriate amount of water at the required time. Moreover, others assert that the increasing irrigation fees over the past few years has made them suffer from significant income loss and made local water crises more serious.

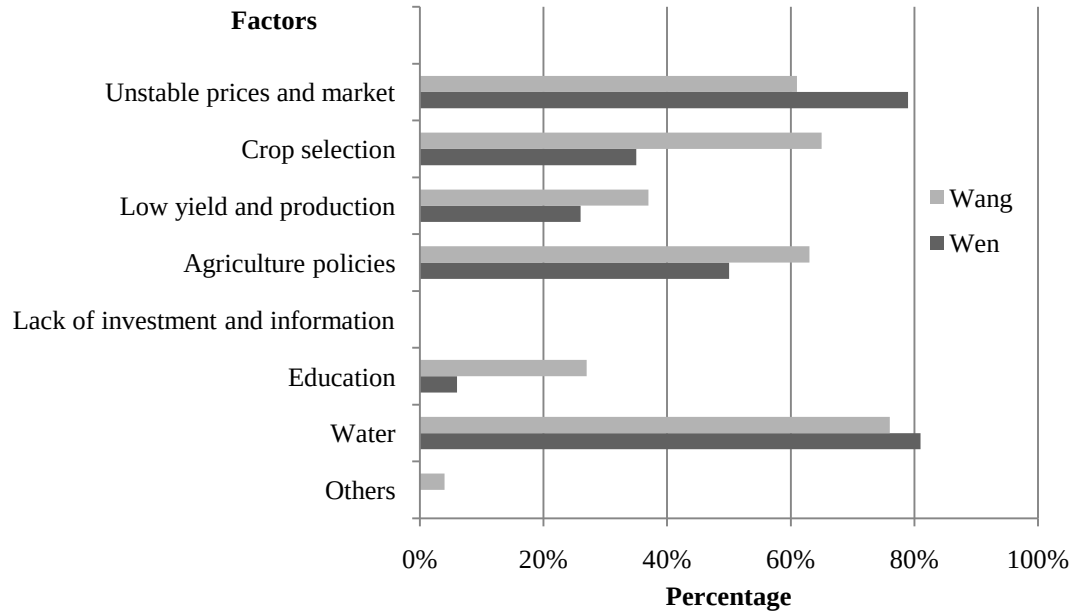


*Figure 2.5 Factors constraining local livelihoods and income from villagers' perspectives*

It is also noteworthy that there are some common characteristics among respondents who believe that they are facing local water crises but not physical water shortage. They share: unsuccessful experiences to get appropriate irrigation include increasing

government water control; experience an incapable team leader who is also the local water contractor not having a good relationship with water agents and local leaders or government officials; they themselves do not have a close connection with water managers and officials; or the undesirable location of their irrigated lands or incapability to influence collective decisions. It seems that what these respondents in both Wen and Wang village have in common is their lack of certain types of capital, particularly financial capital and social capital, such as social networks. This again proves that water crises are not purely natural conditions but are lived experiences that can be constructed differently for different people (Mehta, 2007).

### *2.4.3. Perceived causes of local water crises*

Villagers were further asked about causes of local water crises with the question of "What do you think are the main cause (s) of local water crises". Consistent with Heider's study (1982) which notes that some individuals incline to blame themselves for unfavourable events while others tend to blame other people or other sources, data analysis in this paper shows similar heterogeneity in people's perceptions of causes of local water problems, which can be categorized into natural or anthropogenic factors.

As shown in Table 2.6, villagers mostly (67%) perceived the causes of local water crises as being natural in general including water shortage, higher temperature, less rainfall, drier winters, and extreme unseasonal events during growing seasons, which they further assert are beyond their control so they should not be held responsible. This demonstrates a general lack of connection of stakeholders' own roles and activities with local water problems. On the other hand, local water crises are also perceived to be caused by anthropogenic factors. For instance some (32%) believe that the responsibility lies mostly with the villagers themselves including uncontrolled land extension, groundwater depletion over the years, or cutting too many trees which are supposed to attract rainfall. Still others (55%) believe their water issues are caused by political and social factors, such as government control, unreasonable water policies concentrating on environment rather than local villagers' welfare or livelihoods, inequitable water allocation among different water users especially between upper-middle stream users and downstream users or between well-connected and disadvantaged villagers.

*Table 2.7 Villagers' perceived causes of local water crises (N=119)*

| | |
|---|---|
| **Water competition among different sectors** | **3%** |
| **Government control** | **55%** |
| **Overuse and overexploitation** | **32%** |
| **Natural and climatic reasons** | **67%** |
| **Don't know or Not sure** | **10%** |

In order to explain the individual differences in perceived causes of local water crises, quantitative analysis based on socio-demographic variables were also used to explore the relationship between respondents' characteristics and the perception differences. However results show no statistically significant relationships. But based on qualitative data analysis, some interesting patterns have been discovered. It seems that older villagers (age 50 and above) tend to attribute local water crises to natural reasons. They base their perceptions on their own direct experiences of living and farming locally, as mostly cited: *'the area is more arid because it is much hotter here in summer and so much warmer in winter than the past', 'it rains less and less during growing seasons' and 'with same irrigation amount, time interval between every irrigation for the same crop has to be shortened' (Wen village, male, age 53, N35)*. In contrast, answers of younger respondents about causes of local water crises however are more flexible and diverse. They tend to believe that their behaviour is very likely to have an impact on... These findings are in line with study of Lee and Zhang's (2004) showing that compared with older participants, younger generations were less inclined to attribute desertification to climate change and have more diversified answers.

One of the potential explanations of the age based perception difference is their different existing experiences, habits and information sources(Van Liere and Dunlap, 1980, Zube and Sell, 1986). People construct understanding of their problems with the help of already constituted knowledge (Thomason and Bottomore, 1982, Bird, 1987, Taylor et al., 1988). As Taylor et al argue (1988) local people may be criticized for behaving irrationally while according to their experiences, they are quite rational. After all, water situations used to be a lot worse based on many villagers' especially older generations' experiences and interaction with their environment, which constructed and restricted their understanding. For younger villagers with multiple information and knowledge sources such as the internet and a lack of such experiences with local environment, it seems easier for them to change or accept different ideologies.

## 2.5. Discussion and conclusion

This study gains a clearer and deeper understanding of local perceptions of water crises and the contributing factors that influence them. Consistent with most existing studies showing public perception diversity in different aspects of environmental problems(Taylor et al., 1988, Lee and Zhang, 2004, Lee and Zhang, 2008, Carvalho et al., 2002, Dessai and Sims, 2010), it has shown that there are great perception differences concerning different aspects of local water crises between villages and among individual respondents. Firstly, there are significant perception disparities regarding local water shortage situations. For example, people in Wen village downstream from…believe their water shortages are more serious than those in Wang village upstream. Even in the same village and water user groups, some consider the water shortage as extremely severe while others regard it as not severe at all. Secondly, despite a general agreement of the existence of local water crises, individuals have different perceptions of aspects of water crises. Some express local water problems as physical shortages while others propose that it is about water access, control and affordability. Third, villagers' perspectives on causes of their water crises also diverge considerably. For instance, older respondents believe the causes are natural whereas the answers of young people are more diversified including both natural and anthropogenic factors.

Moreover, factors influencing villagers' perceptions of water crises can vary significantly among different subjects. More interestingly some factors matter more than others. For instance, location, direct personal experiences in local socio-economic and political contexts have the most significant impact on people's water perceptions followed by land area and income levels while gender, age and educational were not significant determinants. More specifically, only age difference seems to have a special effect on people's perceptions of causes of local water crises. In addition, possessions of capital, particularly social and financial capital seem to have a great effect on villagers' perceptions of forms of local water crises. All these indicate that it is prerequisite to understand the interaction between water resources, users and the local socio-political environment within which they are constructed to understand local water crises. More importantly these variables and their impacts when applied to particular situations may

vary significantly and some variables that are relevant to one aspect of water issues in one context may not necessarily be applicable to another.

Instead of being physically determined, water crises are locally lived and constructed within specific social, economic and political situations. This means some of these perceptions may not be accurate reflections of local water situations; however this does not mean that they are useless. On the contrary, these local viewpoints, if properly used, can be very helpful in better understanding local water problems and addressing them more effectively. The present work is consistent with findings of Pretty (2003), showing that local communities lack the ability to grasp that their certain actions may be harmful or to connect them with causes of local water crises. It appears that villagers' water and environmental awareness can only be strengthened when it is substantiated by their experiences, and will be undermined when it shows otherwise(Taylor et al., 1988). In this regard, local groups may need support from higher level authorities and professionals to change their old ideologies so that real changes can finally take place. Although it may not be possible to get generalized conclusions based on findings from this study, these empirical results enrich extant understanding of locals' water perceptions and potential influencing factors in light of the micro-social political context, which can be invaluable in pursuing more effective water management in China and other regions and countries with similar water challenges, especially at local levels.

## Chapter 3 – Paper 2

**“Rushing into action, you fail.**
**Trying to grasp things, you lose them.**
**Forcing a project to completion,**
**you ruin what was almost ripe.**

**Therefore the Master takes action**
**by letting things take their course.**
**He remains as calm at the end**
**as at the beginning.**

**—Tao Te Ching, Lao Tzu, Chinese Philosopher**

# 3. Rethinking WUAs (Water users' associations) and public participation under integrated water resources management (IWRM): a comparative case study in Northwest China

Under review by Journal of Irrigation and Drainage

## Abstract

Water users' associations (WUA) are one of the most acknowledged irrigation reforms over the past decade especially in the developing world. A better understanding of WUAs and public participation from multiple perspectives and the influencing factors can contribute to improvements in water services, management and public acceptability of water policies among others. This paper investigates two typical WUAs in northwest China, drawing upon empirical evidence collected through mixed methodologies. Results show significant discrepancies between understanding, motives and experiences regarding WUAs and public participation among different water stakeholders. These discrepancies are affected by a complex interaction of a variety of factors. The most significant factors are geographical locations, local socio-economic and political contexts, personal experiences, knowledge gaps and incentives and value systems rather than ordinary socio-demographic variables. It concludes that effective implementation of WUAs and public participation has to be context specific and based on accurate understanding of local specifics and shared motives and goals of establishing WUAs and participation among different water stakeholders. The perception differences and influencing factors are discussed in details.

**Key words:** Multiple perspectives; Physical and social factors; Water users' associations; Public participation; integrated water resources management; China

## 3.1. Introduction

Public participation, especially through establishing Water User Associations (WUAs) at local levels, has been increasingly regarded as a key solution to the pressing global water crisis (Narayan, 1995, Ostrom et al., 1999, Jonsson, 2005, Asthana, 2010). Participation is defined as a local process through which the public can have influence and share control over resources, decisions and development initiatives that affect them (Ma et al., 2006). It is argued that through redistribution of labour, power and responsibilities between water officials and users (Vermillion, 1997, Bandyopadhyay et al., 2010) and increased public participation (Narayan, 1995, Priscoli, 2004), WUAs improve irrigation system sustainability, reduce public expenditure and increase irrigation efficiency, allocation equity and standards of services (Meinzen-Dick and Reidinger, 1995).

However, within a large body of literature discussing WUAs, the outcomes are always mixed and vary significantly from case to case. For example, some show that the WUAs have improved the operational efficiency of irrigation systems and reduced allocation conflicts and government burdens (Vermillion, 1997, Narayan, 1995, Liu et al., 2008, Xu et al., 2008). Others argue that this approach has achieved less than expected (Jonsson, 2005, Wang et al., 2010, Yercan, 2003). In practice the driving forces for establishing WUAs vary significantly (Priscoli, 2004) including cost recovery, transferring duties and accountability and alleviating government financial burdens. However little is known about perceptions of WUAs or public participation by different water stakeholders (Wang et al., 2012, Zhang et al., 2008), especially concerning the diversity of local water resources, heterogeneity of water users (Hanatani and Fuse, 2010) and complexity of livelihoods in specific physical, social, economic and cultural contexts (Blaikie, 2006).

The study was conducted under the integrated water resources management (IWRM)

scheme in the Shiyang River Basin, NW China (Yu et al., 2014). The objective of this paper is not to add another case study of WUA evaluation to the extant literature, but to provide a better and deeper understanding of WUAs and public participation experiences in the context of rural China. Based on empirical evidence, this study will provide useful insights into some fundamental issues that are completely lacking in current literature: 1) different perceptions of WUAs and public participation among water stakeholders; 2) factors impacting stakeholders' perspectives on WUAs and public participation in local irrigation management. Although based in arid and semi-arid regions of northwest China, the water problems which are posing serious threats to local livelihoods, stability and development are not unique to China. Some of the experiences may not be directly transferable to other countries or regions; however the basic lessons are fundamental and invaluable to other contexts as well.

## 3.2. Research area

The research was carried out in the Shiyang River Basin (Longitude 101°41′～104°16′E，latitude 36°29′～39°27′N), in Gansu Province, Northwest China (See Figure 3.1). It covers an area of 41,600 $km^2$ with a population of over 2.27 million (), 2007). Surrounded by the Tengger and Badain Jaran deserts, the area has an arid continental inland climate with low irregular rainfall and high evaporation (Li and Xiao, 2005). A large part (77%) of the population living in the basin depend on agriculture for their livelihoods (Gansu Provincial Water Resources Bureau ), 2007). Agriculture accounts for over 86% of all water use (MWR, 2004). The area is a typical example of irrigation-induced growth and stress. Over the past few decades, facing with increasing water demands, particularly from agriculture development (Hu, 2007), local people especially in the middle and lower reaches of the river began to exploit groundwater resources in an uncoordinated manner at an unprecedented speed and scale (Ma et al., 2005a). As a result, the area has been facing serious overexploitation of surface and groundwater resources and related environmental problems (Hu, 2007). Almost all the area is experiencing water stress, meaning that no more water is available for social and

economic development without endangering the environment. Villagers' livelihoods, economic development, social stability and environmental balance have been continuously threatened.

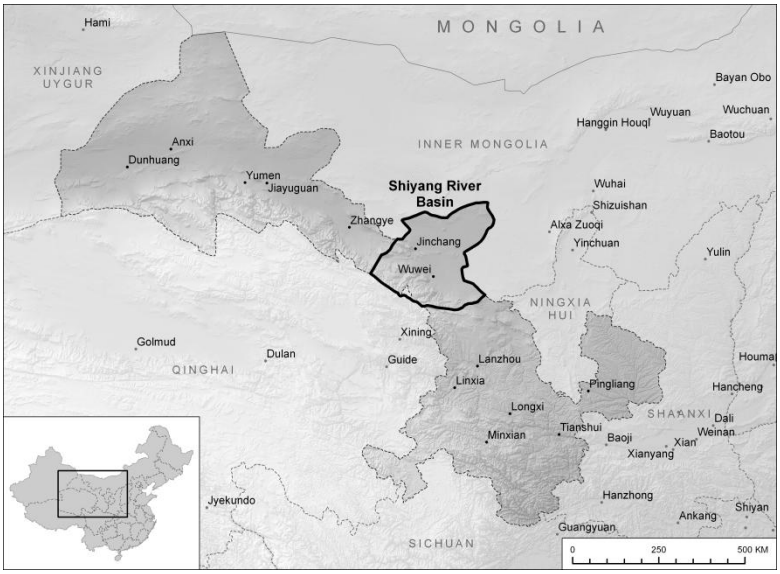


*Figure 3.1 Location of the study Area*

## 3.3. Irrigation management and WUAs

Water resource management in China has always been a political issue (Nickum, 2010). The government owns and controls water resources in a centralized top-down manner, with the political entities planning and making decisions on behalf of the people (Shen, 2012). MWR (Ministry of Water Resources), under the State Council, has the primary responsibility for water resource management, including ultimate responsibility for the preparation of water plans and the management of abstraction permits that balance water demand and supply (Calow et al., 2009, Nickum, 2010). River basin institutions and commissions are then authorized by the MWR to manage water resources in their respective basins. Restructured Water Affairs Bureaus (WABs), at and above county level, are tasked with water resource administration (both urban and rural water, and both surface and groundwater) within their political boundaries in accordance with basin plans. They are directly responsible for constructing and maintaining irrigation

infrastructure, associated irrigation and flood control facilities. The irrigation stations at township level share responsibility for constructing and maintaining branch and lateral canals, ancillary works and small reservoirs, and collecting water fees. Field canals are generally managed by village members. However, since the collapse of the commune system in the 1980s when land was allocated to fragmented smallholder farmers, most local irrigation systems have generally been left unattended (Xie, 2007).

WUAs have been widely accepted and vigorously promoted by the MWR and international donors and organizations (Jonsson, 2005, Lam, 1999, Qiao et al., 2009, Xu et al., 2008, Narayan, 1995, Liu et al., 2008). Theoretically they are farmers' organizations with an executive committee democratically elected by the members (Huang et al., 2010). In the studied area, under water reforms towards IWRM which started from 2007, WUAs were established in a top-down mandated manner to transfer irrigation management responsibilities to local communities. Yet the internal institutional arrangements in the chosen villages are markedly different. Usually they are village-based with an executive committee automatically overlapping with village councils (VCs) under the rule of 'one management team with two boards' (Lu, 2008). There is one membership for every household and this always goes to the male household head. WUAs take over responsibilities for the operation and maintenance of irrigation systems below tertiary levels, collecting irrigation fees, allocating official irrigation quotas to different groups and households, organizing irrigation activities and dealing with conflict resolution. Instead of representing farmers' water needs and benefits, WUAs are generally followers of water policies from higher levels (Wang et al., 2005, Lu, 2008). This is coupled with a water ticket system under which farmers pre-pay. Water users are required to submit an Annual Water Use Plan to their WUAs and administering authority. Water certificates are granted to individual farmers, identifying their share of available water under a WUA/village entitlement. The water quota is based on their certificate volume and the availability they require in a particular year, season or watering. In other words, the granted water certificates are rather informal and the water rights are always changeable from year to year and are not

legally defensible rights. Moreover, instead of carrying out official WUA policies monolithically, local irrigation management depends as much on the socio-economic and institutional environment as on the specific agency of local government officials (Schubert and Ahlers, 2011, Ostrom, 1990). Irrigation water rules are locally designed and vary considerably among different communities, villages and irrigation systems. However, studies on these subjects have hardly received due attention to date (Zhang et al., 2008).

## 3.4. Research methods

To examine villagers' and professionals' perspectives, multiple methods were employed including questionnaire surveys (one questionnaire is designed for villagers and one for water managers), semi-structured interviews (one for villagers and one for water managers), informal conversations, focus group discussions and participant observation. Interview topics focused on the purposes of establishing WUAs, the nature of WUAs, and their effectiveness in improving local irrigation management and public participation. A stratified snowballing method was used to select informants who were representative of the heterogeneous composition of different cultural, social, political and economic groups. Professional informants were government officials, water managers, decision makers, practitioners and researchers at provincial, city, county and township levels. Ordinary villagers together with VC leaders, WUA committee and community leaders were also recruited. In total, 41 water professionals working or researching in the basin and 119 villagers from two sample villages (Wang village and Wen village) were interviewed (See Table 3.1 and 3.2). Interviews were carried out face-to-face either in interviewees' houses, on their farms or in their work places, and last about 1 hour. Five focus group discussions with guiding questions were carried out in Wang village (1 female groups, two male groups and 2 mixed groups); and 7 in Wen village (1 female group, 3 male groups and 3 mixed groups). Questionnaire analysis was carried out through descriptive statistics analysis using SPSS 21. Qualitative data was coded and used to explore and compare different themes in

responses of villagers and professionals. Statements in this paper were formulated and cross-checked by the author after many primary observations, participation and informal discussions with different stakeholders.

## 3.5. Case study villages

Wang village lies in the upper part of the river basin, with a population of 1845 divided into 12 production teams. With an annual rainfall of 164mm and an evaporation of 2000mm, irrigation is indispensible for agricultural production of almost any crops. Groundwater is the only irrigation source for local farmers. The actual average land holding per capita is 5.85mu3 compared with the official record of 2 mu. The major crop is seed corn as cash crop, and wheat mainly for local consumption. The average annual income per person is 6690 Yuan[4] in 2011.

Wen village is in the lower reach and has a population of 1834 people in 10 production teams. Irrigation is dependent on both groundwater and surface water. Increasing surface water supplies from the upper stream started a few years ago through government interventions under IWRM reforms, under the assumption that if more surface water is transferred to the lower reaches, groundwater overexploitation will be reduced. Per capita landholding has been gradually cut to half or less over the past few years, so that it is now 2.7mu per person similar to the official limit of 2.5 mu. Farmers normally grow a combination of wheat, corn, sunflower seeds, cotton and alfalfa for both cash and household consumption. The average annual income per capita for Wen villagers was 5411 Yuan in 2011.

[3] 1 mu=0.067 ha;

[4] Exchanging rate at 1 GBP=10 Yuan

*Table 3.1 Demographic Information of Professionals Respondents*

| ***Personal attribute*** | ***Codes*** | ***%*** |
|---|---|---|
| **Gender** | | |
| Male | 1 | 73% |
| Female | 0 | 27% |
| **Age** | | |
| 20 or younger | 1 | 10% |
| 21-30 | 2 | |
| 31-40 | 3 | 51% |
| 41-50 | 4 | 29% |
| 51-60 | 5 | 10% |
| **Education** | | |
| No education | 1 | 0% |
| Primary school | 2 | 0% |
| Secondary school | 3 | 5% |
| High school | 4 | 5% |
| Vocational education | 5 | 15% |
| College | 6 | 68% |
| Master's degree | 7 | 5% |
| PhD | 8 | 2% |
| **Area of specialty** | | |
| Decision makers | 1 | 12% |
| Water managers | 2 | 46% |
| Researchers | 3 | 10% |
| Practitioners | 4 | 29% |
| Others | 5 | 2% |
| **Time of stay/work in the area** | | |
| Longest | 40 | years |
| Shortest | 1 | years |
| Average | 18 | years |
| **Total** | 41 | 100% |

Total sample size: 41. Different groups were coded for quantitative analysis. For example, female=0, male=1.

*Table 3.2 Demographic Information of Local villagers*

| ***Personal attribute*** | ***Wang village*** | ***Wen village*** |
|---|---|---|
| **Gender** | | |
| Male | 73% | 65% |
| Female | 28% | 35% |
| Head of household | | |
| Yes | 69% | 65% |
| No | 31% | 35% |
| **Age** | | |
| 21-30 | 10% | 4% |
| 31-40 | 29% | 28% |
| 41-50 | 29% | 43% |
| 51-60 | 14% | 18% |
| >60 | 18% | 7% |
| **Education** | | |
| No education | 22% | 6% |
| Primary school | 33% | 28% |
| Secondary school | 26% | 43% |
| High school | 12% | 21% |
| Vocational education | 5% | 1% |
| College | 2% | 2% |
| **Occupation** | | |
| Agriculture based | 100% | 100% |
| Non-agriculture based | 0% | 0% |
| **Time of stay/work in the area** | | |
| Longest | 66 | years |
| Shortest | 3 | years |
| Average | 33 | years |
| **Total** | 51 | 68 |

Total sample size: 41. Different groups were coded for quantitative analysis. For example, female=0, male=1.

## 3.6. Results

### *3.6.1. Professionals' perceptions of WUAs and public participation*

In order to investigate stakeholders' WUA awareness, informants were consulted about the existence of WUAs at local levels in the studied area. Data shows that almost all professionals including government officials, water managers, decision makers, practitioners and researchers, asserted that there were WUAs established locally at

village levels. Most (98 per cent) stated that they knew WUAs well while only 2 per cent reported that they had only heard of WUAs but did not know them well (Figure 2). This indicates that professional respondents are well aware of WUAs' existence and most showed high familiarity with WUAs.

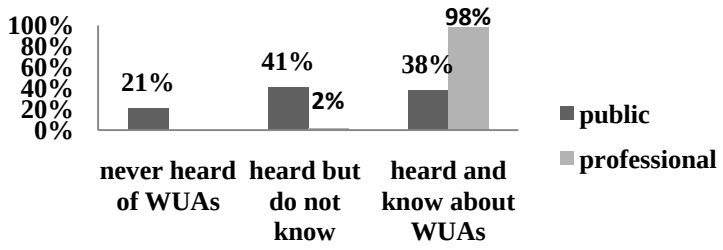


*Figure 3.2 Villagers' and professional's awareness of WUAs*

Professionals were also asked about driving forces and nature of WUAs using two questions: what drives the reform towards WUA, and in their mind and understanding, what is WUA? For them, there were multiple driving forces for WUAs. Firstly, it was to reduce the financial pressures of irrigation and maintenance at local levels and transfer responsibilities for irrigation fee collection, conflict resolution and operation and maintenance of unattended irrigation systems at lower levels, which used to be responsibilities of VCs and township government, to ordinary irrigators. Secondly, WUAs were set up to help facilitate the new water policies and allocation plan at village levels. Thirdly, they aimed to collect irrigation fees and to mobilize local labour and resources in irrigated management at tertiary and lower levels. They also indicated that establishing WUAs was a government policy and a requirement by project donors.

Over half of the professionals responded that WUA leaders and members were decided by local leaders, while 12 per cent stated that it was the decision of local water officials (Figure 3). Around one third also thought that it was local water users who made decisions about WUA leaders and members. As one respondent commented,

*'It does not matter much that WUAs are overlapping with VCs, after all, VC leaders are villagers as well and they are decided by local elections. Remember, there*

*are only a few limited numbers of local villagers who are capable enough to manage, coordinate and make decisions' (interview, male official from city water bureau, age 45, N4).*

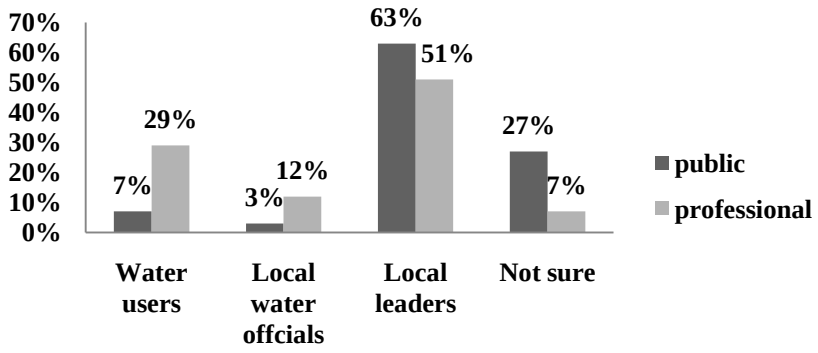


*Figure 3.3 Who decide WUAs' leaders and members?*

Apart from studying different stakeholders' perspectives on WUAs, they were also interviewed about the nature and extent of meaningful public participation in local water-related decision making and management. Most professionals (85 per cent) agreed that public participation in local irrigation management was necessary, which indicates that most professionals have realized the necessity of public participation but did not believe the concept of participatory water governance was practical in contemporary China. A typical quote from an interviewed professional was,

*"The idea of democratic and participatory water governance you mentioned is an idealistic model. Maybe it is achievable somewhere else like the Western societies. In China, it is impossible. We came from a feudal society within which people were and still are used to being governed. The government will not tolerate any factor that may cause instability, conflicts or threat to its power. Even if it (democratic public participation) is allowed, they (the public) will not be able to govern water or operate on their own." (Author's interview, male professional, age 49, N3)*

These findings of professional opinions on the purposes of public participation are consistent with most extant findings (Liu et al., 2008, Lu, 2008, Wang et al., 2010, Ostrom et al., 2011, Kemerink et al., 2013). For instance public participation is considered a necessity because of the increasing costs for water professionals to govern irrigation systems and the difficulty in mobilizing villagers. Professionals expressed

that when irrigators were involved, they would be more collaborative and committed (Jonsson, 2005, Narayan, 1995, Priscoli, 2004, Mostert, 2006). However, most professionals interviewed believed involving or empowering all related irrigators was either unnecessary or impossible. It was the involvement of the more capable and well-connected locals such as VC leaders and team leaders who will facilitate communication, information sharing and implementation of official decisions and bringing changes in people's irrigation uses with less cost and conflict that professionals were more interested in. In other words for professionals, not all local irrigators had the capability to participate, influence and make water decisions. Nor did public participation have any intended impacts on empowering local stakeholders.

Professionals expressed that establishing WUAs had been very successful in increasing villagers' participation in irrigation management. As they further indicated, local irrigators were participating in WUA meetings, irrigation activities, irrigation system operation and maintenance. It seems that although participation is recognized by professionals as necessary in local irrigation management, in practice it is more about information sharing, public cooperation and compliance with official policies rather than public empowerment or self-governance. Overall for professionals, participation is a top-down policy, centralizing the decision making authority and this explains the difficulty for organizations such as WUAs to have real impacts, especially when there are political prices which decision-makers are not ready to embrace (Allan, 1999).

Concerning the effectiveness of WUAs, most professionals (90.2 per cent) reported that WUAs have been useful in local irrigation management, 2.4 per cent considered WUAs were not useful (Figure 4). In terms of where WUAs are most effective, 61 per cent indicated that WUAs had been most effective in conflict resolution. This is followed by 37 per cent, 34 per cent and 39 per cent who chose water saving, fee collection and improving irrigation equity. Only 20 per cent of the respondents believed that WUAs were effective in improving irrigation efficiency or productivity (Figure 5). No respondents mentioned empowering villagers or establishing a cooperative relationship between villagers and professionals through WUAs. Professionals' discussions clearly

suggest that WUA was part of enforcing government control without local hindrances rather than democratic governance or public empowerment.

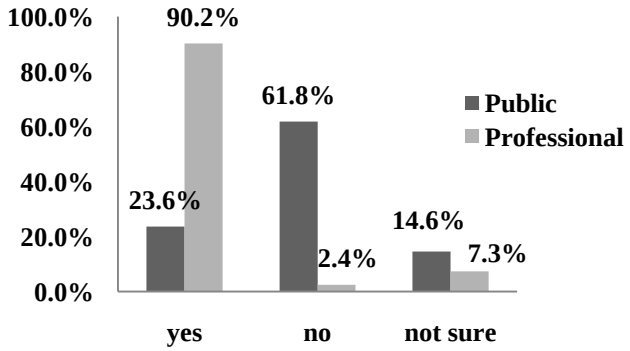


*Figure 3.4 Villagers' and professional's perspectives on WUAs' effectiveness*

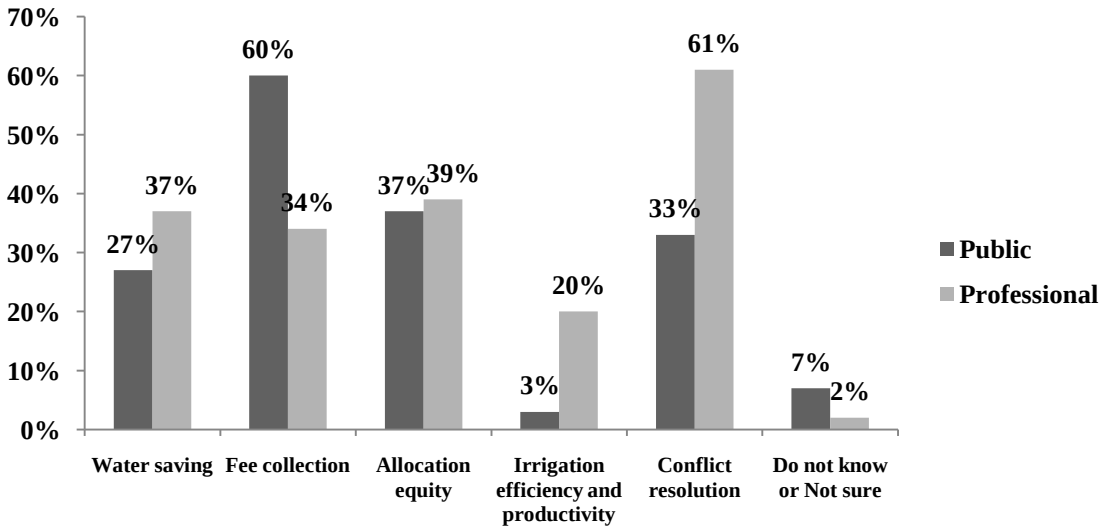


*Figure 3.5 The most effective aspects of WUAs for villagers and professionals*

### *3.6.2. Aggregated villagers' perceptions of WUAs and public participation*

As expected, villagers seemed less aware of WUAs' existence than professionals. Around 79 per cent of villagers (72 per cent of whom are leaders of VCs, WUAs and production teams), were aware of WUAs. Obviously, leaders of VCs and water users groups have shown better WUA awareness than ordinary villagers (Qiao et al., 2009).

Around half (41 per cent) of villagers had only heard of WUAs' existence but did not know what WUAs were. 21 per cent of villagers were even unaware of WUAs' existence after five years of establishment. More specifically, 63 per cent of villagers reported that WUA leaders and members were either VC leaders or were decided by local leaders, whereas around one third (27 per cent) of them were not sure how such decisions were made by whom (Figure 3).

For villagers, the purposes of establishing WUAs also seemed quite ambiguous. Although there were official documents and set rules describing roles and functions of WUAs, most villagers except several VC leaders had no access to such information. As villagers repeatedly mentioned,

*"We can only know what they (external officials and local leaders) allow or want us to know and all we knew is from their word of mouth (koutou chuanda), we have never seen any officially-written documents (hongtou wenjian)" (Interview, male, age 55, Wen village, N19).*

From most villagers' perspective, establishing WUAs was a mandated government policy; WUA was just another government water monitor at village levels, or just another nominal name for VCs. None of the recruited villagers considered establishing WUAs as a process of empowerment or regarded WUAs as their own organizations, and this was the direct outcome of the top-down directives that led to formation of WUAs.

Most villagers (83 per cent) stressed that public participation in local water-related decision making and management was necessary (Figure 6) considering that they were the most direct stakeholders and the most affected, for example, farmers repeatedly expressed *"Our main issue is water. If there is chance for us to participate and make a difference, we are more than willing to (participate)".* Most villagers (78 per cent) showed great interest in participation, but they did not believe WUAs would be able to fulfil this task. Villagers attended WUA meetings on a 'sometimes' basis while only 13 per cent of the respondents said that they participated in all WUA meetings. The processes that villagers are currently involved in are infrastructure construction, and

use, operation and maintenance of local irrigation systems. None of the respondents has yet reported that they have been involved in water planning, decision making, or project monitoring and evaluation. At present villagers only participated in WUAs to get access to predetermined decisions and irrigation information including official water quotas for the coming year, probable time of allocation and irrigation charge. Others considered participation an 'obliged formality' so as not to be fined for non-presence. In different communities, local penalties for non-participation ranged from a verbal warning, extra labour contribution to a certain amount of fine. Still others participated to influence internal decisions, such as irrigation order, labour contribution and allocation of fixed irrigation quota within communities.

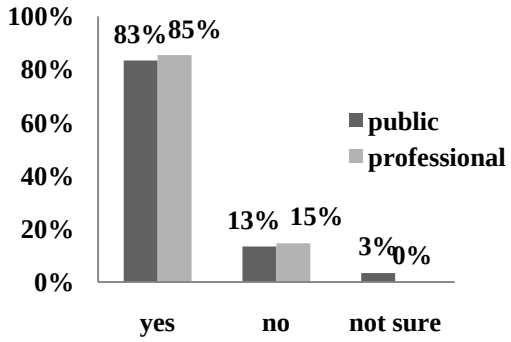


*Figure 3.6 Villagers' and professional's perception of participation necessity*

Following Uphoff and Esman (1974), local people are powerless without organizations or channels to express their needs and have their concerns attended to. Meaningful participation should provide an effective channel to get their needs properly represented by external power holders, especially in the process of planning and implementation of water decisions since this will directly impact their livelihoods and welfare. In other words, the biggest challenge is not whether they are willing to participate but whether they have been offered meaningful participating opportunities, which they strongly believed WUAs were too weak to offer. Typical quotes from farmers include, *"We really want to participate and get our needs and concerns heard by the outside, but there is nowhere to go and there is nothing of this kind that our WUA does" and "There are no opportunities for us (farmers) to participate. Nobody cares*

*for or listens to what we have to say anyway and it has always been like that."* Local people perceived external initiatives of WUAs as camouflaged self-interested agendas with little expectations or trust that these organizations would respond to local concerns (Goodwin, 1998). Realizing this, the powerless were far more interested in working the system to their minimum disadvantage rather than challenging the authorities or changing the larger structures of the state (Scott, 1987). All these make meaningful participation and local empowerment rather difficult, if possible at all.

Regarding the effectiveness of WUAs, most villagers (61.8 per cent) expressed that WUAs were not useful in local irrigation management while 23.6 per cent believed WUAs were useful and still 14.6 per cent were not sure about the effectiveness of WUAs (Figure 4). For villagers, the most effective aspects of WUAs were irrigation fee collection (60 per cent); increasing irrigation allocation equity (37 per cent); conflict resolution (33 per cent) and water saving (27 per cent) (see Figure 5).

### *3.6.3. Perception differences*

#### *3.6.3.1. Between villagers and professionals*

Most existing studies (McDaniels et al., 1997, Lee and Zhang, 2004, Kearney and Bradley, 2011, Vining, 1992) including previous work of the author's (Yu et al., 2013) have shown that environmental perceptions can vary significantly among different stakeholders (McKay and Keremane, 2006). Following previous studies, the Chi Square test is used to determine whether there is a correlation (or relationship) between two categorical variables in a sample, for example being a professional or a villager and awareness of WUAs. So the null hypothesis is that people's WUA awareness is not associated with being a professional or a villager. Consistently, it has been found that people's perspectives of WUAs and public participation also differ significantly, for example between villagers and professionals. Comparing with locals, professionals show better WUA awareness than local respondents ($Chi^2$= 43.71, p=.00) and have clearer understanding of the purposes of establishing WUAs. The Chi-square

test that gives a value of 43.71 suggests that the differences between professionals and villagers are statistically significant at the .00 level. From the professional perspective, WUAs are more effective in practice as well. Moreover, there is significant disagreement about which aspects WUAs have been most effective in. Lastly villagers and professionals also show great disparities in understanding of public participation.

#### *3.6.3.2. Among villagers*

Consistent with most extant findings in China and elsewhere (Orne-Gliemann, 2008, McKay and Keremane, 2006, Ogunjinmi et al., 2012, McMillan et al., 1997, Lee and Zhang, 2004, Krewski et al., 2006), questionnaire and interview results have also shown apparent perception differences among villagers. Firstly, there is a significant perception difference between villagers in the two studied villages. One example is, people's WUA awareness is directly dependent on which village they belong to (See Table 3.3b). Also people in Wen village from the lower reaches are more interested in participation than those in Wang village from the upper reaches (See results from Table 3.3c). Moreover, even within a village or water users group, villagers' perceptions of WUAs and public participation in water affairs also vary greatly, among different gender, education and political groups. For instance, leaders of VCs and water users groups show better WUA awareness than ordinary villagers. Male respondents are more interested in participation than female respondents.

*Table 3.3a Relationship between village and participation propensity*

| Participation propensity | Wang village | Wen village | Total |
|---|---|---|---|
| **Yes** | **30** | **48** | **78** |
| | **59%** | **71%** | **66%** |
| **No** | **21** | **20** | **41** |
| | **41%** | **29%** | **34%** |
| **Total** | **51** | **68** | **119** |
| | **100%** | **100%** | **100%** |

**$Chi^2$=10.35, P= .00**

*Table 3.3b Differences in villagers' WUA awareness among Wang and Wen village*

| | Wang | Wen |
|---|---|---|
| **Aware** | **35** | **59** |
| | **51%** | **87%** |
| **Not Aware** | **16** | **9** |
| | **49%** | **13%** |
| **Total** | **51** | **68** |
| | **100%** | **100%** |

**$Chi^2$=119.00, p=.00**

### *3.6.4. Causes of perception differences between villagers and professionals*

#### *3.6.4.1. Knowledge gaps*

Although there is no general consensus about the causes of the discrepancies between professional and public perceptions, differences in knowledge and expertise (Hansen et al., 2003) and information sources (Brunk, 2006) between the two groups is one of the most widely accepted explanations. The perception inconsistencies between professionals and local villagers can be explained by the fact that water professionals and officials have more access to related information and training (Lee and Zhang, 2004). These two groups have little shared experience and therefore little common insight (Vining, 1992). For example, when evaluating WUAs, professionals were using their experiences as references, which always involved more than one WUA at a larger scale such as county, city or river basin scale that their work is set in, whereas for locals it is based on the specific WUAs that they locally participated in.

#### *3.6.4.2. Incentives and value systems*

Another explanation found for the perception disparities between locals and professionals is their different value systems, motives and expectations in establishing WUAs. The perceptions and viewpoints of locals and professionals are never neutral (Rinaudo and Garin, 2005). For example, increasing irrigation fee collection, cost

recovery and reducing staff from government and water agencies, which have been realized through establishing WUAs, work to make professionals believe WUAs are successful, whereas none of these factors work the same way for local water users. In addition, for many of the professionals interviewed, implementation of WUAs is one of the evaluation indexes for their performances under the administrative system (Edin, 2003), which further explains their better awareness. Establishing WUAs, for example the number of WUAs founded and irrigated areas managed through WUAs, are among the evaluation criteria for work achievements for local leaders and water officials. Thus professional respondents will direct evaluations to favour their interests (Clark et al., 2009, Vining, 1992).

### *3.6.5. Causes of perception differences among villagers*

#### *3.6.5.1. Geographical Factors*

Based on results from 119 questionnaires from two case study village, regarding factors that may have caused the perception differences between two villages, it seems that geographical location plays a critical role in shaping villagers' perceptions (Zube and Sell, 1986, Slegers et al., 2005, Meze-Hausken, 2004). Similarly in this study, Chi-square tests are used to test the statistical differences between two villages to test whether there is a correlation/association between categorical variables. The null hypothesis is that people's WUA awareness is not associated with which village they are in. Results show that there are significant perception differences between the two villages studied regarding WUA awareness ($Chi^2$= 5.78, p=. 01), and participation interest ($Chi^2$= 9.29, p=. 00). People with better understanding of their water situations also show greater participating interest ($Chi^2$=4.33, p= .05) (See Table 3.3c). As Gilbertson et al. (2011) indicate, people are more inclined to participate when they are in places that face more severe water situations, as those in the lower reaches of the basin. Results show a positive relation between people's awareness of water scarcity and their participation propensity. In other words, people who are more aware that they are facing high water scarcity also have higher interests in participation.

#### *3.6.5.2. Local contexts*

Although influenced by geographical locations, villagers' perception differences are not necessarily predetermined but shaped throughout the process in which WUAs have been introduced, implemented and evaluated in specific contexts. Considering the large scale and context diversity of local conditions, there will be significant differences in the way WUAs are implemented in practice (Agrawal and Henderson, 2002) and this will in turn unavoidably influence how villagers perceive WUAs. For example, results show that the top-down implementation manner, focus on short-term mass production of WUAs and lack of meaningful participation and representation have had adverse impacts on participants' belief and interest in WUAs. It is equally important to highlight the roles of VCs and villagers' relationships with them, which play an essential role in shaping local perceptions of WUAs. For example, whether the relationship between ordinary villagers and local leaders is seen as collaborative or manipulating; whether VCs represent villagers' needs and benefits or simply follow official policies; and whether information sharing is transparent and bi-directional, will all impact on people's knowledge of WUAs and on their roles within the local context of water management. Whether intended or not, these processes together with pre-existing context-specific relations such as local regulatory institutions and communal trust, will generate an impression and be perceived by villagers as representative of some specific social groups. This is consistent with Duan's study (2005) on China and the US, which shows that people's perceptions of environmental risks, management preferences and participatory decision processes are impacted by the different social, cultural and political contexts.

#### *3.6.5.3. Socio-demographic Variables*

Socio-demographic factors can influence people's environmental attitudes (Kearney and Bradley, 2011, Van Liere and Dunlap, 1980, Dietz et al., 1998), for example age, gender, education and income. In this study a simple correlation and Chi-Square Test using SPSS (Version 21) was used to test the null hypothesis that there was no

correlation between socio-demographic factors and people's WUA awareness, or that these two are independent. The dependent variable is scale variable, people's WUA awareness on a scale of 0-never heard of it, 1-heard of it but don't know what it is and 2-heard and know about it. The independent variables here are: 1) gender, 0-female, 1-male; 2) education on a scale of 1-6 and one means no education, 6 means colleges and above; 3) household head status, 0-no household head, 1-head of the household. The statistical test here is just to determine if there is a correlation/association between the dependent and independent variables. Results shows that villagers' WUA awareness is also closely related to their gender (Spearman's correlation $R^2$= 0.362, p=0.01), education (Spearman's correlation $R^2$= 0.387, p=0.01) and household head status (Spearman's correlation $R^2$= 0.364, p=0.01) while age and income levels had no significant impact on villagers' WUA awareness.

Agrawal and Gupta (2005) have found that local participation interests are influenced by socio-demographic factors. Statistical analysis was carried out to check if these socio-demographic factors including age, gender, education level, marital status, land holding, family size, and income level and livelihood diversification influenced people's participation propensity in local water decision making and management. There is a significant influence of gender in villagers' participation propensity ($Chi^2$=14.54, p= .00, see Table 3.4). Male respondents show higher participation propensity when compared with female respondents. It can be explained as a reflection of the traditional biases, male domination in governance and decision making and women's low confidence and educational levels (Meinzen-Dick and Zwarteveen, 1998, UNDP, 2003). Another contributing factor may be the gender blindness and lack of any efforts to encourage women to participate (Dietz et al., 2002, Meinzen-Dick and Zwarteveen, 1998, Lu, 2008). This gender-blindness may have consolidated existing gender inequity (Hussain, 2007) and discouraged women's participation propensity.

*Table 3.3c Relationship between Perceived Water Scarcity Mark *Participation Propensity*

| | | Water scarcity mark | | |
|---|---|---|---|---|
| | | **High** | **Low/Medium** | **Total** |
| **Participation propensity** | **Yes** | **55** | **34** | **89** |
| | | **82%** | **67%** | **75%** |
| | **No** | **12** | **18** | **30** |
| | | **18%** | **33%** | **25%** |
| **Total** | | **67** | **52** | **119** |
| | | **100%** | **100%** | **100%** |
| **$Chi^2$=4.33, p= .05** | | | | |

*Table 3.4 Relationship between Gender*Participation Propensity*

| **Participation propensity** | **Male** | **Female** | **Total** |
|---|---|---|---|
| **Yes** | **69** | **20** | **89** |
| | **85%** | **53%** | **75%** |
| **No** | **12** | **18** | **30** |
| | **15%** | **47%** | **34%** |
| **Total** | **81** | **38** | **25%** |
| | **100%** | **100%** | **100%** |
| **$Chi^2$=14.54, p= .00** | | | |

Analysis of the questionnaires shows influences of most variables including organizational membership were not significant. This can be explained by the fact that most WUA membership remains nominal on paper and many WUA members are not even aware of their membership status or the existence of WUAs. In other words, there is no relationship between people's WUA awareness and their participation propensity in water decision making and management. This means people with better awareness of current WUAs may not necessarily be more interested in participation, either because they do not share a clear understanding of the potential benefits and necessity of participation or because they do not think real differences will be made whether they participate or not, based on their WUA experience. As one female respondent commented,

*"It does not matter much whether we (women) participate or not (in WUA*

*meetings). We can always get the announced official decisions from our neighbours or relatives. Most people just feel it is more reasonable to do something more meaningful such as taking part-time jobs than just sitting there and be notified. There is no decision for us to make"* (Interview, female, aged 49, Wen village, N15).

#### *3.6.5.4. Personal experiences*

Personal experiences related to WUAs at village, community, household and individual levels in specific local contexts also have a great impact on villagers' perceptions (Yu et al., 2014, Yu et al., 2013). Lam (1999) argues that people growing up in different communities are likely to have different ideas and conceptions about their environment and may even view a similar phenomenon in very different ways. As discussed above, the implementation process of WUAs at village levels obviously influence villagers' understanding of WUAs and participation interest. Furthermore, within villages, daily activities related to WUAs mostly centre on community and household levels, especially with leaders of each water users group. Thus the characters, capability and management styles of different team leaders, for example whether these intermediaries have good understanding of WUAs, openly share related information with local villagers and make collective decisions in a participatory and democratic manner, will undoubtedly lead people's perceptions of WUAs and participation in diverse ways. For example, the elite-captured management pattern in Wang village, together with VC leaders' understanding of WUA as a government tool for water control, have led villagers to believe WUA is VC rather than farmers' own organization. Individuals' specific situations and perceived costs and benefits will also have a significant impact on their understanding of WUAs and participation interests (Narayan, 1995, Frewer et al., 2003). It has also been found that experiences of being leaders of water users groups and VCs, having frequent communication with local leaders and living in the village on a regular basis will impact respondents' WUA awareness and participation propensity. These findings are consistent with previous studies indicating that people's direct experiences influence their environmental perceptions (Goodwin, 1998, Williams, 1998, Whitmarsh, 2008, Spence et al., 2011, Keshavarz et al., 2013).

## 3.7. Discussion and conclusion

Public participation is embedded in virtually every aspect of today's solutions to water problems (Yu, 2014). Participatory irrigation management, especially through WUAs, is increasingly considered a standard practice. Many international donors have sponsored water projects all over the world, for example Oxfam in SRB, which encourage villagers to participate in project design, implementation, monitoring and evaluation. The efforts of the Chinese government both at central and lower levels in publicizing public participation in China's water issues have attracted much attention (Nickum, 2010). However much less is known from different stakeholders' angles. Therefore investigation of different stakeholders' perspectives on WUAs and public participation in water related decision making and management is essential.

As shown, the established WUAs have only symbolic meaning in the studied area and have done little to improve policy-making process or meaningful public participation. What was found was that actually in many cases, villagers' understanding and experiences of WUAs have adversely impacted their participation propensity, depending on the different angles from which communities viewed the issue of participation and government-initiated water projects. The people wanted to participate in water decisions and activities that will produce a tangible outcome. It appeared that the level of understanding of WUAs and public participation by different communities, beyond what WUAs could produce, was minimal and left communities to a large extent isolated from the projects. The current government concept of WUAs and public participation shaped the institutional contexts, forms and outcomes of water reforms towards participatory irrigation management in the area studied. It was insisted that constructing WUAs and increasing public participation was an instrument to support government water policies and protect government defined interests rather than empower locals to protect themselves against the government.

Built on top-down water control and WUA implementation, both villagers and

professionals have very few incentives to perform participatory water governance effectively. In fact the institutional settings in which local officials finds themselves are often conducive to opportunistic behaviour at the expense of villagers' well-being. Nor do they face any effective incentives to build up a long-term cooperative working relationship with villagers. Not only does this have serious effects on and implication for the ways how villagers and officials perceive WUA and participation in these systems, it more importantly triggers off a process which discourages villagers from engaging in problem solving.

Villagers were aware that their participation was at the discretion of the powerful who maintained control over which types of participation, who participates and when. There is looming mistrust by the communities to see meaningful participation and empowerment (Yu et al., 2014). The way that WUAs were introduced to the communities made villagers passive recipients rather than active participants. This left communities with a misunderstanding of the nature and objectives of WUAs and participation and in return adversely impacted the implementation processes and outcomes of WUAs. Achieving all the required conditions for participatory irrigation management is challenging especially in villages that have in the past been left with empty verbal promises. More should be invested in understanding the various stakeholders and their problems rather than proceeding with projects in the communities without taking major impacting factors into account.

By examining the kinds of perceptions of WUAs and participation, it aimed to understand why officials and villagers are making choices, behaving and interacting in the ways that they are and to seek the links between various perceptions and patterns of actions and interactions of different individuals and groups. This paper does not aim to offer representative results of local and professional perceptions of WUAs, nor does it claim that the use of research and analysis approaches is flawless. It shows the significance of local contexts and stakeholders as well as the synergy between them in perceiving and implementing WUAs and public participation in local

water management. The complexity of contexts and coexistence and interaction of multiple stakeholders are key features in irrigation management and water reforms (Rogers and Hall, 2003) such as WUAs. Significant perception differences and even conflicting opinions have been found not only between locals and professionals but also among different villages and communities. Although respondents have begun to realize the importance of public participation, it seems that both professionals and villagers lack an accurate and shared understanding of participation and WUAs.

Perceptions of WUAs are impacted by factors including knowledge bases of different groups, moral and value systems, local contexts and personal experiences. Partly consistent with most existing findings, the statistical analysis suggests some socio-demographic variables including gender, education levels, and household head position have great impact on people's WUA awareness, while only gender has some influence on villagers' participation propensity. However, perceptions entrenched in people's ideologies can be steadfast and hard to change (Fiske et al., 2010, Larson and Edsall, 2010). On the other hand, the common understanding shared by communities that provides the foundation for their behaviour and interaction with external authorities can hardly be manipulated or controlled by government officials or researchers (Lam, 1999).

Instead of being just a technical or institutional process, or a government action, participatory irrigation management is a complex, localized, social-political process (Molle, 2009, Yu et al., 2014, Yu, 2014). Findings from this study constitute a note of caution for the ways that many WUA programmes have been mass-produced or externally imposed in China and across the globe. Not surprisingly, centralized implementation can be an efficient way of establishing WUAs. However, it has shown that the well-intentioned reforms have brought little real changes other than being generally considered as nominal, weak and ineffective (Yu et al, 2014). Local water stakeholders who appropriate water from irrigation system are not just resource users but a critical element in the management of the systems (Lenton, 2014, Yu, 2014).

However, their roles remain passive and highly constrained to contribution of cheap or free labour in the operation and maintenance of irrigation systems. These results are relevant in the context of work by other researchers that show similar results (Huang et al., 2010, Wang et al., 2010, Garande and Dagg, 2005).

It is fair to conclude that enforced WUAs without reference to the socio-political specifics of collective action around irrigation systems in the Shiyang River basin, NW China would provide a very poor guide to action or to understanding for state or development agencies (NGOs or international donors) to promote participatory irrigation management under currently fashionable IWRM reforms. Partial transfer would at best induce partial benefits (Samad and Vermillion, 1999), which if not appropriately dealt with may even undermine current situations (Irvin and Stansbury, 2004). On one hand it may discourage professionals' efforts and incentives to devolve power or increase meaningful public participation. On the other hand it may adversely impact villagers' understanding, trust and participation interests in WUAs. Both in turn will influence implementation and outcomes of WUAs and water management. As shown, one of the biggest challenges in China's irrigation management is to build an open platform where opinions can be formed and exchanged, where the public can be interested to participate and the professionals are willing to delegate power so that real changes which are adjusted to local contexts and stakeholders can happen in practice. There is no simple panacea such as establishing WUAs to this issue.

## Chapter 4 – Paper 3

**“Learn from the people**

**Plan with the people**

**Begin with what they have**

**Build on what they know**

**Of the best leaders**

**When the task is accomplished**

**The people will remark**

**We have done it ourselves.”**

**—Tao Te Ching, Lao Tzu, Chinese Philosopher**

# 4. From Principles to localized implementation: Villagers' experiences of IWRM in the Shiyang River Basin, Northwest China

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## Abstract

Understanding perceptions of resource users and influencing factors that affect these perceptions have significant value in evaluating successes and failures of IWRM reforms. This paper explores villagers' experiences of China's recent powerful enforcement of IWRM (Integrated water resource management) and the locally perceived impacts through three in-depth case studies. Results show that neither villagers' perspectives nor the implementation processes and outcomes are monolithic. Political trust plays a key role in shaping villagers' perspectives and responses towards IWRM, which is constantly shaped and reshaped by understanding, experiences and negotiation among different stakeholders in the embedded physical, socio-economic and political environment.

**Key words:** Villagers' perspectives, political trust, IWRM, Shiyang River Basin, China

## 4.1. Introduction

Sustainable water governance is essential for society, but remains a formidable challenge across the world (Biswas and Tortajada, 2010). Over the past few decades, the water management paradigm has progressively shifted from the traditional "hard path" approach to a "soft path" (Gleick, 2003), complementing equitable pricing, decentralization, participatory decision making and environmental protection. Integrated Water Resources Management (IWRM) is a process that promotes coordinated development and management of water, land and other related resources to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP 2000), with a special focus on the critical role of public participation.

Scholars argue that public participation will better adjust government intervention strategies to local contexts, increase rate of adoption, reduce management costs and transform adversarial relations into partnerships (Reed, 2008, Susskind, 2013). However, the involvement of stakeholders cannot automatically achieve these objectives (Meinzen-Dick et al., 2002), which to a large extent depend on the processes that lead to it (Reed, 2008, Yu et al., 2013). More specifically, improving irrigation management requires understanding and management of multiple stakeholders and the synergies among them throughout implementation process, which directly influence the implementation and outcomes of IWRM (Tortajada, 2010). Therefore, to understand and assess local IWRM solutions, it is essential to explore different water users' agendas.

However, most IWRM studies have focused on the discussion of potential implementation challenges and outcome assessments from outsiders' perspectives. Notably, there are practical concerns about its wider applicability, considering it has been developed in the West and may not easily transfer to the developing world

(Swatuk, 2005, Biswas, 2008, Grigg, 2008, McDonnell, 2008, Taylor, 2010, Nesheim et al., 2010). To the authors' best knowledge; there is little in-depth analysis of empirical evidence to date on public understanding of IWRM principles, implementation processes or impacts based on insiders' understanding in China

IWRM was written into China's 2002 Water Law and since then has become a general policy framework for water management. However, although the literature emphasizes the roles of local stakeholders, contexts and scales in water governance (Ostrom, 1990), in China as in most other countries, both water policies and research on IWRM take a national or a regional rather than a local perspective. In practice, the incentives for and the processes and impacts of IWRM reforms vary considerably among different actors, households, communities and villages in diverse socio-economic environments. More importantly, implementation of IWRM in these contexts can be severely restricted if key factors influencing those who are carrying out IWRM processes remain overlooked (Goldin et al., 2008). Agrawal (2001) has classified factors impacting resource governance into four categories: characteristics of resources, users, institutions and external environment. In this paper we focus on characteristics of the institutions and environment, more specifically how the factor of political trust affects people's perceptions and reactions in water management process.

The crucial role of political trust in managing natural resources, including water, land and forest resources, has received much attention (Abers, 2007, Breetz et al., 2005, Leahy and Anderson, 2008). Much work has been done regarding how trust in either institutions or regulatory actors affects people's attitudes and responses (Brunk, 2006, Priest et al., 2003). There is a general consensus in the literature that trust in management agencies or government can help increase participation and cooperation, bring public support of policies and decisions without coercion (Sharp et al., 2012b, Manion, 2006, Shi, 2001), while distrust induces doubt, uncertainty and even resistance (Shindler et al., 2002) which can threaten the regime and its principles. Others (Wade, 1988, Juntti and Potter, 2002, Goldin, 2010, Mariola, 2012) argues that the performance

of natural resources management systems depends on local trust in officials and the bigger the systems are, the more crucial the trust elements will be. Leachy and Anderson (2008) also suggest that in the USA trust has severe implications for quality and durability of natural resources policies, while Goldin (2010) suggests that distrust between the public and government is an entrenched obstacle to water reforms in South Africa. In addition, Mariola (2012) proves that trust helps water quality programs succeed through making information more credible to farmers and making projects more acceptable and efficient; and Parkins & Mitchell (2005) similarly show a clear relationship between trust and participatory governance of natural resources. However despite the growing body of literature on the significant role of political trust in the success and sustainability of natural resources management, little has been reported on China.

A number of studies have discussed Chinese villagers' political trust in government (Shi, 2001, Manion, 2006, Li, 2008, Yan, 2010, Yang and Tang, 2010). There are two major contrasting views: one is that the Chinese government has managed to maintain a high level of political trust despite all the changes over the past few decades; the other argues that public, especially villagers' trust in government has declined over the years. More specifically O'Brien (1996) and Li (2010) for example have described the political trust of villagers as divided, which means people attach different degrees of trust to different government levels with a generally higher rate of trust in central government and distrust in local government. Political distrust in local government tends to make villagers uninterested in participating in conventional political activities and adopt aggressive political behaviour (Yang and Tang, 2010). However as yet there is no empirical research in China on the role of political trust in accepting and implementing government water policies, more specifically IWRM policies, particularly at the local level.

To fill in this gap, the crux of villager–state relations and the role of political trust in IWRM processes and outcomes are the centre and original contribution of this article.

Although based within the socialist authoritarian context of rural China, the problems discussed here are not unique to China and thus the findings of this paper should have valuable implications for water governance and IWRM agendas in other regions and countries with similar water-related problems.

## 4.2. Study area and research methods

The study was carried out in the Shiyang River Basin (101°41′～104°16′E， 36°29′～39°27′N), in Gansu province, northwest China (Figure 4.1). It covers an area of 41600 $km^2$ with a population of 2.27 million. Surrounded by the Badan Jairan and Tengger Deserts, the area has an arid continental climate with low, erratic annual rainfall and high evaporation. It is divided into three climatic zones: (1) southern mountain area, with an elevation of 2000-5000 metres above sea level, average annual rainfall of 340-650 mm and evaporation of 720-1200mm; (2) middle arid and semi-arid region, with an elevation of 1500-2000 metres, average annual rainfall of 160-340mm and evaporation of 2000-2200 mm; and (3) northern arid zones surrounded by deserts, with an elevation of 1300-1500 metres, less than 150 mm of annual rainfall and 2200-2640 mm evaporation.

Agriculture remains the dominant livelihood and supports over 77% of the local population. Irrigated agriculture accounts for over 86.4% of all water uses. Over the past few decades, due to rapid socio-economic development and population growth throughout the basin, water utilization rate in the basin has reached 172% (i.e. the ratio between actual water use and total water availability is 172:100). Good summaries of water exploitation history and the physical water problems in the area including physical water shortage, groundwater overexploitation with falling groundwater tables, land degradation, salinization and desertification, are discussed by Kang (2004) and Ma (2005a) among others. These water problems have been increasingly threatening local people's livelihoods, socio-economic development, stability and environmental balance (Ma et al., 2005a). The area is a typical example of unbalanced water allocation

between upper and lower stream water users, between society and nature, and between current and future generations.

In 2007, IWRM reforms were initiated in the Shiyang river basin aiming for more effective, equitable, and sustainable water management. IWRM reforms include introduction of water rights, water pricing and compulsory irrigation quotas; shutting down pumping wells; reducing irrigated land area; construction and rehabilitation of water infrastructures and changing from traditional water-intensive agriculture patterns that are grain-based to new cash crop based patterns. Under the guiding principles, the detailed implementation measures can always vary from one case to another. For example under the slogan of "2311" in downstream Minqin County, the official target is 2 mu of greenhouse, 3 mu of fruit trees, 1 mu water-efficient field crops and 10000 Yuan annual income per capita for every household (1mu=0.067 ha, 1Yuan =0.1GBP). IWRM policies provide the comprehensive framework and set the main official targets, while how these targets are met and the specific measures to achieve them are at the discretion of local governments.

Three villages in the upper, middle and lower reaches of the river basin: Wang, Wen and Xin villages were chosen as in-depth case studies (see Figure 4.2 and Table 4.1) Since it is clear that this study entailed a degree of risk for the people and villages investigated, the names of the villages are pseudonyms to preserve anonymity . Both quantitative and qualitative methods were employed including questionnaire surveys (162 participants, 51 in Wang village, 68 in Wen village and 43 in Xin village), semi-structured interviews (100 participants; some key informants participated in both questionnaire survey and semi-structured interview), group discussion, participant observation and many casual conversations. Villagers were interviewed regarding their understanding of the four basic principles of IWRM, the purposes and actual impacts of IWRM policies. Key informants included village council members, community leaders and villagers. They were selected using a stratified and snowballing sample method.

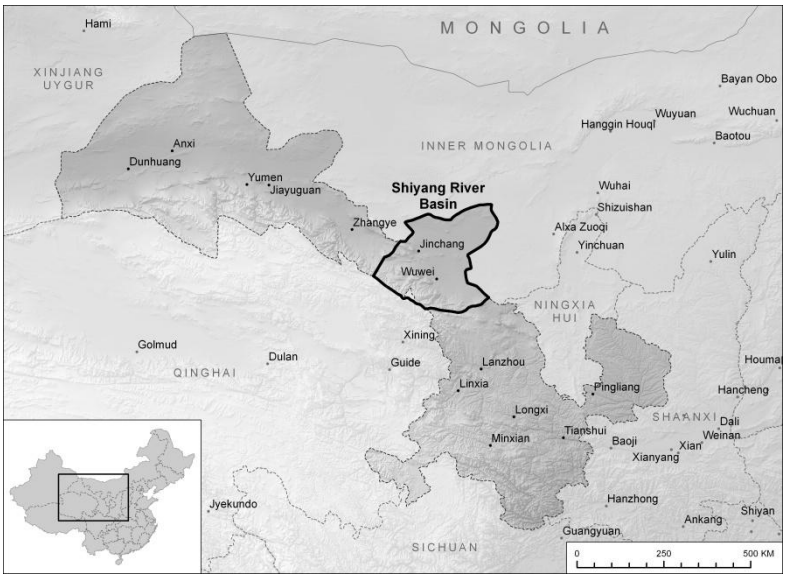


*Figure 4.1 Location of the Shiyang River basin in Gansu Province, China*

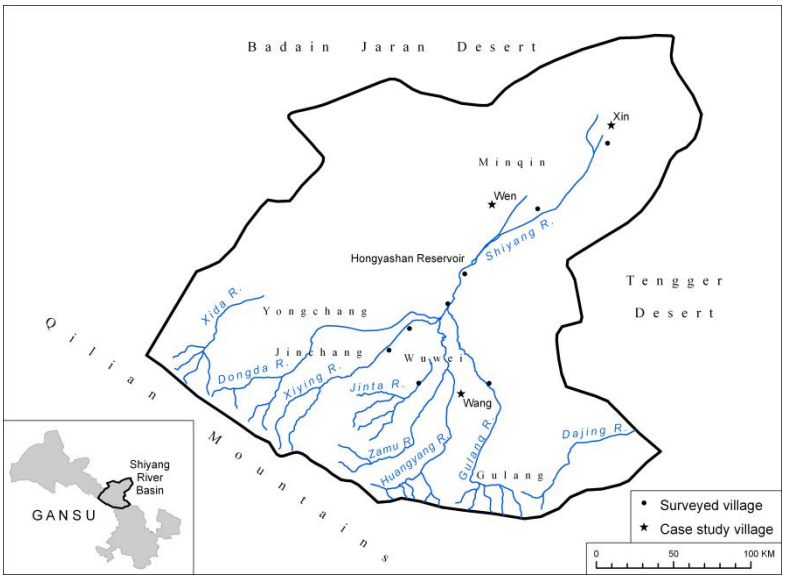


*Figure 4.2 Location of the case- study villages in the Shiyang River basin*

*Table 4.1 Comparison of villagers' awareness of IWRM principles among three villages (%)*

| Village | Principle 1 | Principle 2 | Principle 3 | Principle 4 |
|---|---|---|---|---|
| **Wang** | **66.7** | **70.6** | **88.2** | **25.5** |
| **Wen** | **70.6** | **72.1** | **83.8** | **45.6** |
| **Xin** | **86.0** | **79.1** | **60.5** | **44.2** |

## 4.3. Understanding the IWRM concept: the four basic principles

Villagers were questioned on their understanding of the four basic principles of IWRM, also known as the Dublin principles (GWP, 2000). The four principles are: (1) Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment; (2) Water is a public good and has a social and economic value in all its competing uses; (3) Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels; (4) Women play a central part in the provision, management and safeguarding of water.

### *4.3.1. Principle 1 – Water as a finite and essential resource*

Traditionally, water, especially groundwater, had been perceived as an infinite, open-access resource in China. However, Figure 4.3 shows that among 162 villagers, most (73.5%) agreed that water was a limited and vulnerable resource, while others (26.5%) showed disagreement. There is also a perception difference among respondents from different villages (Table 4.2). It seems that people have a better understanding when they experience or perceive more serious water problems (Whitmarsh, 2008). In addition, there is also a distinct difference between villagers' perception of groundwater and surface water. As one farmer (55 year-old male, Wen village) explained, "For groundwater, the water table may fall one metre per year, but we can always dig deeper". It seems that most interviewed villagers largely based their understanding on former experiences. Other respondents consider that there will always be some groundwater since the water from irrigation goes directly back to the

ground. This shows that some villagers are not well aware of the fact that their over-exploitative behaviour, especially for groundwater resources, will cause perceptible damage to local resources and environment. This finding is in line with Berkes (2002) and Pretty's (2003) argument that villagers do not always have the knowledge to appreciate that their behaviour may be harmful even though scientific evidence and government reports show that it is. Our finding further suggests that external support from environmental NGOs, government agencies or other international organizations in finding effective ways to improve villagers' collective consciousness and water knowledge base is urgently needed.

### *4.3.2. Principle 2 – Water as a social and economic good*

About the social and economic nature of water, 73.5% of villagers expressed the view that any people using the state's water for irrigation should pay for it (see Figure 4.3, principle 2). Results show that despite the increased irrigation water price, most villagers are very willing to pay for their irrigation uses. Actually, most villagers including the poor are more than willing to pay even more for better water services. For example, one villager (46 years old, male, Wen village) commented, "If reasonably priced and correctly measured, we certainly would like to pay for our irrigation water uses". It has also been found that there is a difference between villagers' willingness to pay, in the order from upper to lower reaches: Wang village<Wen village<Xin village. Thus, people in the lower reaches who are at a natural disadvantage compared to their upper-stream competitors are more willing to pay for irrigation water uses. On the other hand, despite this general willingness to pay, villagers share much deeper concerns about irrigation water prices, the calculation methods and the expenses of their water fees that are collected by the government and water agencies at lower levels. These concerns together with a severe lack of transparency in ways of calculating water fees and the expenses of collecting them have resulted in villagers' distrust, which directly influenced villagers' attitudes towards Principle 2. For example, as one villager from Wang village explained, *"I do not know how the amount of water fees is calculated by*

*upper levels or what it is for. All I did was to pay however much they (officials) ask for as all my neighbours did" (Interview, male, age 44, Wange village, N31).*

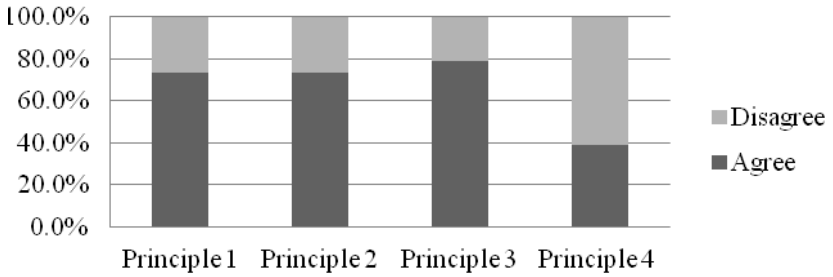


*Figure 4.3 Villagers' understanding of the four basic principles of IWRM (N=162), see question 49 in Appendix 1.*

### *4.3.3. Principle 3 – Participatory water management*

Another key IWRM principle is participatory water management, for instance to increase public participation in decision-making, management and supervision of water rights, water pricing and water allocation processes, through villagers' organizations such as water user associations (WUAs). Actually WUA has been made a mandatory mechanism for irrigation management in the area studied. Villagers' perspectives regarding public participation in water management shows a general consensus in relation to participatory irrigation governance (Figure 4.3, Principle 3). However, analysis of qualitative data further suggests that despite this general agreement, villagers have more doubts about the genuine opportunities for participation and its potential effectiveness. One farmer argued: *"How can they (officials) let us (farmers) participate and make decisions when they need to use it (water) to control us do their biddings and pay their salary?* (Interview male, age 49, Wen village, N29)*"* Another villager went even further, *"Everything has been officially fixed while there is nothing left for us to decide, that is why so few people are interested in participation even when there are fines for non-participation"* (Interview, male, age 55, Wang village, N21). Elsewhere Yu et al. (2013) show that participation incentives are directly related to the actual participation processes in a specific time and context. IWRM policies of decentralizing local irrigation governance by creating mandatory organizations such as

WUAs have actually jeopardized potential participants' interest in participation per se. The state and local governments have shown themselves to be powerful actors capable of penetrating to the lowest reaches of society or greatest details of water control, whereas formal participation channels were in most cases ineffective.

The imperative link between water control and power is hardly new (Nickum, 2010), especially in a hydraulic society such as China with wide variation in water availability (Wittfogel, 1981). In the arid Shiyang River basin which is heavily agriculture-based and with an annual rainfall of around 200 mm, water control basically means absolute power over resource-dependent users. As one villager said, *"If you control water, you control us"*. Thus, it is understandable that meaningful participation or empowerment of water users was not given any serious concern or priority despite the nominal prevalence of WUAs. Stakeholders are more interested in participating if they can have a real influence in water related decisions and IWRM processes that directly influence their livelihoods, rather than official channels existing for nominal participation.

### *4.3.4. Principle 4 – Central role of women*

As shown, women's contribution in irrigation related activities has generally not been acknowledged. Some 61% of respondents showed disagreement about women's roles in local water use and management (Figure 4.3). Part of the explanation is the tradition and the nature of local irrigation activities. Irrigation was considered a laborious men's job, especially considering the poor condition of irrigation infrastructure in the past, for example dredging canals or damming manually. More interestingly, a clear perception difference has been found between respondents from upper and lower reaches regarding women's roles (Table 4.1, principle 4). It seems that while most people from upper reaches still considered women's participation as somewhat unnecessary, half of the respondents in lower-reach Wen and Xin villages agree that women should play and have been playing an indispensable role in local water activities.

This difference can be explained by the different forms of irrigation management in the villages studied. For example in Wang village irrigation is managed by private contracts between male village leaders and hired labour, while in the lower reaches irrigation is managed as a CPR by collective action. It can also be partly explained by the fact that in the lower reaches where people perceived and/or are faced with more serious water problems physically and politically (for example, IWRM policies were carried out more strictly in downstream area than upstream), most male family members have been forced to migrate out for off-farm employment, a process also known as "feminization of agriculture", and this has unavoidably increased women's roles and significance in agriculture and irrigation practices. In Wang village, however, where people have a natural advantage of better irrigation access with more irrigated land and less strict water policies, most male members can still manage to support their families by staying inside villages and making agriculture their main livelihood. In other words, in upstream villages men are still taking control of irrigation related activities and this makes them believe that women's participation or their roles in irrigation management are generally insignificant even if necessary at all.

## 4.4. Perceived impacts of IWRM policies at village level

The impacts of IWRM policies were also evaluated by informants through interviews and group discussion. Based on results from interviews and group discussion, from the villagers' perspective, the impacts of IWRM policies can be categorized into three main aspects. Firstly, for villagers IWRM policies have increased government control of water and have also directly led to unreasonable irrigation schedules and inefficient water uses. For example, one respondent said,

*"The irrigation amount is not determined by us (villagers) or by how high the water fees are, but by the climate, crop types and soil situations here. Now, we do not know when and how much water we will get next irrigation so most people are irrigating more and trying to irrigate whenever we have access, and this has generated a lot of water waste rather than savings." (Interview, Male, 64, Wang village, N05).*

Villagers have been in a constant struggle caused by increasing irrigation instability, uncertainty and less flexibility. The direct result of too much water control is prevalent corrupt behaviour and illegal water use, locally called *"Strategies of survival"*, *"Ways to get by"* or *"To make the best of an increasingly hard life as a farmer in water-scarce communities"* (Author's field note).

Secondly, most respondents agreed that IWRM policies had unavoidably decreased their agricultural income. One respondent (Interview, Female, age 46, Wen village, N11) said, *"Under the IWRM reform, half of my irrigated land area has been mandatorily reduced and abandoned to reduce water uses without any compensation. My income has been decreased even halved."* Another example is the policy of government investment in constructing greenhouses, which aimed to transform traditional water-consumptive agriculture patterns into more profitable cash crops. However this process is considered by local villagers as a non-adaptive, top-down mandatory order for farmers to get irrigation access and a waste of government investment and villagers' own money. Although farmers are forced to finish these tasks, only a few of them would actually make use of the greenhouses or make any money out of them. For villagers, local officials were just trying to finish officially assigned tasks (IWRM policies), no matter how these have adversely impacted villagers' livelihoods.

Thirdly, IWRM policies in general have adversely impacted local equity. A distinct and visible difference has been created among villagers and/or villages that know how to adapt and take advantage of favourable IWRM-based policies, such as attraction of microcredit for construction of water-saving projects and government investment in construction and rehabilitation of infrastructures, while working the reform processes to minimize disadvantages, and those who do not. For instance, villages or teams which are relatively rich or well-connected can take advantage of whatever social networks (Guanxi) they have with external authorities to attract more investment, opportunities and information; and facilitate localized IWRM policies towards their advantage, such as attracting project investment. In many cases, the IWRM process has hurt poor people

who have the least capital (physical, natural, human, financial and social) to start with and have lost most of their lands that they mainly depend on. On the other hand the "best players" who knew how to grab the opportunity and take advantage of local policies had got richer, for example by obtaining government project money and "farming projects" and accessing better control of irrigation either legally or illegally. IWRM reforms are not neutral and there are different social, economic and political factors that determine use and abuse of IWRM policies which is at the discretion of local governments and stakeholders. Local governments which value projects or officially set targets will understandably shift strategies towards short-term perceptible and quantifiable targets such as reducing the irrigated area and the amount of irrigation use, rather than long-term sustainability or people's welfare. This also explains the pervasiveness of hidden agendas, selective implementation and even manipulation and distortion of records.

Villagers were further asked to assess the general impacts of IWRM policies on a scale from 1 to 5, where a value of 1 indicates the poorest level of not knowing and 5 means optimum performance. Figure 4.4 demonstrates that 43.8% of all respondents believe IWRM performance is low and 12.4% regard its performance as very low (Table 4.3). The performance scores among different villages are also highly diversified. It seems that most villagers from upstream Wang village believed the performance of IWRM policies was between low and very low, while Wen villagers considered it as low or average, and Xin villagers from the very end of the river basin regarded IWRM performance as high or very high. These patterns again indicate that perceived impacts of IWRM reforms are rather divided and more specifically localized. Being in different villages seems to have a very significant influence on villagers' understanding of IWRM impacts.

*Table 4.2 Descriptive Statistics of villagers' IWRM performance scores*

| Villages | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| **Wang** | **51** | **0** | **5** | **1.96** | **0.92** |
| **Wen** | **68** | **1** | **5** | **2.32** | **0.94** |
| **Xin** | **43** | **0** | **5** | **4.14** | **0.99** |
| **Total** | **162** | **0** | **5** | **2.69** | **1.29** |

The IWRM score is a general performance score based on the question: "on a scale of 1-5 what is your score of current IWRM reforms performance in your area", see Question 57 in Appendix 1.

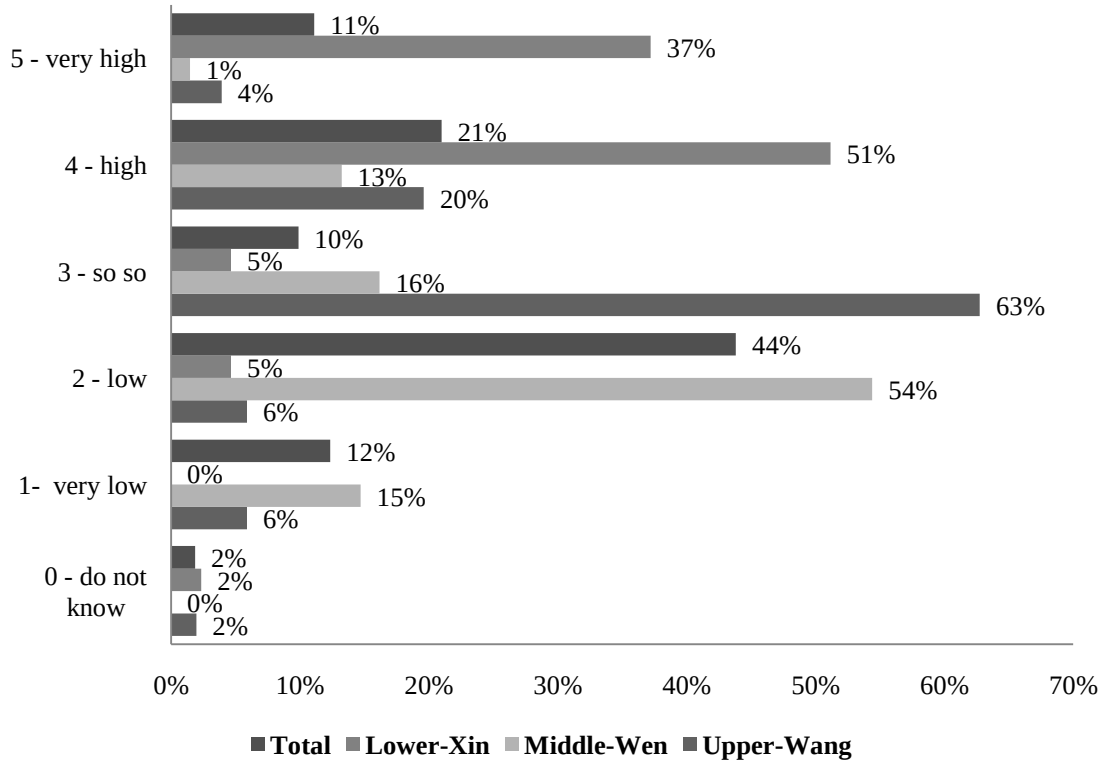


*Figure 4.4 Villagers' evaluations scores of IWRM performances in Wang, Wen and Xin villages*

One is, however, inevitably brought back to the issue of intentions, which can only be guessed at. It is understandable and even natural for affected populations to comment negatively about IWRM policies, considering the negative impacts these policies had on villagers' agriculture production. People must define what the wants and needs of a diversified subordinate class really are. It is difficult to know whether the negative

assessment of IWRM expressed by both upstream and middle-stream villagers is accurate, or if their intention was only to "be left alone" or to attract more government investment and project compensation; and whether the relatively better feedback from the Xin villagers in the lowest reach is true or due to concerns about losing project support. However, it is these complexities that make the case studied interesting and demonstrate that water decisions remain mostly outside the control of those affected, and have affected villagers' livelihoods in significant and different ways.

## 4.5. The role of political trust

Our data shows that political trust plays a pivotal role in shaping villagers' attitudes towards IWRM. Villagers' political trust is grouped into three categories: the general trust in upper and central level governments; the distrust of local government agents; and lack of trust in both central and local governments. Evidence from qualitative analysis of interviews and group discussions confirms that most villagers still trust government at higher levels, for example *"The bigger communist figures are the good ones while the smaller communist officials at lower levels are corrupt, and as it goes down to lower levels, the situation only gets worse"* (Groups discussion, Female, age 47, Wen village, N41). As villagers see it, a lot of the IWRM policies do not come from the central government, but are localized interpretations of IWRM policies distorted by local officials who aspire to implement vanity projects in order to gain rapid promotion, regardless of sacrificing villagers' livelihoods, for example one villager commented, *"no matter what they (lower-level officials) say or promise, if we do not have the belief, the trust, (us) farmers will never have willingly and truly participated in any programs or policies that directly affects how we farm our lands and our income"* (Group discussion, mixed group 1,Wen villager, 47 years old, male participant, N3). Villagers stated that they would support the policies more if they were made by higher level government which they believe is oriented towards their benefit. In contrast, local policies made by untrustworthy local officials have created more doubt and less support, and villagers believe that the importance of their incomes and welfare has been ignored.

One interviewee expressed that, *"well, I just don't believe that these projects would have much success, I don't think they (lower-level officials) care about how much we have to sacrifice, I don't think that they (lower-level officials) have much respect for that (their wellfare and income)"* (Interview, Wang villager, 59 years old, N. 51). In line with previous findings about the crucial roles of trust in local acceptance of policies (Jones et al., 2012, Ellis et al., 2007, Mankad and Tapsuwan, 2011), this study concludes that political distrust of local agents and their policies has obviously affected villagers' understanding of and responses to IWRM.

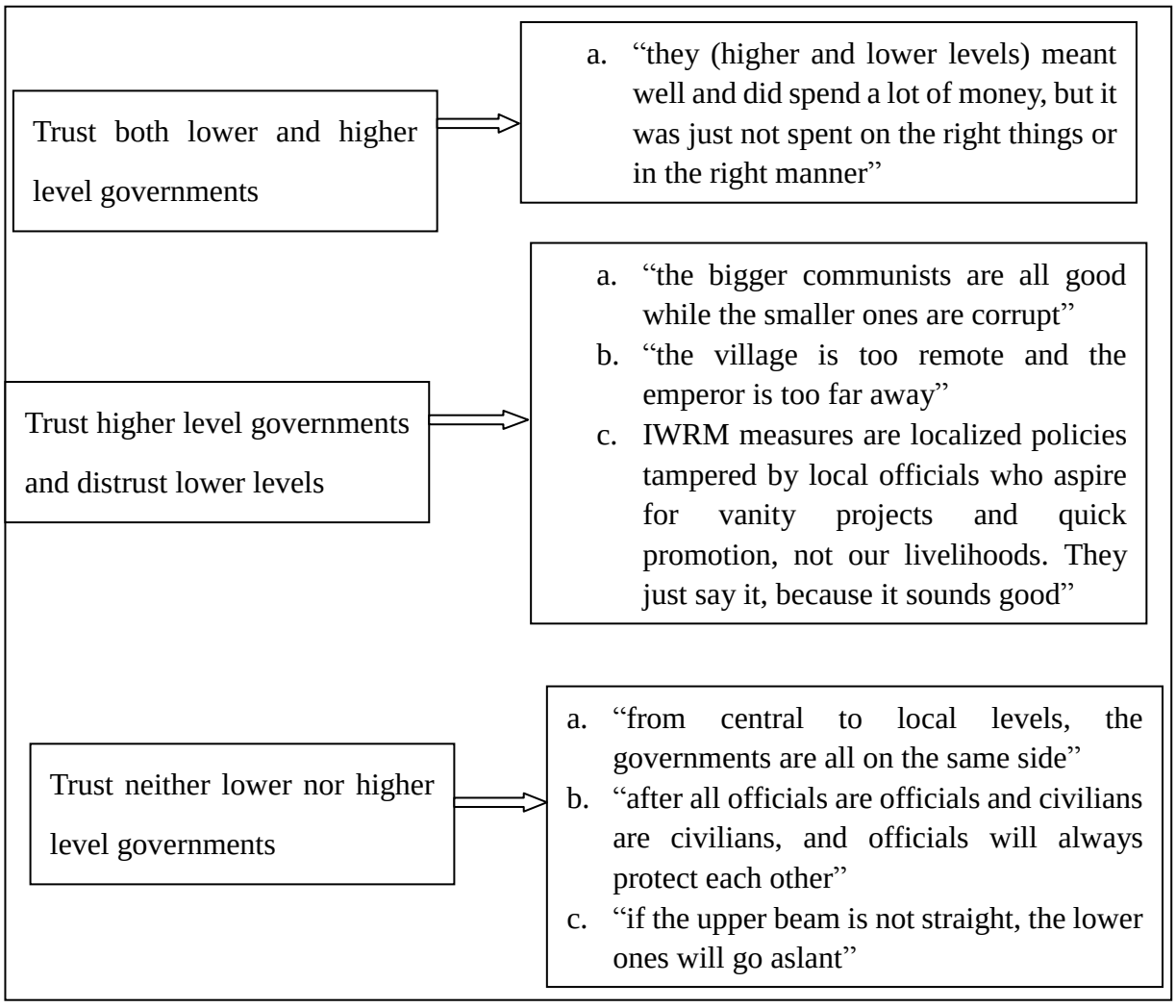


*Figure 4.5 Categories of villagers' political trust*

Moreover, villagers who trust government at central and higher levels distinguish between the government's good intentions and its actual capacity to implement IWRM reforms as planned or to monitor its local agents from results of interviews and groups

discussions (See Figure 4.5). Some respondents emphasized that, *"upper-level officials do not know the actual situations and the village is too remote and the emperor is too far away"* (*shangao huangdi yuan*); whereas other villagers argued that leaders from higher levels are aware of what is happening on the ground, but there is nothing they can do to make local agents do their exact bidding. Some respondents went even further, stressing that from central to local levels, the government officials are on the same side and are all corrupt, for instance, *"after all, officials are officials and civilians are civilians, officials always protect each other"* (Casual discussion, 61 years old, male, Wang village, N44). It appears that people may perceive their relations with local government agents as being either exploitative and coercive or supportive and cooperative, and this difference will largely influence their perspectives and responses towards IWRM policies, and the actual implementation processes and outcomes of these policies in specific contexts, for instance in Wang and Wen villages. A general lack of political trust and a perceived exploitative relation between local officials and villagers in the Wang case has increased illegal behaviour such as corruption, water-stealing and over-exploitation of groundwater resources and farming extra land areas than official allocation. Whereas a less exploitative relationship in the Wen village has lead farmers to make the best use of what is available and conserve water rather than water exploitation. In addition, the implementation of IWRM is better than the Wang case as well, see the performance scores for example.

### *4.5.1. Uncertainty*

Increasing uncertainty caused by the external origin of IWRM policies in terms of the purposes, processes and impacts is another key factor. Instead of being induced by a lack of knowledge (Ostrom, 1990), this research shows that the uncertainty is largely caused by communities' lack of political trust. As some put it, *"Nothing is certain apart from the official orders that these changes must happen at any price"* (Interview, male, age 48, Wen village, N22). Many respondents summed up their concerns by saying that these policies may neither benefit their community as a whole nor benefit them

individually in the short or long term. For example, *"Nobody knows where all these changes will lead us. Officials come and go while we stay and suffer from the consequences" (Interview, male, age 55, Wang village, N15).*

It is quite common to find most villagers are caught in a complex and uncertain situation or an "IWRM reform dilemma". Water and land still lie at the root of villagers' livelihood security. On one hand, villagers welcome changes, especially considering the increasingly low profit margin that is caused by growing agricultural input and the constant threat of water shortage. On the other hand, they fear changes, more specifically the uncertain policies and outcomes that follow these changes bearing in mind they have little trust in local agents.

Villagers also claimed that the local IWRM implementers were frequently behaving in an inconsistent manner, which is another source of uncertainty. For example, interviewees stressed that, on one hand officials alleged that their purpose was to conserve water for future generations, on the other hand, when farmers were willing to pay more, officials secretly agreed, as if there would be more water to sell only at higher prices. In practice these previous experiences and local officials' inconsistent actions have fuelled villagers' distrust in the allegedly well-intentioned IWRM policies. This has increased villagers' perceived uncertainty which in turn, triggered responses of non-cooperation and even resistance towards local IWRM policies, in individual or organized forms.

### *4.5.2. Fairness*

- *"I hate to admit this, but many of the communist policies are not as fair as they used to be in Mao's time anymore, our land and water uses have been cut compulsorily while in other places people were reclaiming new lands and digging new pumping wells" (Interview, Wang villager, male, age 61, N17)*

Fairness is another very important aspect that has been caused by political distrust. It has a significant influence on villagers' attitudes and responses towards IWRM. Communities repeatedly stated that they were being treated unfairly, this being a key factor influencing their decisions about whether or not to accept and trust IWRM policies. There is already ample evidence from our earlier discussion that not all communities are impacted in the same way. Conflict between upstream and downstream water users is nothing new. For instance, according to results from interviews and group discussions, it has been found that informants perceive significant unfairness between upstream and downstream residents. For the upstream Wang villagers, they tend to believe the dire water and environmental circumstances in the lower reaches has little to do with their actions and thus they are not supposed to pay either. They believe that down-stream villagers over-exploited their water resources for agriculture development, which they made a fortune out of and now upper and middle-streamers are unfairly forced to pay the price through IWRM reform. On the other hand, down-stream users argue that it is the over-use of surface water resources by up-streamers that directly forced them to overexploit groundwater for their livelihoods. Therefore, upstream users should contribute to restoring the water and environmental situations downstream as well, especially considering the strategic role of the downstream basin in protecting the eco-security of the whole river basin.

Just as officials use irrigation access and mandatory quotas to make farmers comply with local IWRM policies, some farmers also realized the officials' need for their cooperation as well. Thus they use this need to negotiate with external authorities for extra water allocation and other benefits. The key would seem to be how to manipulate, bargain and selectively implement IWRM policies using social networks (*guanxi*) or other privileges to villagers' benefit. Therefore local inequity has been increased rather than decreased and this perceived unfairness has fuelled villagers' doubts, dissatisfaction, non-cooperation and even resistance, as some indicated: *"If they treat me unfairly why would I help them fulfil their tasks (official IWRM targets such as construction of greenhouses)?(Interview,Wang village, male, age 41, N50 )"*

## 4.6. Discussion

So what is the actual situation? Successful implementation of IWRM in the Shiyang river basin has been widely reported. According to official records, (See official website: http://www.gs.xinhuanet.com/shiyanghe/index.htm), overall water use in Wuwei County had decreased by 0.714 BCM (billion cubic metres) in 2010; agricultural water use was reduced by 0.884 BCM; groundwater abstraction was reduced from 1.105 to 0.494 BCM; over 3300 pumping wells were shut down, over 816 WUAs were established and the irrigated area was reduced by 0.63 million mu; 266400 mu of fruit trees were planted and farmers' average annual income was reported to have increased from 3724 Yuan in 2006 to 5617 Yuan in 2010. In the lower reach of Minqin county according to official figures, overexploitation of groundwater has been controlled and groundwater abstraction reduced from over 0.29 to 0.0869 BCM; the water table in Qingtu lake in the lowest reach has increased by 0.42 m compared to 2007; the average income per farmer has increased by over 1000 Yuan to 5200 in 2010 according to official records. However caution is advisable when interpreting this apparent success.

Evaluation of the real impacts of IWRM policies, in terms of real water saving, improvement of water use efficiency or water productivity in the area of study can be rather difficult, if possible at all. This is not only because of the extreme sensitivity and difficulty in obtaining information which is always hidden or fabricated, but also because of the difficulty of validating such information or working out credible figures. Local agencies, for example the Water Affair Bureaus and Electricity Bureaus which keep track of villagers' electricity and water uses always have multiple records which are prepared to be shown to different audiences: the official records which match the officially-set targets are used for inspections, while the actual figures are kept separately, for charging villagers or other internal uses.

China's official evaluation system under its new President has now abandoned the

GDP-centred assessments and put more emphasis on public well-being and environmental performance as an improved gauge of official success, rather than the blunt instrument of pure economic growth. Although being a positive step towards a more balanced and sustainable development mode, it is as Nickum (2010) argued, not hard to imagine the implementation problems such as obsession with measurable indices, manipulation of report results and the trade-offs between these measures and other evaluation norms such as GDP. Under the bureaucratic upward-accountability system, the IWRM reform has created a context where not only villagers but also local leaders face conflicting requests for a limited supply of reliable water. In the studied area, fulfilment of the IWRM reform has been achieved through official targets. These included reduction of irrigated land area and the number of boreholes, and increasing plantation of fruit trees. Public participation was measured only in the number of WUAs established and farmers included. Thus leaders at city, county, township and even village levels are placed in a very difficult position. To be successful, officials have to accept and implement the limitations imposed by higher level governments, most of which are not welcomed by both implementers and those affected. Officials therefore have to learn to get around and fulfil these targets or to fake results; this is achieved through, but not confined to, hiding authentic records from higher level officials, falsifying reports, and illegal use of IWRM funds to fulfil official targets. Even if the widely reported outcomes are reliable, we argue that the use of these targets to evaluate real impacts of IWRM policies in local water use, management and environmental sustainability can still be rather restricted.

From villagers' perspectives and experiences, IWRM at the local level has more than a single face. In practice, the impacts of these interventions vary significantly with regard to the different implementation purposes, processes and outcomes which are disaggregated into various categories among different people, groups and villages. As discussed above, political trust plays a critical role in shaping perspectives on IWRM. Villagers show significant trust in central and higher level government while distrust in governments at city, county, township and village levels is evident. Among those who

trust higher level government, there is also a contrast between their trust in the government's good intentions, and their belief in its capability to implement well-intentioned policies at the local level as planned.

The impacts of villagers' distrust of the implementation processes of IWRM policies are significant. From the author's discussion with locals, participation in local activities and long-term everyday observation, lack of political trust, especially of local government, has generated increasing uncertainty and widely perceived unfairness as discussed above. All these have fuelled villagers' lack of interest in participation and cooperation and "local adaptations". One of the key strategies is to hide actual water use, irrigated land areas and crop patterns, taking advantage of the difficulty in accurately measuring each field. The whole inspection system is by production team leaders reporting to village leaders who report to upper levels, with inspectors' occasional checks limited by the immensity and difficulty of the task. There are examples of under-reporting of water use and related electricity consumption at community, production team and village levels. Ironically, this fabricated reporting is what officials use as the reference for water planning and allocation. Another common strategy is to steal water by using locally invented schemes. For example, after installing the smart card which controls the water flow and quantity of pumping while recording the electricity use of each pumping well, villagers invented their own strategies of using a short circuit to pump water into their canals without even using the smart card or showing any water use record. During interviews and discussions, local respondents repeatedly expressed, *"Officials applied some new system and we have to adapt accordingly as well, simply to survive and get by"(Interview, Wang village, male team leader, age 39, N6).*

Another interesting example is the policies to change local agriculture patterns through constructing greenhouses, breeding sheds for livestock husbandry and planting fruit trees such as grape, pear and plum. Based on results from interviews and grops discussions, detecting the crucial importance for officials to fulfil quantified targets

such as how many trees have been planted or acres of land have been used for fruit tree plantation, villagers tried to strike a deal of "returning favours" by complying at least superficially with these policies to get more illegal irrigation access. Under this strategy, many greenhouses and breeding sheds were built while few of them were actually of proper quality or even used; many trees were planted while few of them were expected to survive. These examples provide insight into how and why the official reports of successful IWRM policies are dubious, and explain how lack of political trust influences implementation of IWRM in practice.

It is crucial to note that villagers are not as passive or powerless as they seem or are alleged to be, despite a general appearance of compliance with imposed IWRM policies. Similar to Oi's (1991) study of implementation of agriculture policies in China, we find that even today it is still necessary, and prevalent, for villagers to create an appearance of conformity with official policies, and sometimes they even create an image of better compliance than officially regulated so as to construct or reinforce a reciprocal relationship with local IWRM implementers. This helps them gain an advantageous status to work the system to maximize their interests or to minimize adverse impacts such as decreased income or irrigation control. For example in Wang village, 100% of irrigators were illegal water users who on average managed to irrigate twice the officially allocated land area with illegal access. It is thus self-explanatory that there are considerable infringements and violations such as stealing water, tampering with the electricity record and bribing local agents. However, instead of overt resistance, these confrontations (organized or not) have remained rather covert, comparable to what Scott (1969) calls "Weapons of the weak" or Oi's (1991) "Strategies of survival" or "soft opposition" and "Rightful resistance" (O'Brien, 1996, Li, 2010), which if not appropriately dealt with, can induce huge social, economic, environmental and political costs, such as losing villagers' political trust and participation incentives.

While the general state–society relation remains hierarchical, the relationship between villagers and lower-level officials is a complex one. Villagers did not challenge central

authority or its IWRM policies and this offers the higher level governments some room to manoeuvre, since this trust in upper levels has prevented demands for any radical upward political reforms or resistance. On the other hand, villagers learned to keep their distrusted leaders at an arm's length and make "reciprocal deals" or bargain with them. Each side tries to work the system to pursue their own interests rather than constructing a benign cooperative partnership and working towards the same IWRM goal. These findings enrich the on-going debate on state–society relations in China, going beyond the traditional confrontation or compliance dichotomy.

From evidence identified during the author's fieldwork, however, it would be entirely wrong and even risky to assume that lower-level officials are incapable of maintaining strict water control. Because what appears to be "participatory and localized" water reform is still open to local cadre manipulation and failing to appropriately understand this point will fail to touch the root causes of both local water problems and policy implementation failures. In fact, how strict the control of the implementation processes is, depends entirely on local agents who are in complete charge of passing and interpreting IWRM policies to local stakeholders in a one-way communication of information. Local officials still have effective power, based on continuously influencing access and distribution of local resources and having a free rein to locally interpret, circumvent or even subvert IWRM policies. Lower-level officials are well aware of the fact that some local policies such as a compulsory water quota are unrealistic, but to fulfil their political task and ensure their political career, they have to enforce it anyway. This means that they need villagers' support and cooperation in fulfilling these targets too. It explains why local political authorities tolerate villagers' infringements by "keeping one eye closed" in implementing localized IWRM policies as long as these actions do not threaten the local political status quo or the big picture. In light of this, success or failure of IWRM cannot and should not be defined by whether officially set targets are met or not, but by the dynamic villager–official negotiation processes which are constantly redrawing the lines of what IWRM actually consists of and what successes mean in different local contexts. It is important to keep

these different perspectives and the impacts of physical and socio-political factors in mind in any effort at policy implementation or analysis. Slogans such as “IWRM” may mask important underlying processes rather than providing useful guidelines for effective reform.

## 4.7. Conclusion

This paper explores Chinese villagers’ attitudes and perspectives towards IWRM by highlighting the essential roles of political trust, policy certainty and fairness through in-depth study of three villages from the upper, middle and lower reaches of the Shiyang River Basin, Northwest China. It shows that most respondents have a good awareness of IWRM concepts and principles, whereas the perceived processes and impacts of IWRM policies are rather divided and problematic.

As shown in section 4.5, most villagers regard the central and higher level governments as trustworthy while local agents are seen as corrupt and untrustworthy. Most villagers believe that there are substantial differences between the good intentions of IWRM reforms at the higher levels of government and the distorted localized IWRM policies (*tuzhengce*), which are not necessarily the same as originally intended. This pattern of trust revealed in this article has several important policy implications. First, the trust and belief in upper levels expressed by most villagers suggest that the communist regime still has the most power and popularity among villagers. Moreover, villagers are not as powerless as they are believed to be. The perceived incapability of upper levels to implement their policies, together with the distrust and dissatisfaction with lower levels, have generated varied incentives for villagers and local officials to manipulate IWRM policies and each other in localized forms.

People do not automatically accept or reject IWRM policies that are allegedly in the public interest. It is expressly related to their past experiences, their political trust and relations with local government agents in specific physical, social and political contexts.

It is these dynamics and localized adaptations that define and reflect the reality of IWRM processes. Successful implementation cannot be guaranteed by the existence of well-intentioned IWRM policies or by whether the officially set targets are met or not. It depends on the degree to which and how IWRM policies are locally understood and implemented by different stakeholders throughout the constant bargaining and negotiation processes of everyday water politics. It is concluded that to assess the processes and impacts of a special IWRM reform in isolation from its local contexts and stakeholders ignores the fundamental character of the reform.

Political trust in central government seems not to have a direct impact on locals' reaction towards IWRM, while trust in local government, their intentions and the institutions can be good predictors of local support for IWRM policies. Thus, building trust especially between lower level governments and civil society is crucial in promoting the legitimacy and sustainability of IWRM policies and in enhancing implementation outcomes. Although the scale and potential solutions of water problems may be location specific, understanding the nature and extent of issues related to IWRM in an area such as China and the lessons learnt can provide important insights for others as well.

# Chapter 5 – Paper 4

**“You have to learn the rules of the game. And then you have to play better than anyone else.”**

**― Albert Einstein**

# 5. Governance of the irrigation commons under IWRM – a comparative study in contemporary rural China

Accepted and to be published by Journal of Environmental Science and Policy

## Abstract:

This paper evaluates two key patterns of irrigation institutions under IWRM (Integrated water resources management) reform – private contracting and collective management using Ostrom's (1990) design principles for robust common pool resources (CPR) institutions and see how and to what extent are they applicable in an authoritarian society. Results show that these principles are applicable but insufficient in evaluating local irrigation institutions in the Chinese context, where uses of collective action and social capital to pursue one's interests are prevalent. It concludes that use of collective action and social capital within particular socio-cultural contexts accounts for not only water users' behaviour but also the development and performances of local irrigation institutions, with mixed outcomes including collective corruption and overexploitation which are better planned and more difficult to detect. Contextualized understanding and strategic uses of positive impacts of collective action and social capital on governance of the irrigation commons while minimizing their downsides are suggested.

**Keywords:** Irrigation institutions, collective action, social capital, common pool resources, integrated water resources management, China

## 5.1. Introduction

Good governance is one of the key solutions to the pressing global water crisis (Rogers and Hall, 2003). Over the past few decades, irrigation management has undergone a remarkable shift from the traditional focus on technical and engineering based solutions to the construction of robust, flexible and sustainable institutions and decentralized integrated management (Nickum, 2010, Crase and Gandhi, 2009, Giordano and Shah, 2014). This requires collective efforts by different stakeholders especially those at local levels, who have the information and incentives to improve irrigation management and outcomes (Ostrom, 1990, Fraser et al., 2006, Araral, 2009, Yu et al., 2013).

Collective action, as the pursuit of a common goal or interests by more than one individual, lies at the centre of management of common-pool resources (CPR) (Adger, 2010, Araral, 2014, Giest and Howlett, 2014). The most common and chronic problems preventing collective action include free-riding, shirking and destructive uses of CPR by self-interested individuals (Hardin, 1968, Lane and McDonald, 2005). However, a large body of literature has shown that communities can and have managed to address local CPR problems that cannot be addressed by either the government or the market alone (Tang, 1992, Lam, 1999, Joshi and Hooja, 2000, Araral, 2009). As Ostrom (1990) argues, local communities in both developing and developed countries have not only been capable of self-governing CPR but also collectively establishing, maintaining and modifying institutional arrangements in specific contexts.

In order to identify factors and preconditions for robust CPR institutions, Ostrom (1990) has proposed eight design principles through in-depth analyses of multiple case studies of CPR management at local levels in both the developing and developed world. Some scholars have evaluated CPR institutions using these design principles, and have found them very effective (Ostrom, 1990, Quinn et al., 2007, Cox et al., 2010, López-Gunn, 2012, Agrawal, 2014). However, principles that are derived from or applicable to certain contexts can have substantially different meaning if used in another. Thus they

must be studied within local contexts that they are implemented (Mosse, 2006, Selman, 2004).

Dozens of variables that affect collective action by resource-dependent populations have been identified. For instance, Wade (1988) and Meinzen-Dick et al (2002) show that physical characteristics of CPR including physical scarcity, size, and proximity to markets affect local collective management action. Others investigate influencing factors such as heterogeneity (Reyes-Garcia et al., 2011), group size (Poteete and Ostrom, 2004), and social capital in local resources management (Coleman, 1988, Uphoff, 2000, Pretty, 2003, Poteete and Ostrom, 2004, Adger, 2010) and more specifically the roles of social capital in collective action and CPR governance (Pretty and Ward, 2001, Bowles and Gintis, 2002, Pretty, 2003, Mosse, 2006, Bouma et al., 2008, Jones et al., 2012).

Whilst much literature has focused on origins and maintenance of social capital and collective action in CPR management (Agrawal, 2014, Lane and McDonald, 2005, Lam, 1999, Mosse and Sivan, 2003, López-Gunn, 2012), the linkages of social capital and collective action are far from clear (Ostrom and Ahn, 2009, Sharp et al., 2012a). One explanation may be the incomplete understanding of how to tailor programs to build or make effective use of social capital based on differences in the implications of social capital (Ghazouani et al., 2012). Alternatively this may due to the fact that stakeholders due to their individual identity, often are motivated to use social capital in their personal benefits even in a collective environment (Tiewtoy et al., 2011). Moreover much of the focus has been one-sided, looking at intrinsically positive aspects as a built-in mechanism ensuring cooperative behaviours and collective action and (Ostrom, 1990, Uphoff, 2000), while few studies have paid attention to the outcomes of localized uses of collective action and social capital. Their mixed roles and especially the downsides have been generally overlooked (Ghazouani et al., 2009, Adhikari and Goldey, 2010).

Through accessing and analysing villagers' everyday water struggles and socio-political experiences of irrigation management in water-scarce regions, the objective of this paper is to evaluate local irrigation institutions using Ostrom's (1990) design principles in the Chinese context. Instead of following most of the literature which focuses on enabling conditions or factors for successful collective action in governance of CPR (Agrawal, 2014), this paper paid attention to a much needed investigation – exploration of the mixed outcomes of collective action and social capital including trust, reciprocity and social networks (Guanxi[5]) (Abernethy et al., 2001, Xin and Pearce, 1996, Gold et al., 2002) and their roles in governing irrigation commons in two typical villages in arid and semi-arid regions of Shiyang River Basin where people's water behaviours and livelihoods are closely tied to embedded physical, socio-economic and political realities (Yu et al., 2013). Study on this will have implications for future water reforms, especially considering the increasing discussion about using Western-based analytical and management tools to resolve water issues in specific contexts.

## 5.2. Methods

### *5.2.1. Study area*

The study was carried out in the Shiyang river basin (Longitude 101°41′～104°16′E, Latitude 36°29′～39°27′N), in Gansu province, Northwest China (See Figure 5.1). It covers an area of 41,600 $km^2$, and has a population of over 2.27 million. Over 77% of its population depends on agriculture for their main livelihood. It is one of the most water-stressed, highly-developed and ecologically vulnerable inland river basins in China (Ma et al., 2005b). It has an arid continental inland climate with low irregular annual rainfall of 220 mm and extremely high annual evaporation between 2000 mm and 3000 mm (Li and Xiao, 2005). Agriculture is highly dependent on irrigation and

[5] Guanxi is a Chinese term which generally means relationships, social connections and networks between individuals and groups.

accounts for over 86% of fresh water use (Ma et al., 2005b). Much of the groundwater resources which the agriculture depends on are palaeowater which is non-renewable and being unsustainably mined (Edmunds et al., 2006). Water scarcity, inappropriate management, uncoordinated development and over-exploitation of water resources, especially groundwater, are seriously threatening local livelihoods, economic development, social stability and environmental sustainability (Yu et al., 2013).

The government initiated water reform towards integrated water resources management (IWRM) in 2007, aiming at controlling overuse and extraction of water resources especially groundwater resources in the basin. Under this reform, drastic actions have been taken including cutting irrigated land areas, reducing the number of pumping wells and controlling abstraction of groundwater. Water users' associations (WUAs) were established to transfer irrigation management to local communities at village levels (Yu et al., 2014). However the internal institutional arrangements varied markedly under different circumstances.

### *5.2.2. Case study villages*

Wang village lies in the upper part of the basin (Figure 5.2), with a population of 1845 people divided into 12 water users' groups, also known as production teams. A production team is the lowest level of villagers' organization composed of 20 to 30 households sharing common living and agriculture space. With an annual rainfall of 164mm and evaporation of 2000mm, irrigation is indispensible for local agriculture production of most crops. Groundwater is the only irrigation source for Wang villagers. The actual average land holding per capita is 5.85mu[6] compared with the official limit of 2 mu. The predominant crops are seed corn as a cash crop, and wheat mainly for local consumption. The average annual income per person is 6690 Yuan in 2011.

[6] 1mu=0.067ha

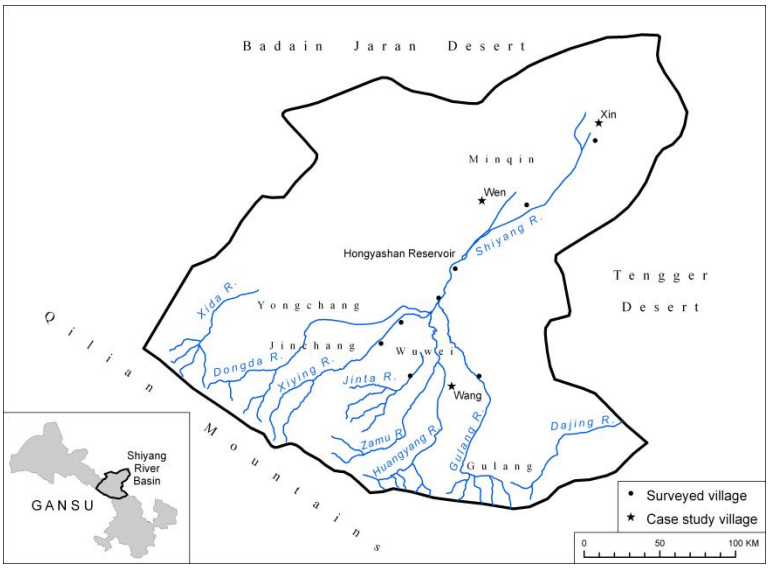


*Figure 5.1 Location of the Shiyang River basin in Gansu Province, China*

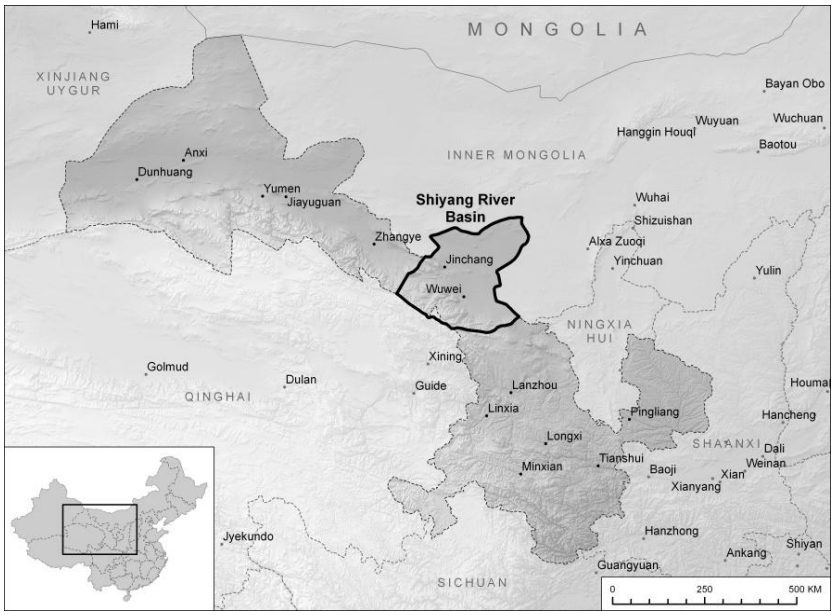


*Figure 5.2 Location of case study villages*

In Wang village, the WUA committee is made up of a village council (VC) committee and 12 contractors from different communities. WUA meetings are held twice a year with extra meetings being held if other issues arise. Contractors and production team leaders are relatively well-educated, in better economic condition, and having good socio-political relationship with village leaders, local government and water officials.

They are allegedly selected by villagers while actual decisions are mostly made by village leaders and particularly the party secretary. Different water users' groups internally devise, maintain and modify their own set of rules for irrigation charges, operation and maintenance based on physical, social, economic and political situations. Payment for contractors is largely based on villagers' irrigation uses (the more people use, the more they pay), apart from a fixed annual rate (about 1400 Yuan or 140 GBP) from local government.

Wen village lies in the lower reach (Figure 5.2), with a population of 1834 people from 10 production teams. Irrigation is dependent on both groundwater and surface water. Increasing surface water supplies from the upper catchment area started over the past few years through government interventions, assuming that if more surface water is transferred to the lower reaches, groundwater overexploitation will be reduced. Over the years landholding per capita has been gradually cut to half or less (See Table 5.1). Unlike the uniform crop types in Wang village, Wen villagers normally grow a combination of wheat, corn, sunflower seeds, cotton and alfalfa for both cash and household consumption. Its average annual income per capita was 5411 Yuan[7] in 2011.

Irrigation management in Wen village is still largely dependent on traditional collective management led by selected production team leaders. The WUA committee is made up of the VC and 10 team leaders. WUA meetings are held before each time of irrigation and more often if other matters arise. Similar to Wang village, each production team makes their own irrigation rules. Team leaders are paid by local government, with an annual income of around 1800 Yuan. Their main responsibilities are announcing official decisions and tasks, allocating official quotas, organizing irrigation activities, collecting water fees and requesting extra water access from local governments and water agencies.

[7] Exchanging rate at 10Yuan=1GBP

### *5.2.3. Data collection*

Data is drawn from a long-term field study (from September 2011 to September 2012) throughout the studied basin. Both qualitative and quantitative methods were adopted including semi-structured interviews, group discussion, and questionnaire surveys. A range of stakeholders of different ages, genders, and socio-economic and political status were sampled to represent the community heterogeneity in the two case study villages. Within each village multiple criteria were used to participants including stratification, snowballing and purposeful selection. Firstly, questionnaires were carried out in each village and production team during the early visits to grasp the general information and potential key informants, and then snowball sampling method (Tollefson et al., 2014) was used to represent the heterogeneity of age, gender and socio-economic status. Data collection was stopped until saturation is reached. In total, 65 interviews of villagers (30 in Wang village, 35 in Wen village) from different social, economic and political backgrounds were conducted using snowballing methods. Mixed sex and single sex focus group discussions as well as participant observation through local activities and meetings were also employed. Secondary data including project documents, official reports and scientific publications were also used as an additional information source. These methods helped to corroborate information and form a detailed and deeper understanding of local irrigation struggles and institutions. Quantitative data was analysed using IBM SPSS statistics (version 21) and qualitative analysis was through content analysis and coding to identify themes and interpretations, for details see Chapter 1.

*Table 5.1 Basic information for the two case-study villages*

| **Village name** | **Wang** | **Wen** |
|---|---|---|
| **Population** | **1845** | **1834** |
| **Average annual precipitation (mm)** | **164** | **110** |
| **Average annual evaporation (mm)** | **2000** | **2644** |
| **Distance to nearest city/town (km)** | **27** | **10** |
| **Average annual income per capita (Yuan)** | **6960** | **5411** |
| **Land area per capita in mu (Actual/Official)** | **5.85/2** | **2.7/2.5** |
| **Official irrigation quota ($m^3$/mu/year)** | **430** | **410** |
| **Irrigation sources** | **Groundwater** | **Groundwater and surface water** |

Note: 1Yuan=0.1 GBP, 1mu=0.067 ha. Source: Author's field study

## 5.3. Analysing local irrigation institutions by Ostrom's design principles

Local irrigation institutions in two selected villages were examined through Ostrom's (1990) key design principles (See Table 5.2). Findings show that despite facing similar government regulations and intervention measures as discussed earlier, villagers have devised and modified their own institutional systems as they have lived through the water problems within specific physical, social, economic and cultural contexts. Furthermore, even though there are marked differences in institutional forms and arrangements in both cases, all of the design principles have been identified in local irrigation institutions. Finally, it shows that despite the general presence of eight design principles, the management outcomes of the irrigation institutions were rather different, which further shows the inadequacy of using Ostrom's principles to assess local irrigation institutions. The management outcomes were evaluated through assessing conservation of water, equity in distribution of water and project-related benefits, and local empowerment in water management processes.

*Table 5.2 Design Principles of long-enduring CPR institutions (Ostrom, 1990)*

- **Clearly defined boundaries**
  Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must be the boundaries of the CPR itself.
- **Congruence between rules on appropriation, provision and local conditions**
  Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labour, material and/or money.
- **Collective-choice arrangements**
  Most individuals affected by the operational rules can participate in modifying the operational rules.
- **Monitoring**
  Monitors, who actively audit CPR conditions and appropriator behaviour, are accountable to the appropriators or are the appropriators.
- **Graduated sanctions**
  Appropriators who violate operational rules are likely to be given graduated sanctions (depending on the seriousness and context of the offence) by other appropriators, by officials accountable to these appropriators, or by both.
- **Conflict resolution mechanisms**
  Appropriators and officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.
- **Minimal recognition of rights to organize**
  The rights of appropriators to devise their own institutions are not challenged by external government authorities.
- **Nested enterprises (for CPR that are part of larger systems)**
  Appropriation, provision, monitoring, enforcement, conflict resolution, and management activities are organized in multiple layers of nested enterprises.

### *5.3.1. Clearly defined boundaries*

Clearly defined boundaries of both the water service area and individual/household water rights is a foundation for successful CPR institutions (Ostrom, 1990). It is crucial to specify who are eligible to appropriate, manage and benefit from local resources, so that overuse and free-riding can be avoided. In the two cases, the geographic boundaries of water services have been clearly defined by locations of villages, canals, communities and farms. Villagers who have contracted lands within these boundaries are authorized users of communal water resources. Other potential users were excluded from taking water. In addition, to limit irrigators' water use in studied areas, water rights were also officially fixed under the water permit system which is based on the

irrigated area and officially set quota for specific crops, which means there are official rules limiting appropriation of both surface and groundwater resources. The actual situation is: for surface water, only a fixed quota is accessible at officially decided times with mandatory provision, which once delivered to the boundaries of villages and production teams, becomes CPR that are managed by community-based mechanisms. For groundwater resource uses, there are official groundwater abstraction quotas on a per household basis which are renewed every year and not legally protected. The annual irrigation quota per capita for Wang and Wen village is 430 $m^3$ and 410 $m^3$ (See Table 5.1).

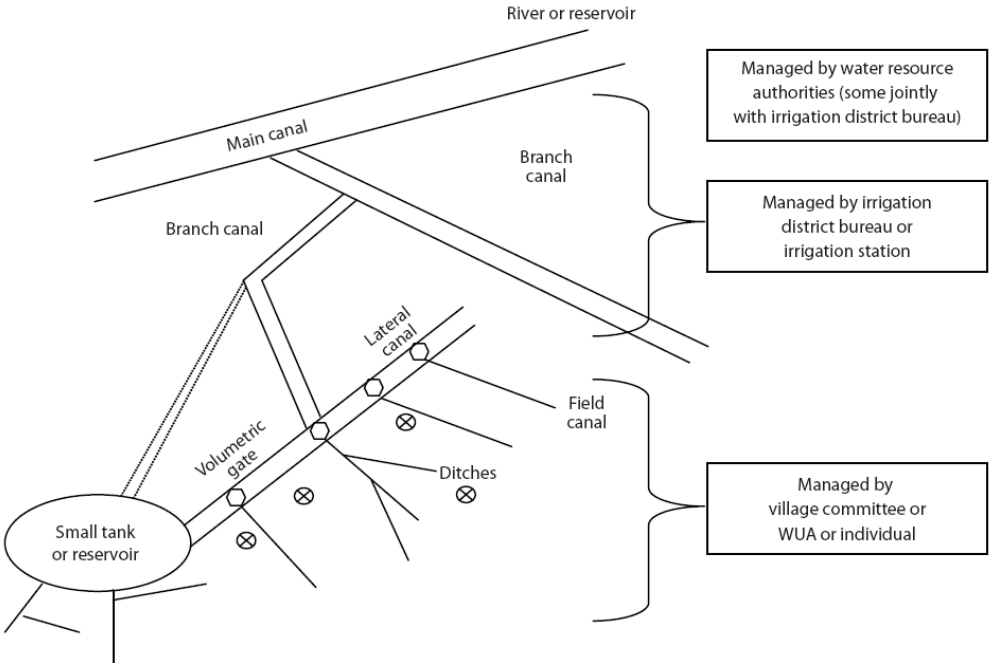


*Figure 5.3 Conceptual model of boundaries of irrigation system in study area*

However, empirical results show that in practice the clearly defined official water rights systems have not been applied as straightforwardly as defined. The mechanisms that regulate irrigators' water use in both cases were endogenous, self-restricted by irrigators' long-term agricultural experience and perceived needs rather than officially defined water rights.

### *5.3.2. Localized rules and collective agreement*

The appropriation rules restricting time, place, technology, and/or quantity of resource units must be adapted to local conditions and as the situation changes water users must be able to modify these rules collectively (Ostrom, 1990). These two principles have also been identified in our case study villages. Empirical results show that villagers in different communities have devised their own localized institutional arrangements corresponding to specific situations. For instance, in Wen village, when surface water reaches communal canal at community or village levels, it is considered a CPR. Members of each community are regularly gathered by their team leaders to participate in water meetings and make collective decisions regarding irrigation time, amount, labour division, operation, maintenance and water charges among other matters before each irrigation. In Wang village, irrigation decision making is organized by private contractors through collective bargaining between them and water users. Once decisions are made, they are relatively stable unless other problems arise, for example change of contractors. For both villages, these gatherings for decision making are quite informal and can be held in communal space or villagers' homes on a rotational basis. The overall attempt to maintain proportional equivalence between benefits and costs among villagers is achieved (Ostrom, 1993). There is no presence or role of external authorities in the day-to-day management of local water resources and enforcement of local water rules. Despite the different forms of irrigation institutions in the two cases, devising, maintaining and modifying water rules are based on collective agreements in specific local situations.

### *5.3.3. Monitoring*

As Ostrom (1990) further stresses, for successful CPR institutions, monitors who actively audit physical conditions and appropriator behaviour must be accountable to the appropriators or are the appropriators themselves. Effective monitoring mechanisms are indispensible for sustainable irrigation institutions at the local level, because the existence of good agreed water rules does not necessarily ensure

compliance. In our study, monitoring in Wang case is done by the water guards hired and paid by private contractors either at a fixed rate or according to their work time. In some production teams, there are multiple water guards each being responsible for certain pumping wells, while in others, there is only one water guard for all wells. In Wen village, monitoring of groundwater use was also done by water guards. But unlike the Wang case, monitors are collectively selected and directly paid by water users. The number of guards and their income also vary among different production teams. For surface irrigation, monitors rotate on a regular basis and are decided in community water meetings.

Usually, for surface water irrigation there are two types of guards, those who supervise the irrigation amount and water behaviour within the community; and those who supervise illegal water abstraction by non-members. Guards for surface water irrigation are not paid but count as collective labour contribution. The surveillance usually lasts all day and night until the irrigation is over. Overall although through different mechanisms, there are monitors in both villages who are accountable to water users and actively audit water use and water users' behaviours. Interestingly, monitoring mechanisms at village and community levels are very effective and the cost has been extremely low, as in the Wen case. Mutual trust, reciprocity and cooperation based on customary norms and rules, facilitate collective cooperation and contribution and significantly cut the management costs (Lejano and Fernandez de Castro, 2014).

### *5.3.4. Graduated sanctions*

Another proposed principle for successful CPR institutions is the existence of graduated sanctions. In other words, violators of operation rules of water governance are likely to face sanctions by other water users, by officials accountable to these users or by both (Ostrom, 1990). Empirical evidence from both cases shows sanction systems developed both by villagers themselves and by external authorities. There is a local system of quasi-voluntary compliance found with exceedingly low violations, even

without coercion or external enforcement or coercion at local levels. Compliance is ensured because (1) villagers perceive that collective objectives have been achieved; (2) others also comply in the same way; and (3) related actions happen on a repeated basis. Furthermore, there are other sanction mechanisms such as fines (depending on the seriousness and context of violation) to ensure villagers' compliance. For more serious violations, people face sanctions from the VC or higher level water authorities. It is important to note that most monitoring and sanction activities are undertaken by villagers themselves rather than external authorities. For Wang villagers, since irrigation management is through private contracting, irrigation allocation is based on the principle of "users pay". This means villagers can abstract as much irrigation water as they need as long as they can afford the collectively-agreed payment, so generally violation reports are extremely rare. Overall, villagers in both cases act within their own set of endogenously enforced rules rather than behaving opportunistically even when occasions permit. This means that people tend to follow the rules that they are involved in devising and management.

### *5.3.5. Conflict resolution mechanism*

According to Ostrom (1990), there should be rapid low-cost local arenas for conflict resolution for robust CPR institutions. In both of our cases, production teams and VCs are the basic forums for conflict resolution, with team leaders and/or contractors being the mediators. When conflicts arise, they will be brought up during water meetings or through personal visits to team and village leaders. Internal conflicts are perceived as threatening and are avoided whenever and wherever possible. The mechanisms for solving internal conflicts among water users are largely informal. Results show social norms, interpersonal networks (guanxi) and reciprocity are among the most effective tools for conflict resolution. Multiple complex networks tying villagers together create easier and more cost-effective enforcement of water rules. As one team leader put it,

*"Conflicts are no good to anybody and are better solved within our communities and villages. They (villagers) may not listen to external agents but they will listen to me or the other VC leaders. Here in one way or another we all need each other."(Interview,*

*male, age 51, Wang village, N32)*

Results further suggest that the potential for conflict within communities and villages are low, while conflicts between internal water users and external water authorities has been increasing through intensified water control and government interventions (Yu et al., 2014). Consistent with Ostrom's design principle, there are local mechanisms for conflict resolution in studied cases. These mechanisms are low-cost, rapid and mostly internal and informal.

### *5.3.6. Recognition of the right to organize and nested enterprises*

The last two principles are minimum external recognition of water users' rights to devise and modify their own irrigation institutions; and nested enterprises (Ostrom, 1990). In practice, WUAs have been established and legitimized as the lowest level of water authority (Yu et al, 2014). To a certain extent they have been given some autonomy to manage officially allocated water resources and set their own rules for allocation, fee collection, operation and maintenance among other related water rules at village and community levels, which are unchallenged by external authorities. The reason is that the government is well aware of the financial burdens and difficulties in managing irrigation systems in the diverse physical, social, cultural and economic contexts. Moreover, appropriation, monitoring, enforcement, conflict resolution, and management activities are organized in multiple layers of nested enterprises. Production teams are organized on the basis of twenty to thirty households, and nested in village level, township level, county level and regional government jurisdictions. In the two cases, the last two design principles of minimum recognition of rights to organize and nested enterprises as Ostrom (1990) notes, are explicit.

## 5.4. Evaluating local irrigation institutions

As empirical results show, all of Ostrom's design principles for successful CPR institutions are identified in collective management in the Wen case and in the private contracting system in Wang village (See Table 5.3), even though these working rules in

the two cases are markedly different, as shown in section 5.3. They have been locally devised and constantly modified over time and through collective agreements. Besides, these institutions have also shown the features of successful institutions suggested by Crase and Gandhi (2009), including clear objectives, connectedness, adaptability, appropriateness of scale and compliance. Villagers have shown that they are clearly capable of organizing themselves in different ways to manage their water commons in a locally efficient and cost effective manner. Thus, to a certain degree one should not hesitate to call these studied institutions effective and robust.

*Table 5.3 Application of Ostrom's design principles in the two villages*

| Principles | Wang | Wen |
|---|---|---|
| **Clear geographic boundaries and water rights (officially)** | √ | √ |
| **Congruence between rules of appropriation and provision and local conditions** | √ | √ |
| **Collective-choice arrangements** | √ | √ |
| **Monitoring** | √ | √ |
| **Graduated sanctions** | √ | √ |
| **Conflict resolution mechanisms** | √ | √ |
| **Minimal recognition of rights to organize** | √ | √ |
| **Nested enterprises** | √ | √ |

However, one must distinguish between effective, long-enduring irrigation institutions and sustainable irrigation use. This paper argues that identification of Ostrom's design principles does not necessarily ensure sustainable irrigation management through local irrigation institutions. In the Wang case for example, overexploitation, especially groundwater resources, has been and continues to be obvious, despite the increasing control of water by the government and existence of principles for successful irrigation institutions. In this case obtaining illegal irrigation access has been one of the primary responsibilities of WUA leaders and contractors. Wang villagers managed to irrigate an area per capita of 5.85 mu despite the official quota of 2 mu. As Figure 5.4 shows, among 30 interviewees from Wang village, most stated that irrigation water use per unit area has not changed (51.4%) or even increased (40.5%). It is also worth noting that there are significant differences in institutional performance, for example in terms of

perceived changes of irrigation use per unit between Wang and Wen village (Chi-Square=9.61, p=.00), even though their irrigation institutions both meet all the design principles. These differences indicate that instead of simply relying on Ostrom's design principles to evaluate local irrigation institutions in the studied villages, we must extend the analysis to other factors to understand the differences in irrigation institutions and their performances.

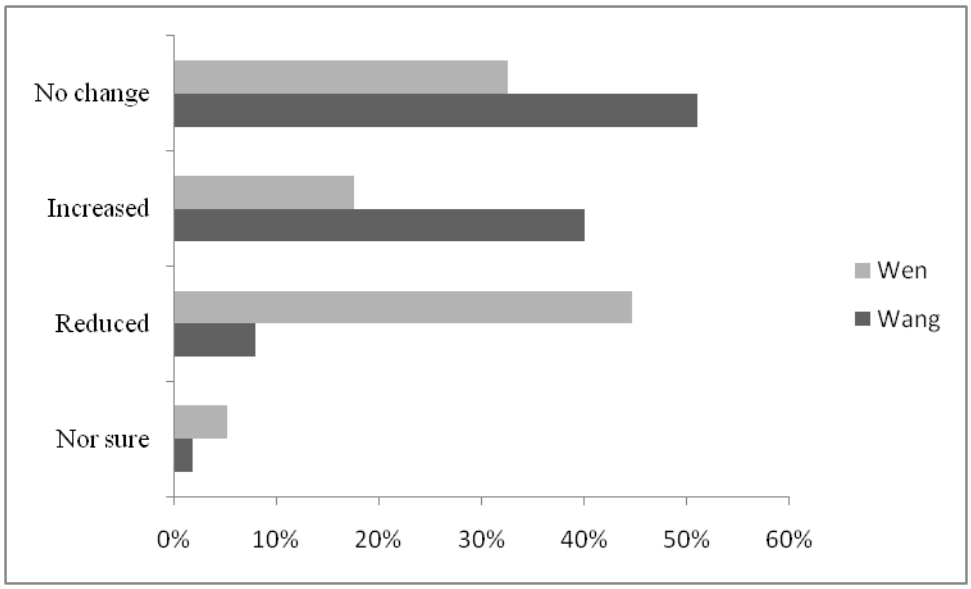


*Figure 5.4 Irrigation water use per unit area compared to 5 years ago before IWRM reform in Wen and Wang village.*

## 5.5. Factors affecting local irrigation institutions

Irrigation institutions are influenced by a variety of internal and external factors (Mosse and Sivan, 2003). Agrawal (2001) categorizes factors influencing management of CPR into four sets: characteristics of resources; stakeholders; institutional regimes; and the relationships between internal and external actors and environment. Considering the similarities the two villages share in the first three elements, here attention was paid to analysis of the nature and relations between internal groups and external authorities and environment and their roles in affecting irrigation institutions. The roles of two key factors, collective action and social capital, which pervade almost all aspects of local irrigation institutions and influence all of Ostrom's (1990) design principles in the two cases, from localized collective agreement to monitoring, sanction and confliction

resolution, were discussed in detail.

### *5.5.1. Collective action*

Olson's (1965) and Hardin's (1968) classic works about collective action note that rational self-interested individuals will not act to achieve common goals or group interests unless there is coercion or a special device like the market to make them act accordingly, which is the main reason for governance failures. Our analysis questions this statement's applicability in the context of rural China with some very interesting findings. Firstly, instead of facing the common collective action dilemma, collective action or collective practices seem rather prevalent and important in irrigation management in both studied cases. Through the author's long-term communication and participant observation, most people in these communities share a common past and have lived and farmed side by side for generations. They are quite familiar with both local environmental factors and each other. They communicate on a regular and repeated basis even in the form of casual conversation (See Figure 5.5). Collective action has been and continues to be the general norm of behaviour.

*Figure 5.5 local casual gathering in one afternoon, discussing about weather, crops and irrigation needs. Source: author's field work*

Scholars agree that people will contribute only if perceived benefits outweigh the costs

(Hardin, 1968, Ostrom, 1990). However, water users' behaviour and decisions in a particular situation depend on a mixture of locally perceived costs and benefits individually or collectively, which is hard to be neatly quantified, particularly in contexts like the studied area where a majority of the population pursue resource-dependent livelihoods. Moreover, it seems that "self" has very different meanings in the rural Chinese socialist context. "Self" can be interpreted as individual household, community or village. Moreover, under an entrenched tradition of "sacrificing oneself for the greater good", villagers instead of seeking to maximize personal gains as self-interested individuals often are willing to coordinate and sacrifice for collective benefits, assuming that their contributions will be repaid later in one way or another considering that the processes are iterative. This widespread group concept has greatly facilitated and maintained collective action in local irrigation institutions (Wutich et al., 2012). However this may not necessarily work towards water conservation.

On the other hand, over the past few years, villagers have been facing increasing pressures from centralized water control and external interventions including cutting the irrigated land area, changing crop patterns and compulsory irrigation quota. Villagers call themselves "the last generation of traditional Chinese farmers" (modai nongmin) and also do not consider agriculture as a livelihood option for their future generations. Thus relations between the local population and their environment, or the "place attachment" (Garcia et al., 2013), have been adversely impacted. Villagers do not expect their future generations will reap the benefits of a sustainable future or make a living as farmers in the same location. They discount future and long-term benefits such as sustainability (Ostrom 1990) and are motivated to make the most of what's accessible and purse the best interest. Collective practices are perceived by villagers as indispensible strategies to reduce the water-related risks and uncertainty.

This makes it crucial to note that when collective practices or actions are not a potential dilemma as stated earlier, what kind of collective action is being carried out for what

goals and for whose purposes is the key. Despite the appearance of public compliance, it is clear that farmers in the studied villages have considerable knowledge and experience of rule infringements collectively. According to them, collective action increased their leverage and was more effective and less risky compared to individual violations, considering the Chinese government's prioritized need to maintain social stability above all. It is much more difficult for the government to ignore or confront the needs of a group than an individual. One example is the differences distinguished between the collective rules which govern irrigation practice and the official rules. Taking groundwater for instance, decisions such as irrigation time and charges are based on collective agreement: irrigation is usually carried out at night when official investigations are impossible; water charges are proportional to villagers' irrigated land area or a collectively decided price based on irrigation time and water fees to be collected rather than official pricing.

### *5.5.2. Social capital*

Uses of social capital are indispensable in collective practices, especially at local level (Giest and Howlett, 2014, Sharp et al., 2012a). Our results have shown mixed outcomes of villagers' use of social capital in collective practices of irrigation management at local levels. For example, in Wang village under private contracting, villagers are organized to invest in constructing costly "reciprocal" connections with external water authorities and local officials. There is an unspoken rule that every year each production team will have to pay a fixed amount of money to VC leaders for their assistance in facilitating guanxi with external authorities and accessing information in good time, such as when official investigations will be carried out by whom. Following Bourdieu (1986) and Coleman's (1988) argument about convertibility of different types of capital, local communities turned their possession of natural and economic capital into vertical social networks or guanxi to get illegal irrigation access, manipulate irrigation records and steal unaccounted-for water use. As one villager noted, *"It (Water management) is not just about water, but about who you know and*

*what they are capable of doing"* (Group discussion, male age 39, Wang villager, team leader and contractor). The mismanagement has been the direct result of too much external control and regulation, such as the increasingly tighter water control, allocation of water quota, and using of smart cards in groundwater control.

Wang villagers are using social capital in the pursuit of organized forms of collective bargaining and exploitation of groundwater resources, which is better planned and far more difficult to detect. Irrigation management has been supply-driven, focusing on exploitative irrigation uses and subverting official interventions, since water users have collectively invested in the construction of "socio-political" capital either through networking or collective corruption for example. Therefore a covert confrontation between water users and external authorities has been created over the use and control of local water resources. Villagers are perfectly aware that their irrigation access and related benefits hinge on exploiting the diverse interests of officials at different levels, whom they astutely align with. Another effect is that due to the elusive "collective investment" and lack of transparency in managing it, villagers' trust in local leaders and external water authorities as well as imposed water policies has been jeopardized. This in turn has directly affected villagers' acceptance of official water polices and their effectiveness (Pretty, 2003, Jones et al., 2012).

On the other hand, in the Wen case, the less advantaged economic situation which is caused by smaller lands and lower agriculture income and lack of Guanxi with external authorities seems to have influenced villagers and their irrigation use differently. Instead of investing in reciprocal vertical linkages and negotiating for more water supplies, villagers took advantage of extant horizontal relations of mutual trust and customary rules and norms within the village and communities to facilitate better collective management of local water commons. Wen villagers have the confidence to invest in the collective good, for example rehabilitating communal aqueducts. In addition, instead of having to invest in monitoring and sanctioning, villagers trust each other and follow the rules and this has improved cooperation and management

efficiency. Moreover frequent face-to-face communication and reciprocal arrangements among villagers have significantly cut water waste and increased irrigation efficiency.

Villagers' uses of different social capital have achieved different institutional outcomes (Adger, 2010, Jones et al., 2012, Yu et al., 2014, Yu, 2014). This can serve either as an effective complement for the formal policies and regulations or a potential threat with disastrous consequences. The two cases demonstrate the radically different outcomes of using collective action and different forms of social capital under specific circumstances: while some farmers were forced to enforce external water rules and pursue internal water conservation strategies collectively, others are able to defuse and even subvert these imposed official rules through strategic uses of social capital, Guanxi in particular. In fact, uses of different types of social capital have been one of the key factors accounting for the different performances of irrigation institutions in the two cases.

## 5.6. Discussion and conclusion

Villagers in both cases show their capability of working collectively and effectively towards shared goals and communal interests with or without external coercion or support, which as shown in the study can disturb and hinder effective water management. Local irrigation institutions are collectively established and tailored to a specific environment. They are constantly modified over time and reach down to the lowest level. They also have internal mechanisms to maintain accountability, fairness and cost-effectiveness among villagers. In terms of evaluating local irrigation institutions, Ostrom's design principles for successful CPR institutions have been identified in the two villages. In a sense, one should not hesitate to call these institutions –private contracting or collective governance, effective, efficient and long-enduring.

However, the management outcomes of these local irrigation institutions in practice

seem less satisfactory and considerably different in terms of water use efficiency, equity and sustainability. Our work extends Ostrom's (1990) work as well as others' and shows that meeting design principles alone is insufficient to assess whether irrigation institutions are successful or not within the local social, political and institutional contexts. To go beyond examination of design principles, towards an understanding of local irrigation institutions and outcomes, one must examine the details of local construction and uses of various types of social capital and means of collective action.

Social capital has strong explanatory power, especially in collective CPR management (Adger, 2010, Ellis et al., 2007). Each studied case has its own social and cultural procedure to construct and transform heterogeneous social capital into effective resources for collective practices. In other words, problems in these irrigation systems are not individual destruction or lack of coordination and collective action by self-interested users, but in the nature and the inappropriate uses of collective action and different types of social capital. We argue that uses of and relationship between social capital and collective action are inextricably interrelated to local irrigation institutions. It is argued that more social capital as in the Wang case, may not necessarily always be a positive thing (Adger, 2010). It depends on what kind of capital and how it is used, by whom and for what purposes. As argued, the capacity of authorities to enforce rules (social control) can be jeopardized by the existence of tight networks whose function is precisely to facilitate violation of those rules for private benefit.

Even at village level, social capital is a geographic and political concept (Bebbington and Perreault, 1999). In the context of Wen village, people were cooperative and collective management was chosen as the major form of irrigation institution. They as a social group directly responded to the external government interventions. Villagers collectively acted to define their water rights at the community level, and to devise their own water rules for management, monitoring, sanction, conflict resolution and

operation and maintenance of irrigation systems. They even devised time-specific rules for water allocation corresponding to the official irrigation quota. In the Wang case, instead of responding directly to external policies, villagers respond to them through powerful local mediators like private contractors and VC leaders and by constructing reciprocal Guanxi with external authorities. Compared with Wen village there was not much collective contribution of labour required in operation and maintenance of irrigation systems, or monitoring and sanction. Under the private contracting system, these were restricted largely by villagers' willingness to pay and how much they can afford. They may also be partly explained by the fact that compared to Wang village, Wen village lies in the very lower part of the river basin, where the water problems are more serious; and the fact that local water and electricity departments are required to share information which makes manipulation of irrigation records more difficult.

Results also have shown the complex interplay between social capital and collective action and local institutions (Ostrom and Ahn, 2009). Our analysis of irrigation institutions in the studied area has provided initial insights into both positive and negative outcomes in using social capital and collective action in local irrigation institutions under different circumstances. Negative consequences such as illegal collective practices rather than collective action towards conservation have been found in Wang village. Despite the clearly defined boundaries of water services and individual water rights, villagers have constructed and used their social capital, more specifically vertical social networks, collectively to violate officially imposed regulations and work the system to their maximum advantages or minimum disadvantages. This mutual reciprocity and connectedness is so well thought out that it has made external monitoring and sanction of violating behaviours almost impossible (Pretty, 2003). In addition, villagers are less likely to contribute or cooperate in local irrigation management or change their water behaviours. On the other hand, in Wen village, despite a lack of vertical linkages, people make better use of extant horizontal connections such as trust, reciprocity, customary norms and networks among villagers and this has facilitated collective action of irrigation management, lowered transaction

costs of collaboration, monitoring, sanction and conflict resolution (Pretty, 2003). In return, through these collective processes, horizontal social capital in the forms of mutual trust, social bonds, norms and reciprocity within communities has been strengthened. Finally, this has helped to change Wen villagers' water behaviours and provided them with incentives for demand-driven institutions and water-conservative practices, such as collective investment in lining canals, land levelling and reducing the size of irrigated fields.

As shown, local irrigation institutions are continuously impacted by the interaction, negotiation and accommodation processes embedded in the local cultural and socio-political systems, the understanding of which requires understanding of the everyday water struggles and experiences on the ground (Reed, 2008). The problems are very obviously not just physical or technical but include socio-political factors that have been generally excluded in water policy making and implementation. The mixed roles of social capital and collective action have been incorrectly overlooked in current water reforms in China and indeed elsewhere when attention has been focused almost entirely on higher levels of policy and legislation reforms, establishment of formal organizations and increasing government water control.

Local irrigation institutions are shaped, constrained, and redirected by specific water users' groups and the socio-political contexts they reside in (Mosse, 2006, Cowell et al., 2011, Trawick, 2008). It is unwise and even misleading to assess local irrigation institutions simply through identification of the existence of Ostrom's design principles (1990) without discussing significant and yet mixed roles of social capital and collective action, especially in a authoritarian state such as China where the use of Guanxi in everyday water politics is so prevalent. More careful analysis is required when Ostrom's principles are applied in different contexts. It is crucial to note that uses of collective action and different types of social capital can bring in positive as well as negative consequences such as collective corruption and collective over-exploitation of water resources, which remain largely invisible and unexplored. Instead of seeking the

"best practice" that meets a set of design principles, the challenge lies in better understanding and strategic uses of the complex factors and processes that constitute water problems in particular conditions, more specifically collective action, human attitudes and social capital.

To conclude, this paper has shown that the IWRM reform did not eliminate local struggle over water that is central to village politics. In fact under certain circumstances, it had adversely impacted the performance of local irrigation institutions and opened doors for collective collusion. Neither Ostrom's design principles nor the prevalent existence of collective action and different types of social capital are sufficient in ensuring successful irrigation institutions or sustainable water governance. The dilemmas of collective and social capital are not unique to China, thus these findings should have profound implications for management of CPR, especially water resources at local level in China and elsewhere. Future study should focus on understanding detailed processes, causes and effects of localized uses of social capital and collective action in different contexts; unravelling relations between institutions of CPR governance and the local needs; and identifying practical ways to make strategic uses of their positive impacts while minimizing their downsides in management of local irrigation commons in specific contexts.

# Chapter 6 Discussion

# 6. Discussion

This Chapter was formed into an article that is now under review by Journal of Water Alternatives.

## 6.1. Introduction

The previous chapters have detailed the approach and findings of this thesis, identified the social, economic, political and environmental changes in the SRB and examined local people's experiences of living and dealing with local water crisis. This chapter goes beyond data and analysis to deepen the understanding of the wider significance and the implications of this research, so that lessons can be drawn for the development and implementation of integrated water resources management for a wider audience, including researchers, policy in the studied basin and other water-stressed regions and countries.

One of the prevalent arguments of global environment studies concerns the challenge of successful governance of CPR especially in the context of climate change. This debate has been readily argued at country, regional and local levels in most developed and developing countries while in China, these issues have received little attention. Why is there so little work on water policy reforms and water politics in China particularly at local level? Is it that authoritarian hierarchy, corruption and political sensitivity, are so profound that there are few government initiatives worthy of study? The arid region of this study is emblematic of potential challenges resource-dependent populations are facing in a harsh, changing and uncertain environment. There are policy lessons and theoretical insights to be gained from Chinese case studies. Results from this research may help change the way water problems and solutions are understood and approached.

This Chapter is a cross-cutting analysis and discussion, which combines the central themes and findings in these four main chapters and papers and examines the

socio-economic and political structures and processes which lie behind the reform. First it discusses the issue of framing of water crisis as a social-political process rather than a physical one. Secondly, combined all findings in different Chapters, it focuses on stakeholders' perceptions of local water issues and the causes and the results of these generally. Thirdly the discussion focuses on the reforms of IWRM, their effects and the causes of the failure. Fourthly, the author stresses the topic of implementing public participation and WUAs in China. At last, the multiple roles of social capital, collective action and interplay between different levels of government and human-environment are analyzed in greater details.

## 6.2. Framing and the socio-political nature of the water crisis

*"Of course we are facing increasingly severe water problems. But taken as a whole, the amount of water has not changed much, after all what we pump out of the wells goes directly back into the ground again" (Author's interview, Wen village, male farmer, age 59, N22)*

*"With development of technology and economy, people can always dig deeper; it just depends on what the government wants or allows us to do." (Author's interview, Wang village, male farmer, age 39, N12)*

*"The water and environmental situation in the lower reaches has not been as bad as has been reported, it was the scheme of local (lower reaches) leaders who exploited the opportunity (framed water crisis ) to attract political attention and government funding…" (Author's interview, Wang village, male farmer, age 39, N5)*

*"If you control water, you control us" – (Author's field note)*

This thesis stresses that the water crisis is a complex and relative phenomenon. Instead of being a resource crisis or the classic Malthusian problem, the global water crisis is a governance crisis (Rogers et al., 2010). It occurs when water demands for different uses cannot be met at the appropriate time with the right quantity and/or quality for a variety of reasons, ranging from physical scarcity, and economic scarcity to socio-political scarcity. It is manufactured for different reasons in specific contexts, to strategically serve different stakeholders' purposes, especially the objectives of the powerful. Still

many of the most fundamental social factors behind the water crisis have not been analyzed coherently and water programs still fail to effectively include socio-political considerations (Reyes-Garcia et al., 2011).

Water and power are inherently and fundamentally connected (UNDP, 2006, Zwarteveen, 2008, Molle et al., 2009, Yasheng Maimaiti, 2009, Agnew, 2011). Wittfogel's (1981) classic work despite many critiques has become the centre of scholarly debates, showing the universal correlation between water control and control over man, especially the suggested linear relations between irrigation development, state formation and centralized power. In China water control continues to be a major basis of power. This is especially the case in a region such as the arid and semi-arid zones of SRB which constitutes a typical example of the socio-economic and ecological issues at regional and national levels. The still-significant story of how Yu the Great controlling the Waters (Dayu zhishui) and ruling the country in Xia Dynasty (~2000 BCE-1600 BCE) is a testament of the fundamental importance for China's leaders: to control its water and deliver services and fulfil needs of its population with continuous economic growth. Modern examples include the controversial and yet massive Three Gorges Dam and the South-North-Water Transfer Project among others (Berkoff, 2003, Mertha, 2008). These examples provide a typical example of top-down government control of water resources and the mobilisation of water users to protect "government-defined benefits", be it economic growth, food and water security or a sustainable future. In China there are enduring links between water control, power and politics (Molle, 2009, Mollinga et al., 2008, Mehta, 2001, Wittfogel, 1981, Bakker, 2012). Wherever water flows, is not only a sign of physical geography but also a flow of social and political power (Molle et al., 2009).

This thesis argues, the IWRM project in the SRB is as many previous projects also an ambitious political project. It is fundamentally underpinned by the political and economic need of the Party and government to better control its water resources and fulfil the goals of restraining ecological degradation which has been caused by a

bureaucratic history, lack of scientific policy-making and an uncoordinated, exploitative development mode over the decades. It is not only about developing the physical infrastructure and implementing policies but also a strategic reflection of how the water crisis, as in SRB, can be constructed and wielded as a "political weapon" and an "economic tool" to maintain or even enhance the power of the "powerful" and increase social inequity. For instance, few other countries can fulfil the task of mobilizing local population, constructing one greenhouse per household, halving farmers' irrigated land; or mobilizing its population to "voluntarily" grow tens of thousands of trees in the desert area of the SRB.

Water control remains central to maintain Chinese government's political legitimacy. The water dispute between users from upper-middle stream and lower stream has been chronic. The allocation of water between Wuwei basin and downstream Minqin basin actually had been drafted and issued dating back to the Qing Dynasty (Tiewtoy et al., 2011) but it had barely been implemented. For government at lower levels, water control remains fundamental to rural politics in an agriculturally-based region where rainfall is scarce and variable, and where irrigation access has been critical to productivity and human livelihoods. Decision-making power has been hierarchically administered through various layers of authority with little participation of local users.

Government-funded water projects can be an important way to address the increasing water crisis. However often there is little relation between the two. In this study, although the government has invested much money on improving physical infrastructure and water saving techniques, the impacts of these efforts on the ground to control environment degradation or water exploitation in meaningful ways seems less than expected. Where or how water projects are carried out can be a highly political decision (Sainath, 1996). That is what local people call "projects farming" or "The squeaking wheel gets the oil" (huiku de haizi you naichi). Farming water project which always brings government funding, technology support and disaster relief is a growing industry. For officials, issue framing like water crisis and environmental

degradation tend to attract a disproportionate amount of government attention, followed by government projects, funding and other resources (Sainath, 1996). This provides unparalleled opportunities for local governments who had been deprived of important tax and revenue sources which resulted from the economic and political reforms over the past few decades (Tilt, 2010) . This 4.7 billion Yuan IWRM project has offered the studied region the opportunity to become a provincial and national example of successful government intervention in achieving sustainable water governance and development. Political careers have been enhanced through highlighting the monumental achievements. One notable example is that of the local officials and project implementers, whose performance is closely linked to highlighting the fulfilment of officially set IWRM targets. This further explains the officials' determination of carrying out IWRM reform measures at any cost. This reform to address local water crises is framed as a monumental career opportunity for many local, regional and national officials. For some local residents, these projects can beget widespread support, especially financial support to lay roads, dig wells, repair and construct water infrastructures, create new job opportunities, increase income and attract loan. Moreover, "project farming"[8] can be risky and can sometimes bring more loss than benefits. Even when these projects are carried out, as in the SRB case, those most in need may not necessarily be able to benefit from them and it rarely addresses the real water problems or even touches their root causes.

In China, the socio-political dimensions of water issues have always been overlooked. The focuses has been on more simplistic and technocratic approaches emphasizing the physical and natural aspects of water supply (Agnew, 2011, Nickum, 2010). The struggle to control the water commons and environmental degradation is often contextualized in a discourse of modernity, invoking the prowess of advanced technologies (Kang et al., 1996, Zang, 2008, Lohmar et al., 2003, Deng et al., 2006). The consistent political message delivered to the public is to get rid of poverty will

[8] "Project farming" is an increasingly popular phenomenon which local officials and villagers use to get funding from donors and higher-levels, for example, using fulfilling current projects to get more projects.

depend on water saving technologies and agriculture techniques. However these efforts have only been adopted and implemented to a very limited extent. It seems that in order for the government to effectively address the water crisis, it would always have to sacrifice its economic growth and some people's livelihoods, especially those marginalized and most resource-dependent. Without appropriate financial and technical support from the government, poor regions will find it difficult if possible at all to escape the poverty trap, in which poverty leads to environmental degradation and environmental degradation deepens poverty.

The difficulty in accurately attributing the effect of human activities and natural causes such as climate change on the water crisis has been widely recognized. In studied area, the culpability of smallholder farmers and their agriculture and water practices as well as a changing climate is widely discussed (Edmunds et al., 2006, Kang et al., 2004, Ma et al., 2005a) whilst the impacts of government policy and mismanagement of water resources are generally denied. Officials identify local population as backward, ignorant and irrational. The root of the water problems was perceived to be the villagers or irrigators themselves and their over-exploitative water behaviour. Therefore coercion is considered indispensible to bring changes in local water use. This further helps legitimize the mandated government water control and interventions which leaves local people little choice but to comply and sacrifice for the "greater good"- a water-conservative and sustainable future This makes it at least supposedly, easier for government to exert its power over water, other related resources as well as the resource-dependent population. It seems that a sustainable development mode is not achievable unless government intervenes with its power. Thus projects such as IWRM which is centrally planned and top-down mandated are considered the key solution to make things right (Gansu Provincial Water Resource Bureau ), 2007). This has neglected understanding of the social-political nature of water crisis at different levels, and unavoidably resulted in misguided attempts to solve water problems without fixing the root causes or actual exacerbating factors (Yu et al., 2014).

To conclude, the framing of the water crisis therefore is a combination of institutional, economic and ideological conditions at national, state and local levels. It is never politically neutral. In other words, water governance and/or control is wrapped up in relation to the interests, goals and power of different socio-political groups at multiple levels. Water issues are therefore about how they are perceived and faced by local residents that vary socio-politically and spatially, about understanding the power relationships that shape and influence them and about proposing innovative and locally applicable systems of governance to alleviate them.

## 6.3. Addressing governance

This section will address the issue of governance in the bureaucratic and authoritarian Chinese context. Firstly it explains how and why current governance system works. Then it will critically examine how water governance and IWRM reforms affect water, livelihoods and local environment in various ways. At last, it will analyze the roles and interactions of different stakeholders in the process of IWRM reform and water governance.

### *6.3.1. Understanding governance*

Governance of water has undergone a prevalent transition from traditional engineering-dominated approach to a focus on the human dimensions of water governance. Water cannot be dealt with in an isolated, controllable way or just only as a commodity. The relationship of water with its natural and socio-political environments must be well considered. Human activities in the past, for example the uncoordinated and intensive farming in the Shiyang River Basin with an annual rainfall of less than 200mm, had and continue to have an enormous impact on the future, including ecosystem degradation and the water crisis that is getting worse.

"Water governance" in this thesis is used for collective action to manage water at different levels among various stakeholders. It is distinct from governance that is

established by rigid hierarchy from bureaucratic government. It is about different levels of society using different means and methods to coordinate in more than one way to address water problems. It is the processes in which different stakeholders interact with and influence each other in the pursuit of their own interests.

To deal with the increasingly severe water crisis in the Shiyang river basin, a series of measures have been launched by the government under the IWRM reform in 2007, and it was approved by China's State Council with provincial and municipal governments being the major promoters and local governments as the main implementers. As discussed in earlier chapters, the detailed measures include, water right (quota) allocation based on water availability, establishing WUAs and participatory water management, increasing water pricing through a scalar mechanism, strengthening water infrastructure and water-saving technologies, and changing of local agriculture patterns from water-consumptive to water-efficient.

As shown in studied area where the majority of population depends on irrigated agriculture for a living, through water reforms such as IWRM government can significantly influence people's water behaviour, agriculture production, income and livelihoods in various ways. For example as discussed in previous chapters, after introducing water right, water permit and irrigation quota, most villagers had to adjust their cropping patterns based on water needs of crops rather than their market value and in some cases local farmers can only grow government-selected crops. Also due to increasing difficulty and uncertainty in local irrigation access caused by IWRM reforms, villagers chose to irrigate more rather than less every time they had irrigation access and this had led to inefficient water use and water waste. In addition by reducing farmers' irrigated land area, some local farmers had to seek alternative off-farm job opportunities or become part-time farmers. Also those villagers who have better "guanxi" or social networks had managed to become bigger landholders and this has significantly increased local socio-economic differences by creating bigger landholders and smaller landholders. In downstream area where environment degradation is most

serious, irrigated agriculture was officially banned and villagers were forced to leave their villages and become ecological refugees. As villagers repeatedly expressed, through increasing water control, government especially at local levels managed to gain control over local farmers.

### *6.3.2. IWRM implementation process*

China's water governance as was characterized by a powerful central state which dominated a mandated and non-participatory policy process; a generally weak and uninformed civil society; and a regulatory regime which functioned on command-and-control instruments. It was the upper-level governments who initiated IWRM policies and reforms. These measures were made and imposed from higher levels such as the provincial government and the Shiyang river basin water bureau (See Figure 6.1). In this process, the provincial and municipal authorities consider the reform policies fit quite well with the national policy towards a water-saving society and environmental sustainability, and they see their own role as one of initiating stimulation policies and bring resources such as funding and different partners together. The country and township governments make water allocation planning and issuing water permits of surface and groundwater on annual basis. These water rights or quotas were then assigned to lower levels, for example to the village councils and WUAs. These institutions would make their own implementation plans and report the implementation processes and outcomes to their superiors, with occasional and random investigations from upper levels (See Chapter 4 for more details).

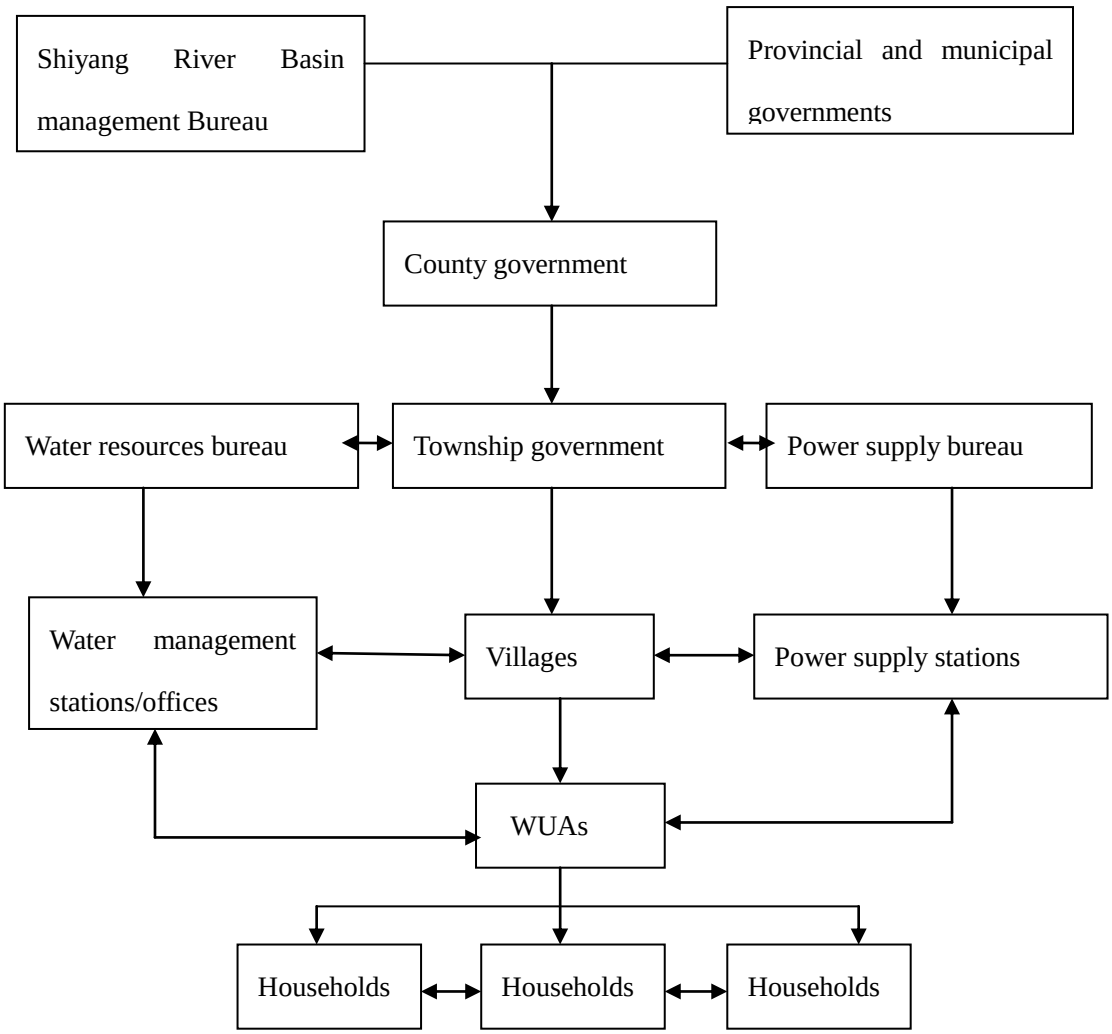


*Figure 6.1. IWRM implementation process.*

### *6.3.3. Localized governance*

Implementing IWRM reform in a fragmented bureaucratic system such as in the studied area has unavoidably created some political space for local governments to take on multiple roles including the role of representatives of local interest and distort the policy guidelines. Local governments, who are responsible for the implementation of the water reforms, are highly autonomous in choosing and implementing specific programs and delegating project related resources. Informality, flexibility and prevalence of using "guanxi" (Yu et al, 2014) and reciprocity in water governance across a diversity of scales, make it debatable what purpose is served by the IWRM reforms.

Taking the policies to change local agriculture patterns through constructing greenhouses, breeding sheds for livestock husbandry and planting fruit trees such as grape, pear and plum for example, local governments have autonomy in managing the project funding, selecting tree species to be planted and allocation of official tasks such as land area that must be used for growing fruit trees or number of greenhouses that have to be built each year. Detecting the crucial importance for officials to fulfil these targets, and the requirement of villagers' support in the implementation process, villagers tried to strike a deal of 'reciprocity' with local officials by complying (partially or superficially) with these policies in exchange of extra irrigation access or government funding. This process was normally led by WUAs leaders and facilitated by leaders from village councils and township. Meetings were held within each WUA and production team discussing about implementation details such as which field and how much area of land will be sacrificed for these tasks and distribution of potential costs and benefits were also shared among villagers. Under this strategy, many greenhouses and breeding sheds funded by the project were built (sometimes more than annual requirement), most of which were of poor quality or never even used; and many trees were planted with low survival rate (See chapter 4, 5 and 6 for more details).

Considering the scale and size of IWRM implementation and the fragmentation of village agriculture, compliance is mainly assessed by self-evaluation or internal reporting without any stringent inspections. Consequently, regular fabrication of water use reports was very common and the quality of project-related statistics is rather poor (this is also frankly admitted by officials). This system vividly reflects the common historical saying in Chinese politics that "when there are policies from above, there are countermeasures from below (shang you zhengce, xia you duice)".

Most lower-level officials are well aware of the fact that some policies, such as a compulsory water quota or forcing farmers to change their crop patterns to fruit trees, are unrealistic, but the political system requires them to fulfil their political task. In

order to ensure their political career, they have to enforce these policies regardless of the price since questioning superiors' policies and decisions is politically unfeasible in the Chinese context. Officials thus need villagers' support and cooperation in fulfilling these targets. This explains why local political authorities sometimes tolerate villagers' infringements by 'keeping one eye closed' in implementation of IWRM policies as long as these actions do not threaten the local political status quo or the "big picture". In light of this, the success or failure of IWRM cannot be defined by whether officially set targets are met, but by the dynamic state-society, villager– official negotiation processes which are constantly redrawing the lines of what IWRM actually consists of and what successful water governance means for different stakeholders in different local contexts (more details about the effects of IWRM will be discussed in section 6.5). This again stresses the prevalence of fragmentation of authoritarian power throughout water governance process, as conflicting financial and political incentives reward implementation/mis-implementation. The nature of water governance in China depends not only on power and policies of government, but also the central-local politics and local dynamics. Water governance reforms take place in profoundly local ways.

### *6.3.4. Governance challenges*

One major challenge for successful local water governance is at intermediate levels, especially when current implementers and policy makers, and reporting and evaluation mechanisms often fail to provide accurate information or effective communication. On the surface, leaders at higher levels, county levels and lower levels seem to complement each other in developing and fulfilling IWRM related arrangements. However, more often than not they are driven by different socio-economic and political incentives. For example apart from upward accountability towards superiors, leaders at village and community levels have to represent and take good care of farmers' benefits if they need villagers' support. This is one of many dilemmas faced by local leaders. Under China's new president Xi Jinping, evaluation of officials has abandoned GDP-centred

assessments and put more emphasis on public well-being and environmental performance, which is a positive step towards more balanced and sustainable development. However, it is not hard to imagine implementation problems, including obsession with measurable indices, manipulation of report results, and trade-offs between these measures and traditional evaluation norms such as GDP. There are examples of under-reporting and fabrication of water use data at various levels. Similarly, cross different sectors, the water bureaus sometimes require electricity records to crosscheck actual groundwater use in different villages. Considering that the power supply bureaus and stations benefit directly from farmers' electricity fees, they always tend to show fabricated version of records of electricity use to hide villagers' overexploitation of groundwater. These again revealed the rural and local realities of water governance that people either as individuals or groups across different levels and sectors assert right and control over water; and how access and control of water can be negotiated (formal and informal). Thus examinations of the ways in which different stakeholders are charged or compensated in the governance process help explain the difference between policy and practice.

However, one should not assume that officials are incapable of maintaining strict water control. IWRM is tightly mandated by the government and remains a top-down political process. Control and planning of water-related policies and reforms remain in officials' hands. Officials still have effective power through governance of the access and distribution of local resources. Effective water governance reforms in studied area require important institutional changes throughout the governance process which do not exist under current circumstances or in the foreseeable future. Implementing IWRM remains a political decision with high political priority rather than a technical or scientific decision. For example, the IWRM reform was actually pushed forward by a directive from China's former Premier Wen Jiaobao who alleged that "we should never let the Lop Nor tragedy happen again in Shiyang river basin". The framing of water policies was done with little or no meaningful consideration of local realities, rules and norms in informal institutions especially in areas such as the SRB where irrigation is

essential for local livelihoods.

Merit of authoritarian governance system with upward accountability is its ability to produce a rapid centralized response to water crisis and to gather resources and mobilize state and social actors. However, in a bureaucratic and fragmented system, the aims of governance reform can easily be undermined or distorted during implementation stage. Lack of understanding and substantive input from local villagers in particular is imperative to achieve successful water governance. The implication for water governance in the Chinese context and elsewhere includes a need for institutional reform across its social ecological system, with policy makers considering local specifics, water dynamics and water perceptions of different stakeholder throughout policy formulation, implementation and evaluation processes.

## 6.4. Perceptions

People's environmental perceptions will shape how water issues or policies are constructed and approached (Pringle and Conway, 2012). It is these perceptions, for example how people understand their water situations, that opens up space for change (Folke et al., 2005, Dunlap and Mertig, 1997). Relevant efforts abound, such as water perceptions in India (Mehta, 2001, Quinn et al., 2003, McKay and Keremane, 2006), Tanzania (Quinn et al., 2003, Slegers, 2008), Spain (Aguilera-Klink et al., 2000); governance of the water commons in Japan (Sarker et al., 1999), Taiwan (Tang and Tang, 2001) and the Philippines, Sri Lanka, Turkey and US (Ostrom, 1990); and the costs and benefits of social capital and collective action (Ballet et al., 2007, Gautam and Shivakoti, 2005, Fujiie et al., 2005, Agrawal and Ostrom, 2001, Araral, 2009, Lam, 1999, Meinzen-Dick et al., 2002, Mosse, 2006); and the nature of IWRM reforms that seldom renders an equitable result (Ako et al., 2010, Giordano and Shah, 2014, Goldin et al., 2008, Hofmann et al., 2010, Maganga et al., 2004, Mitchell, 1990, Nesheim et al., 2010). One of the key focuses of this thesis is about the wide variety of ways, in which water crisis is perceived, with the aim of incorporating these insights into a more

effective, equitable and participatory water governance.

There is a general consensus among participants that the SRB is facing "the water crisis". This is exemplified by the majority response at the village and community levels that, *"It is raining less and less than the past"*, *"farmers have to irrigate more to maintain the crops"* and *"a lot of the desert crops have died because the area is becoming drier"*. On the other hand, various stakeholders think differently about the causes and appropriate solutions of water crisis and impacts of IWRM reforms. People's water perceptions are impacted as much by villagers' personal circumstances, social networks and experiences. They are also influenced by conditions at different geographical scales and different time horizons (Dunlap and Mertig, 1997). The findings revealed that the water crisis is more than the simple physical quantity or water supplies (Mehta, 2003). Although most villagers did recognize the deteriorating water situation (Yu et al., 2013), it was largely seen as a necessary by-product of an eminently desirable goal of economic development and poverty alleviation (Tilt, 2010). For instance, "*We survive through farming and in here farming needs irrigation, without which we cannot make a living*." (Interview, male, age 54, Wen village, N41). Changing people's water behaviour will be rather difficult if the perception of "develop first, deal with environmental issues later" continues. In the absence of effective training and capacity building to improve villagers' understanding of water related issues, it will be very difficult to change the popular water perceptions. In other words, to address increasing water crisis requires more than supply-driven interventions and technology-based solutions but changing stakeholders' perceptions and mind-sets, both the lay public and the professionals (Yu et al., 2013, Yu et al., 2014). These also stressed the importance of education and appropriate policies in effectively improving people's water and environmental awareness.

To conclude, the struggle over water in the area studied is not merely about water availability, property rights, policy implementation and livelihoods. It also is a struggle over how the water crisis is understood, a struggle to identify problems as well as their

causes and solutions, a struggle over the appropriation of power, benefits and socio-political relations. The increasing government control and policy implementation may not consolidate government power, governing legitimacy, economic growth or social equity at various levels, but induce conflicts and inequity. Thus, projects such as IWRM in this basin tend to tap into the resource bases of less powerful places, reinforcing the marginal status of such places by either depriving them of resources or impacting them negatively in significant ways, considering that these groups normally are the poorest, the most resource-dependent and the least capable to adapt to changes (Thomas and Twyman, 2005).

## 6.5. The effects of IWRM

Although authoritarian leaders from CCP (Chinese Communist Party) have played and continue to play a dominant role in decision making and in shaping policy agendas, it is important that researchers today do not attribute more effectiveness in policy implementation than it has actually achieved. As noted local implementation especially in this large and diversified context, has rarely resembled what has been envisioned in the policy agendas or reported in government reports (Nickum, 2010, Wang et al., 2010, O'Brien, 1996, O'Brien and Han, 2009). Thus it is critical to capture what actually happened in practice and the nature of engagement between water resources and water users and among different stakeholders.

### *6.5.1. The effects on water use, equity and sustainability*

So how did IWRM-aimed water reforms affect local water resources, users and sustainability? On one hand, case studies demonstrates that what is reported or said in documents can be quite different from what actually happened in practice (Paper 2 chapter 3). Reported outcomes of reforms at different levels remain preliminary and sometimes contradictory based on the responses of officials and local stakeholders. Most expressed that it had not changed much or even been increased (Yu et al., 2014). One reason would be that the increasing unpredictability and uncertainty has falsely

encouraged farmers to irrigate more whenever they have irrigation access so that the crops can last longer till the next round of irrigation. Moreover, as demonstrated earlier, since the total irrigated land area per household has been cut, farmers have to make the most out of what is left, and for them sufficient irrigation is indispensible in term of a good harvest. Empirical data shows that the authorities have actually encouraged overexploitation of water resources. For example, despite increasing government control and banning the growth of water-consumptive crops such as onions in 2011, almost all farmers in studied villages rushed to grow onions that year under the perception that since the government was banning the growth of onion there would be a large market for it and good profit. As a result, there were too much onion and nowhere to go. Some farmers had to use onions to feed livestock while others even lost all their saving (See Figure 6.2). On the other hand, shutting down boreholes and cutting farmers' irrigated land area especially plots in the desert area had reduced the overall water use in the river basin. Newly issued water allocation plans had increased surface water flow into the lower reaches and alleviated overexploitation and recharge groundwater. Subsidies invested in construction or rehabilitation of irrigation infrastructures had increased water use efficiency and reduced water loss in canals. Water pricing and water management through irrigation quotas had to a certain extent improved farmers' water consciousness and encouraged them to conserve water.

*Figure 6.2 Onions that cannot be sold were stacked in front of a household*

Moreover IWRM reforms in the studied area have largely failed to deliver the expected or theoretically predicted benefits to local communities. As commented, *"Over the past few decades we (the village) have experienced more rapid economic development and higher agriculture income. But now our wells are shut, our lands are cut and abandoned so we have stopped developing now, even lagging behind other villages and areas."* (Author's interview, male, age 41, Wen village, N31). Policies to promote water-efficient agriculture patterns had also forced rural communities to seek alternative sources of income or learn to practice commercial rather than water-consumptive subsistence farming. Some farmers had developed a variety of livelihood sources to supplement farm income, such as casual labour, selling hand-made shoes, renting plots and off-farm jobs.

While the local and regional biophysical, socio-economic and political characteristics varied significantly (Yu et al., 2013, Yu et al., 2014), these heterogeneities had not been appropriately taken into account in either policy making or implementation. Efforts had been exclusively focused on the quantity of implementation of specific measures rather than the quality. A good example is the reform of greenhouse- and livestock-focused agriculture. The aim had been to change from grain-based, water consumptive agriculture pattern to a less water intensive and more water-efficient pattern (increase per unit water output to >5 RMB/$m^3$). Government subsidies were inadequate (9000 Yuan RMB per greenhouse for these projects can only support half of the investment) while about half of the investment was to be paid by farmers themselves. Villagers' social and economic benefits had been adversely impacted with little or no compensation. Respondents repeatedly reported that their income had dropped and promised compensation had been delayed or even denied.

A number of inequities in the distribution of project costs and benefits had been identified from fieldwork experiences, observation and communication with locals. A trend towards marginalization began to appear, dividing farmers into the privileged and the vulnerable. For instance, it was the privileged groups who have the necessary

economic, social and political power/capital to invest in these projects gained in practice. For weaker and smaller farmers, these measures were too expensive to afford and even harmful. The privileged groups included people from richer villages and areas, village committee members and relatives of the committee members and members of villages with better socio-political connections. They managed to work the scheme towards their advantage or minimizing the disadvantage. For example, the privileged farmers managed to acquire more land by renting plots from vulnerable groups who were unable to cultivate them either because they could not afford increasing inputs or the labour cost of small-holder farming; or because they had migrated out for off-farm employments. In some cases they took advantage of plots belonging to members of their large extended family who had moved to the city. They also took advantage of socio-political connections with local water managers and officials having access to project information in order to reduce irrigation risks and attract government subsidies. The vulnerable groups however were adversely impacted or reduced to the status of casual laborers for the privileged farmers (See Figure 6.3.).

*Figure 6.3 Local smallholder farmers were working on lands of bigger farmer (the man standing in the middle) as casual labourers*

Taking this as a great opportunity to attract government funding and projects, local officials had ambitiously focused on project quantity rather than effective

implementation. In some cases, the decisions to select construction sites were not based on farmers' choices but on local leaders' decisions. Priorities were given to sites close to main roads (See Figure 6.4) for construction and on larger pieces of land, since most agricultural lands were small and dispersed, in order to facilitate the official inspection and monitoring. This is considered a main way to demonstrate to upper-level superiors "implementation success" and local government's accomplishments. Consideration of biophysical factors such as soil conditions and productivity was neglected. Most villagers were unwilling to engage or change. In some communities, to fulfil these targets, every 2-3 households invested to construct one greenhouse. As a result, 10 greenhouses or livestock greenhouses were shared among 30 households so they were either in really bad shape or barely used at all after construction (See Figure 6.5. and 6.6).

*Figure 6.4 To get irrigation access and start agriculture production, one woman in local communities was carrying the seedlings and organized by the community leaders to fulfil the official task of fruit tree plantation on a officially selected field.*

*Figure 6.5 Vacant greenhouses. Local people used barren fields to fulfil the green house task so that they can farm the fields of better quality. As a result, most of the invested greenhouses were neither used nor usable*

*Figure 6.6 Empty livestock greenhouses (or sheds). Many people agreed to build greenhouses for livestock to get government funding, or fulfil government tasks. So the greenhouses were always of poor quality and barely used*

Another example is the government funded project of fruit-tree planting. The local water authority only granted irrigation access if these tasks are fulfilled. In many

communities, the plantation area was allocated on a per capita basis, e.g. 0.4 mu per person/year. The efforts to instantly expand the coverage of these measures such as areas of fruit tree plantation and greenhouses construction had sacrificed careful planning and effective implementation; and increased public resistance. There were multiple cases when farmers who were forced to plant fruit trees, planted the seedlings upside-down as a protest against oppressive conditions and grew other crops on the same land to make better use of the limited irrigated lands (See Figure 6.7). One respondent commented, "They (officials) don't *care how or where we (farmers) carry out these tasks, as long as we fulfil the allocated tasks. They control water so they control us. We just have to cope with official orders?*" (Interview, Male, 51, Wang village, N15)

With time, it became clear that the projects under IWRM scheme would not have any lasting impact. The constantly changing and imposed policies had made agriculture planning almost impossible. It is very common to see that irrigated agriculture had been left in the hands of the older generation, women and children (Figure 6.8and 6.9), while men sought off-farm jobs elsewhere. This indicated an increasing absence of inputs, labour and better-educated and more capable participants in local agriculture production and water projects. Actually finding the land, labour and appropriate crops with reliable irrigation access to cultivate had become a serious problem. These projects have been sustained poorly though continuous government investment. Most of them were badly located, either chosen by unwilling villagers or by local officials who favoured "Vanity projects". In other words, once the government funding and projects come to an end, it is highly likely that farmers would go directly back to their old agriculture pattern.

*Figure 6.7 Enforced fruit tree plantation (a- one grapevine field with intercropping to make better use of lands wasted on tree plantation; b- one grapevine field with almost no seedlings survived*

*Figure 6.8 (left) One local family getting ready to farm on their lands*

*Figure 6.9 (right) Two local women were damming the irrigation ditch and irrigating their lands. Both their husbands have left for off-farm employments.*

## 6.6. Why IWRM had failed?

So why is it most of IWRM policies did not work in studied area? One explanation is that water conservation is as much about socio-political processes as physical ones. The major constraints are not technical, but social and political. As shown in previous chapters, water-use and management patterns are an expression of deep cultural,

socio-political and economic structures. They do not change over a short period when the government sounded the alarm that its resources base or sustainability is threatened. There is an urgent need for integrating the social, economic and political factors as they occur in local situations in policy making and implementation of IWRM. These mandated policies did not work because the socio-political and cultural factors had been analyzed insufficiently. This frequently ended up with the state using tougher implementation attempting to protect the environment against the majority of the people who use and depend on it.

Villagers' lack of participation and their past experiences of the state's policies and especially their relations with local officials have direct and significant impacts on their reception of new policies and on their potential to have successful implementation and positive outcomes (Diduck et al., 2013). It is those officials who were introducing and implementing the IWRM policies and administering the project funds who were widely considered by the villagers as corrupt. Over the course of field work, I have gained a strong sense of widespread scepticism. Villagers were convinced that IWRM reforms were yet another ploy conjured up by local officials to seize government funding at the expense of villagers' income and livelihoods. A meticulous analysis of the socio-political aspects of perceptions may provide useful insights into why policies are understood and treated in given ways.

The previous analysis presents a broadening of the various strands of examples of how concepts with their roots in the Western context can take place in policy making and changes in an authoritarian society such as China. A bureaucratic and fragmented political system provides a key chance essential for different stakeholders to compete and manoeuvre within the policy process and to act strategically in working the process towards their interest or pursue their policy goals. Both inputs and outputs of these mandatory reforms are diverse and difficult to quantify in practice, particularly in a political context where questioning official decisions and policies is not duly appreciated. It is argued that to view community benefits simply from government's

perspective and use mandatory reform measures as a device for public acceptability is insufficient. More attention must be given to the complex nature of fostering public acceptability and to the specific contexts and multiple ways in which these measures are approached by different parties throughout the processes. This argument has relevance beyond water and China, to the wider debates about governance of CPR, environmental justice and sustainability. To make future policies more socially acceptable, these factors have to be appropriately taken into consideration throughout the process of policy making and implementation. Unfortunately, good indicators of the practical impacts of IWRM are not available.

## 6.7. Public participation and WUAs

Public participation in water management processes has been widely accepted as an institutional imperative (Ostrom, 1990, Folke et al., 2005, Uphoff, 1986, Narayan, 1995, Reed, 2008, Agrawal, 2014, Yu et al., 2014). Generally speaking despite the widespread popularity of integrated and participatory water management, there is surprisingly little empirical evidence about its practical impacts (Samad and Vermillion, 1999, Yu et al., 2014). This study suggests that the dichotomy over the two water governance regime – top-down versus bottom-up, might not be the most effective way with which to govern a country's water governance especially in a traditionally authoritarian society such as China. Participatory irrigation management imposed on local governments from above is not participatory at all.

In the SRB, existing attempts to develop participatory water governance though models such as WUAs, are being implemented in a mandatory, top-down manner that seeks to manufacture rather than achieve genuine public participation or empowerment. It is the very form that it took that made it impossible to expand and play its role. Despite the political support from higher levels for participatory water governance, in practice, the influence of local participants is circumscribed by local officials who are wary of potential challenges to their power and authority. It has been degraded to pursuit of

number of WUAs constructed or irrigated areas covered under WUA-based management. Therefore, many respondents who were reportedly WUAs members and participants of local water governance were not even aware of the existence of WUAs or their rights and responsibilities as WUA members (Chapter 3). These points were barely given any attention in extant implementation or assessment of IWRM reforms.

Results show that decentralization is occurring because the government has been facing pressures from fiscal deficit, and from local communities' increasing need for greater control over local resources (Steinberg and VanDeveer, 2012). This process is subject to a number of methodological and political constraints. Firstly the government authorities have been dominantly shaping the concept, forms, degrees as well as implementation contexts of public participation. Secondly there is a lack of understanding and successful examples of how participatory processes can improve the performance and effectiveness of irrigation systems. Unlike participatory processes in other parts of the world (Narayan, 1995), the ultimate aim of public participation in China is to support a supreme unified interest defined mostly if not solely by the CCP (Chou, 2009) and facilitate implementation of government policies, rather than to empower the public or enable them to defend their own benefits against the government. Collective action and organizations that are outside the control of the Party or aimed at defending participants' rights against the state is strictly forbidden. Government maintains control over which types of participation are allowed, and who may participate and articulate their opinions at what level. Invariably, participants are well aware that their presence and behaviour is at the discretion of the authorities and their advisory participation is not able to have real impacts on decision-making. This has largely discouraged people's participation interests and incentives to make a change.

Generations of authoritarian governance and political clientelism (Oi, 1991) have also worked against the IWRM rhetoric of participatory governance and the formation of autonomous farmers' organizations at the lowest level in desolate and backward rural China (Chapter 3, 4 and 5). It is natural that elite officials resist power decentralization

or participatory governance considering its nature of reconfiguring power relations. Empowering villagers in any way will only make it impossible to complete official tasks, such as water quotas, collection of fees and enforced water-saving projects. Changes in the water sector or environmental changes generally require political and institutional changes embedded within the broader historical, socio-political context, which both the state and its agents are reluctant and/or unable to provide. This creates constant struggles over power at local levels.

Results from fieldwork including participant observation, interviews and group discussion, at village and community levels, public participation is local, informal and more imperative in addressing water and related matters. Here participation is internally determined by localized rules, norms, customs and nature of local relations. In practice it has been found that production teams are the most common basis for discussion and decision-making related to community issues, such as groundwater irrigation timing and sequence, labour distribution, reallocation of contracted lands and implementation of officially set targets including construction of greenhouses and fruit tree plantation. The heterogeneities within these teams were normally very small since most members are agriculture-based, growing similar crops and with irrigated landholdings that only differ according to the household size. People's contribution was proportional to their benefits – based on their landholding or the number of landholders in their families. In some communities with larger irrigated land areas, most men stayed inside the village, women's participation is relatively rare, while in others with smaller pieces of lands men migrated out for off-farm jobs and women's participation was more prevalent. Still in other cases, men and women in the family would take turns to participate, depending on who is available at the time. The meeting was usually at night after dinner when most people were not busy with farm work, either inside team leaders' homes or a chosen public place that is big enough to hold all participants (See Figure 6.10). For some matters it might take one or two meetings to make a final decision while for others it can be a constant negotiation or even argument over a long time until a consensus can be reached.

*Figure 6.10 One local public meeting. From the sitting and the organization, it shows a very clear trend- older male sat in the middle while women grouped together and sat in the back far away from the team leader (the one standing on the left side).*

This thesis argues that neither involving a few stakeholders who have capital and political influence in certain process, nor is nominal involvement of almost all local water users as in most WUAs sufficient. For successful water governance and reforms, it is required that stakeholders with the right characteristics, roles and purposes should be involved throughout the process. Political institutions matter not only for political outcomes but also environmental issues (Steinberg and VanDeveer, 2012). The problem is not one of creation of new institutions such as WUAs but one of facilitating meaningful public participation and strategic uses and regulation of existing power relations and institutions, either formal or informal throughout the governance process. The local context is also very important in constructing participatory institutions and management.

## 6.8. Social capital and collective action

> *"We (as a community) do water stealing cleverly. It's a strategy of survival." (Author's field note).*

Social capital and collective action are the basis for all social institutions and effective tools for pursuing sustainable governance and socioeconomic objectives (Folke et al., 2005, Yu et al., 2014). The use of these creates profound differences between

theoretical benefits and practical outcomes (Portes and Landolt, 2000, Putnam, 2001, Cleaver, 2005, Ostrom and Ahn, 2009). However little data exists regarding IWRM implementation at different levels or the significant roles of social capital and collective action throughout the process. In Chapter 5, it is argued that CBWRM (community based water resources management) can be utilized as an effective tool to facilitate water management or a site of local resistance and an opportunity for local people to reshape the social-political relations in ways which suit their needs and benefits. On the other hand, external official policies can also be a double-edged sword- a chance to make changes or a disturbance of existing socio-political relations and institutions for example reinforcing hierarchical governance and elite capture of the powerful (Blaikie, 2006).

As has shown in previous Chapter 4 and 5, collective forms of local resistance and inappropriate use of social capital have grown in sophistication and complexity. Collective collusion has become a powerful and necessary weapon in pursuing individual benefits and avoiding project induced risks. Taking collective corruption as an example, it has become better planned and coordinated in its collective forms; it is more justified as a survival strategy and rather difficult to detect. There is rich evidence of intentional, tactical manoeuvres and "site-specific" accommodations between increasing government control and collective resistance. It is thus no surprise that different social groups may construct and approach IWRM policies and projects strategically or selectively in ways that best serve their own purposes and interests. The possession of socio-political capital such as that in Wang village has somehow enabled local officials' rent-seeking behaviour (in the forms of hospitality, such as meal treat, gift money, commission, and kickback) in constructing a reciprocal relationship with local cadres at township and county levels, which makes it easier to influence policy outcomes in their favour (Yu et al., 2014). Therefore it can be more destructive, for example inducing more political distrust and public resistance rather than common understanding or cooperation between the internal users and external officials.

Is there only "one way" to achieve sustainable water governance, for example through

CBWRM, government control or the market? There is no single best way to solve the governance dilemma (Ostrom, 1990). From this study, it is clear that there was no choice between the three different forces which should be symbiotic rather than antagonistic. Water governance process is a complex evolving system which lies beyond control of one force, whether it is the government, market or local communities, each of which has a limited power while being an indispensible component of successful mechanisms. Local farmers and communities have developed their own and usually long-enduring and effective methods of water governance which had evolved according to local social, economic and environmental conditions, but which continues to be disrupted by the increasing interventions. Even though these systems cannot be controlled, they can be influenced, based on critical analysis to deconstruct the actual processes and uses of social capital and collective action especially in water management process, which however remains unexplored. This thesis has added people's understanding in the rural Chinese context.

## 6.9. The human-environment relations

As Blaikie argues (1985), there are three major sources of uncertainty which lead to the difficulty in resolving the world's environmental problems: uncertainty in obtaining accurate and widespread measurement of specficial environmental problems; uncertainty in how these problems are viewed and apprached; and uncertainty in singling out the effects of humans from other effects such as climate change. The realtionships between resource, environment and its users affect the processes and outcomes of institutuional arrangements in a wide variety of ways (Evans, 1997, Berkes et al., 2000b, Adger, 2010, Thomas and Twyman, 2005, Sternberg, 2014). Many papers have concentrated on the roles of different sets of variables but not inlcuded a broader disucssion of the intertwined human-enviornment relationship (Agrawal, 2001). The multi-faceted relationship between human, socio-political institutions and the environment within which they are embedded cannot be approached or resolved in isolation. It requires addressing the increasing complexity of how society comes to

understand, confront and deal with past, present and potential water threats (Sternberg, 2014, Conway and Schipper, 2011). Actually it is probably impossible or even risky to attempt a single cause of water crisis or the failure of government-led water reforms.

This research shows, even when water overexploitation and falling groundwater tables occur as an alarming rate, they may remain unrecognized or insignificant to people who live in the area, especially when they have more urgent issues such food and livelihoods security. These considerations fuel the vicious circle of chronic poverty, increasing inequity, resource depletion and environment degradation, all of which are both results and causes of local water issues (Bebbington, 1999, Cleaver, 2005). The recognition of water scarcity and overexploitation as problems always come from above followed by interventions from government institutions and their agents. Conflicts arise between the deeply embedded human actions which have allegedly led to water depletion and the interventions that contradict with local people's interests, such as changes of local water rights, pricing, and allocation among other arrangements. This means to make meaningful progress in local water behaviour and governance, a significant change in people's relationship with environment and resource base, mindset and incentive structures are required, for both professionals and the public. These can be achieved through constructing effective capacity building initiatives and mechanisms, for example through curriculum in education systems. Moreover, effective capacity building for different stakeholders cannot take place within a short term and requires a learning-by-doing process.

### *6.9.1. The historical impacts*

Historical context is especially relevant (Folke et al., 2005) in locating the roots of present-day agriculture practice and resources management, for example in the assertion of man conquering nature, bureaucratic management and government control, and the disastrous consequences of government decisions in China. The water problems in SRB also occurred due to a centrally and highly planned economy in the

last few decades, where decisions were made to use water, land and labour in a non-sustainable manner. The ideology of man's mastery of nature is essential in the agro and economic development in China and has led to some disastrous decisions on uses of local natural resources (Shapiro, 2001). The "Great Leap Forward" and "Learning from Dazhai" are typical examples. From the 1950s to 1990s, the SRB and elsewhere in China had undergone a major period of planned economy, which singlehandedly stressed grain production, which led to the greatest famine in history (Smil, 2000), land reclamation and water development without considering the local environmental situation and local appropriateness of policies. These have directly led to overexploitation of water resources and environmental degradation. Even today, these historical events had overwhelming impacts on people's relations with environment, on their persistent focus on food security.

The pursuit of economic growth has come at significant and unexpected environmental costs. Field study shows that the financial links between resource-dependent agriculture and local livelihoods has been and will continue to be important. Most local residents were widely aware of the devastating water and environmental issues. They were familiar with the longer, drier summer with less rainfall, tired of the repeated sandstorms and angry about damaged crops and economic loss caused by them. On the other hand, villagers have benefited directly from local agriculture and water development in terms of local food and water security and poverty alleviation, even through predatory overexploitation of land, water and related resources, which clearly have come at heavy environmental costs. Most importantly local stakeholders care more about the short-term benefits the reform measures will bring rather than some hypothetical impacts that may or may not happen in the distant future, especially when their individual/collective investment of scarce resources such as water access and financial investment for government-promoted projects are required.

However, the people who depend on agriculture water and the land and spend long working hours are not lazy, backward and indifferent minions plotting about how to

best destroy the resource bases and their living environment. They like any other people in both developed and developing world, are both the producers and products of specific socio-political, historical and cultural formations. They are part of the tens of millions of people who followed and were significantly affected by the government policies including "Conquer (the) nature" (Shapiro, 2001), "Great leap forward", "Household responsibility system", "Opening up" to "Go west" campaign. They were and most of them still are among the poorest (See Figure 6.11). Reclaiming lands and exploiting local water resources had made a better living for them and their families. Nevertheless the IWRM reform measures have cut villagers' irrigated land area, restricted their cropping patterns and controlled their irrigation quota, left them no secure access to land or water anymore. To quote local participants' words from fieldwork, "*everything is uncertain now and it is difficult to be a local farmer or see the way forward"*. In this sense, it is natural to view local villagers as victims of a top-down, authoritarian, unambiguous and unpredictable socio-political economy in China, where the state and its agent can implement policies when they deem necessary while retreat from many of their responsibilities. Under these circumstances, changing the human-environment relations would be difficult if possible at all.

*Figure 6.1 An old man standing in front of his land. Without any family, the land is not only his only food source and income but also his social security*

Being environmentally aware or not, local people's choice of behavior is directly affected by their weighing up of a mixture of potential costs and benefits. If people are

facing physical and economic insecurity, they may discount long-term goals such as water and environmental sustainability. Significantly, historical experiences such as the disastrous Great Leap forward; the famine of the "three lean years" (1959-1961) and long history of poverty cannot be downplayed in villagers' environmental behaviour and decison making. In China, most farmers' livelihoods and welfare are only as secure as their small pieces of land and agriculture outputs. This serves to illustrate the fact that the relationships between people and environment are fluid and are embedded within different social, economic and political contexts, which may differ temporally and spatially (Tilt, 2010). Political approaches to manage water resources therefore need to take account of both the difference and the similarities in the history, experiences and perceptions of different groups within communities, villages, regions and the river basin.

### *6.9.2. The impacts of policy stability*

Another element which influences the human-environment relationship is policy stability. According to Deng Xiaoping, "*Policies should not only be right but also stable and continuous*". The stability of policies indicates that the content and frameworks of major policies will last for a long period, without fundamental changes. If a policy is unstable, it will be difficult for affected populations to comply and adapt. Moreover, abrupt changes of policies result in widespread opposition and instability. Throughout the policy history of the SRB, from ancient Dynasties to modern times, there has been a huge diversity and intermittency in agriculture and water polices, which have directly led to uncertainty and blindness of agriculture and water development. Moreover if the unstable policies do not fit into local agriculture and economic practice, they are not accepted by farmers. For example in this study greenhouses and fruit tree planting have met popular resistance since farmers do not consider these as locally applicable or politically long-lasting. As a result coercion had to be used to force local people to undertake these measures. This is particularly true for marginalized farmers who have smaller pieces of land and who cannot afford the

instant loss of food production and income considering that it will take at least 2 to 3 years for them to actually benefit from fruit trees. The elements such as lost income, unemployment and loss of social security were not considered.

Land and irrigated agriculture are still seen as one of the few sources of social security for rural people in China. One of the local villagers expressed that, "*We removed sand from the earth to make those lands arable and we dug our wells too. It took decades of hard work and suffering to get to where we were. Now it's all gone*" (Female, 47, N2). When forced to undertake such measures, there are cases when farmers planted the tree seedlings upside down, or planting plastic trees in the desert as a protest against the oppressive conditions (See Figure 6.12). Other factors that have fuelled villagers' resistance include: i) extra financial and labour investment which most farmers cannot afford or are unwilling to contribute; ii) insecurity and uncertainty of policies and compensation in both short and long term; and (iii) lack of accepted means through which local people and authorities can share their concerns and lack of participation of local water users in the planning, design, implementation and evaluation of the projects. In other words the causes of uncertainty have been both top down and bottom up. It is not so much the lack of policies and regulations but the lack of willingness or inability of government at different levels to enforce appropriate measures on the ground which is the fundamental problem.

*Figure 6.2 Plastic trees "planted" by farmers in the desert (Personal communication from Dr Troy Sternberg).*

It has been argued that communities restrict their CPR use, protect CPR and enjoy better benefits when they own the commons and have significant rule-making autonomy (Chhatre and Agrawal, 2008, Gibson et al., 2005). As the cases studied have shown, increasing interventions by outside agencies that aim to improve water management can be problematic and if not appropriately dealt with, the reforms can actually exacerbate water explotiation and envrionment destruction and local socio-economic and political situation. In this way, it is critical that people look beyond the local level to analyze different perceptions, behaviour, reaction and the interplay between different levels horizontally and vertically, which pose a potential element for change.

## 6.10. Interplay between different levels and different actors

> *'I cannot understand why would you take all the trouble to do so much hard work collecting data about how farmers think or feel, when I can tell you exactly everything you want to know about them' (Personal contact, senior water official, age 48, N11)*
>
> *I do not know how such unrealistic water decisions have been made by those powerful figures. Maybe they just plan everything in their own offices without even knowing how wheat is produced in the field' (Author's interview, Wang village, male farmer, age 53, N29)*

The state-society relation or multi-level relations are nothing new in commons literature (Cash et al., 2006, Berkes, 2002, Adger et al., 2005, Shapiro, 2001, Lam and Ostrom, 2010, Ostrom et al., 2011). It is stressed that instead of focusing on the autonomy of either the state or the society, this thesis focused on a more complex picture of the interrelations among various groups. People must look beyond the state or central government to a broader range of actors and processes in order to understand and evaluate water policies changes and politics (Steinberg and VanDeveer, 2012). Actually one of the most dominating challenges is the complexity of underlying social

relations shaped by multilevel institutions and networks throughout the governance process (Steinberg and VanDeveer, 2012, Yu et al., 2014). It must be taken into consideration how different policies and actions were implemented in local contexts through existing socio-political relationships. In addition, the interplay between different goals for different sectors, different agencies and different levels of government such as poverty alleviation, economic growth, other drivers of local and regional agriculture and water development, must be better understood, which for now is only insufficiently understood.

### *6.10.1. The role of the state*

This thesis has shown that in agreement with Mansbridge (2014), the state should play four types of roles in water governance: (1) To impose a solution when agreement cannot be negotiated among local parties; (2) To provide accurate and neutral information for decision making which local parties fail to provide; (3) To provide a negotiation forum through which low-cost, efficient negotiation can take place; and (4) To carry out activities, including monitoring compliance and sanctioning defection.

However from previous discussion, it seems that none of these roles have been carried out properly by the state in pursuing IWRM. First of all, government interventions had been interruptive, destructive and even abject failures. The conventional models of monolithic state control as in "hydraulic societies" (Wittfogel, 1981), no longer seems to apply. On the contrary, many of the incorrect environmental perceptions and behaviour of local population were actually largely government-led (Chapter 3, 4, 5). Government imposition which did not appropriately taken into account the sensitivity of demands of different stakeholders and specific contexts have been destroying local institutions and resource base (Yu et al., 2014). Government led solutions had become an enabler for resource exploitation and a barrier to resource conservation; it is not uncommon to find local people are forced to collude with local agents. Officials as well as villagers were torn by the two different directions, on one hand, they were forced to

fulfil the tasks assigned from higher levels; on the other hand, they felt the need to collude and corrupt to protect their benefits which are not the same or even incompatible with the government interests.

Secondly, it is hardly achievable for the state or higher-level government to carry out information collection considering the large scale and the diversity. These activities have largely been done through upward reporting. Overall the effectiveness of reporting system was limited. For instance, the government has been issuing directives on what kind of crops farmers should grow with mandatory irrigation quota. However due to a lack of effective communication, mutual trust and fragmented landholdings, it has been almost impossible for officials to accurately get hold of people's real water needs and to deliver adequate water at the right time to farmers. It suffered from underreporting of areas of water-consumption crops such as wheat and corn and onion; and over-aggregation of officially promoted; water-efficient crops such as fruit trees as discussed earlier (see Figure 6.1 and 6.6). Different stakeholders/agencies/sectors possess different bodies of contextually constructed and validated knowledge which has often been taken as a leverage and not mutually shared (See Chapter 2). Thus people have to consider the interconnectedness and interactions of different parts of government and realize that the sum of different parts is not necessarily equal to the whole.

Thirdly, there are no government-initiated, low-cost and easily accessible arenas for negotiation (Yu et al., 2014). The CCP's high priority remains political survival and government control in a top-down approach (Chou, 2009). The introduction of the reforms aimed to satisfy the needs of centrally defined, long-term benefits. Therefore local uniqueness and villagers' needs were not well taken into consideration. Local villagers continued to be regarded as problems to be dealt with rather than stakeholders to negotiate with or to be served. The initiatives of negotiation did not lie with the state. In this regard, building arenas for negotiation requires changes in villagers' awareness of rights, politics, and a willingness to question authority lower as well as higher levels.

In addition, more studies are required to research on which level or layer is the most appropriate to build such an arena in a large and diverse society as China.

The fourth role of government is monitoring, compliance and sanction of defection in implementation of policies. As Ostrom (1990) pointed out, for a large, heterogeneous society, monitoring can be difficult. As one official said,

> *"when you superiors allocate you some task, you do not confront or argue with them over whether it is practical or not, because if you choose not to do it, there are a dozen others waiting to fill in your place. You only aim for better fulfilment of the assigned targets."* (Author's interview, male water official, age 46, N3).

Lower-level governments and agents are expected to be directly responsible and absolutely subservient to their superiors. Although local governments have doubts about the projects, they are often tied to government funding and cannot suggest that the projects have failed or are not as effective as it is projected to be. On the other hand, local monitors at township, county and village levels always faced conflicting demands from upper level officials and lower level villagers. Each demand entailed different obligations regarding the management of the water commons. It was common for them to "keep one eye open, one eye closed" (zheng yi zhi yan bi yi zhi yan), and provide information when there was casual or routine investigation. All these make it extremely difficult for the state to fulfil its role of monitoring, compliance and sanction.

### *6.10.2. The power and interrelations that control water*

The state-society relationship in China although remaining hierarchical, has become more and more complex. Findings from this study enrich the ongoing debate on the traditional confrontation or compliance dichotomy. It shows that political trust plays a pivotal role in shaping the state-society relations and villagers' attitudes towards IWRM reforms (Yu et al., 2014). There is a general trust in upper and central-level government and distrust of local governments. Villagers did not challenge central authority or its policies, and this offers the higher-level governments some room to make adjustments, with the "give and take" nature of China's political pluralization (Mertha, 2008). However, villagers who trust government at central and higher levels

distinguish clearly between the government's good intentions and its actual capacity to implement IWRM reforms as planned or to monitor its local agents.

Although China has a centralized political structure, it seems that central government's policies can often be averted or ignored by local governments who are responsible for their implementation (Xie et al., 2009.p48). Initiated by the central and higher level government under a political system with upward accountability，IWRM measures were introduced by powerful elites who were neither held responsible, nor responsive to or familiar with local situations, needs or concerns. It did not alter the basic nature of water politics in China. IWRM is fragmented vertically and horizontally, with the connections and the contradictions being largely unknown, as are the impacts of IWRM schemes on local livelihoods and different stakeholders across different levels. Echoing previous studies (Li and O'Brien, 1996, Bernstein and Lü, 2000), it seemed that despite the decentralization efforts, local officials can still impose arbitrary local countermeasures, divert government funds, manipulate records and even use coercion to deal with reluctant villagers.

The nature of the interaction between villagers and local cadres from villagers' perspective has changed from serving the public to a relation that is viewed as reciprocal (O'Brien, 1996) and exploitative (Yu et al., 2014). Villagers believed that local officials had first used the local water crisis for "project farming", then coerced them to comply and fulfill these targets without considering their needs and interests. Villagers expressed they had never seen any "red-headed" documents from upper levels and have only been notified orally which means they don't know what is true and what has been concealed. As one interviewee said, *"We can see from the CCTV (China central television) news that the central government is encouraging farmers to grow grain for national (food) security. While here local government forbade grain production. This (going against central government policy) cannot be right."* (Interview, Male, 48, Wang village, N17). Villagers distrust lower and local governments, this has largely restricted villagers' support or acceptance of IWRM

policies- localized, and distorted by officials who aspire for vanity projects, rapid promotion, regardless of villagers' livelihoods.

However, instead of challenging local officials' authority directly, villagers have learned to keep their distrusted leaders at arm's length and make 'reciprocal deals' or bargain with them to fulfill their own needs. For example, in many cases villagers organized themselves in production teams to build more greenhouses or plant larger areas of fruit trees as a favor to local officials. In return they would later bargain for a larger water quota or lower fines when they were caught for water stealing. Each side tries to work the system towards its own interests rather than constructing a benign cooperative partnership and working towards the same goal. The interplay and the nature of relationship among multiple levels and stakeholders is key in people's attitudes towards IWRM policies and the actual implementation processes and outcomes in specific contexts. A general lack of political trust and a perceived exploitative relation between local officials and villagers has increased illegal behavior such as corruption, water-stealing and continuous over-exploitation of groundwater. Corruption was the result of too much control and regulation (Scott, 1999).

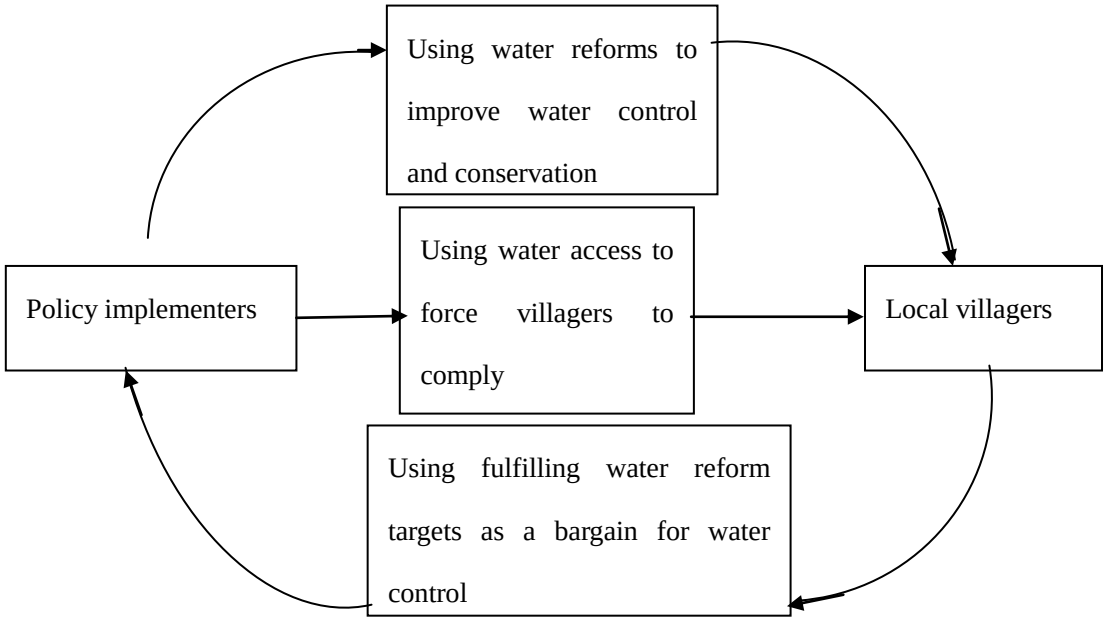


*Figure 6.3 The balance and counterbalance of bargaining power among villagers and policy implementers.*

To conclude, implementing IWRM as shown in previous chapters is not monolithic but a balance and negotiation process of disparate stakeholders many of whom have different and even conflicting interests and multiple identities. There are struggles over power, conflicts of interests, and the powerful and the powerless, alliances and collusion. The same central state that discriminates villagers when they try to over-exploit local resources can be a benefactor that acts on their livelihood complaints. The same local cadres who at times protect villagers from over-bearing tasks can be antagonists when villagers lodge complaints about distorted policies. The same villagers who trust the central state and its policies can be resisters who collectively sabotage policy implementation when they are carried out by distrustful, corrupted cadres. More importantly, reformers and policy makers must keep in mind the people for whom the reforms were carried out and these groups are and continue to be the poorest groups in China. Policies should contribute to and not conflict with basic human needs or bring adverse impacts on the living conditions on the resource-dependent populations. Depriving land and water resources from them means the deprivation of livelihood, welfare and social security. The fact that government-enforced IWRM reforms seldom do in ways to help but run counter to most interests of poor villagers living in marginal areas has already been discussed in Chapter 2, 3, 4 and 5..

As Blaikie (1985) argued, the circumstances under which authoritarian environmental policies such as conservation can succeed are either there is substantial agreement with the policy by direct producers, or where there is massive security operation which militarily and strategically overwhelms any opposition. According to this study, neither of these existed. Instead of searching for one panacea such as the state, the government or the single layer of community management, it is critical to acknowledge that each of these elements has its crucial and indispensible role to play in the complex process of policy-making, appropriation, monitoring, enforcement, conflict resolution and evaluation (Agrawal, 2014). Following Ostrom (1990), it is argued that governance of CPR such as water should be organized in a multi-layer nested system, under the central

concept of polycentrism (Pahl-Wostl et al., 2012). The effectiveness of environmental conservation in communities is determined by the will and capacities of communities themselves and cannot be imported from outside. External agents can assist in creating a conductive environment, with a training role, rather than just enact the ideology of the government to coerce resource-users into performing the required roles. The success depends on whether the content, context and implementation measures and objectives effectively fit together. IWRM reforms like any other (water) reforms need to be appropriately monitored, evaluated and adapted in a "learning by doing" way. It involves governance of complex social-ecological systems and therefore cannot be subject to water control and planning by the government under the concept that the government attempt to protect the environment and water resources sustainability from the majority of the people who depend on it.

## 6.11. Reflections

Doing field work about water in arid and semi-arid regions, as in the study area is never a simple task despite the author's long-term working and researching experiences in the area and well-established networks with officials from water bureaus at various levels. Support from above is no guarantee that local officials will cooperate considering the rapid transition of leaderships. I may not soon be able to forget the shock and trepidation experienced before setting up my residence in local villages studied. First local officials suspected that I was sent from upper-level to investigate their reform process and water uses, which if not appropriately dealt with may bring in unimagined troubles to them. I was thrown out of a village twice by village leaders who perceived my existence in the village per se as a potential threat. Villagers also were apprehensive: some often suspected that I was aligned with local government. Still others hoping that I was from the central or provincial government to inspect local reforms, hear and pass their voices above. On a practical level, the capability of local leaders to coerce villagers to follow their directions is also surprising especially considering the successful and prevalent decentralization under the Organic Law which is supposed to

empower local villagers politically.

Being familiar with how to deal with external investigators/researchers and warned of the potential negative consequences of candid answers with outsiders, villagers can be closed-lipped. However by long-term stay and direct experiences of working and discussing with community members, that I gradually gained their trust. It took much more social connections (guanxi) and the lucky coincidence that the water official who recommended me is from the same village with the township leader that he accepted my stay. It also took much longer than expected for local leaders to come to the conclusion that my research poses no harms. However, it is almost impossible to avoid the discomfort and the hesitation or even inconsistency between informants' answers when they are alone or around local leaders.

During my stay, it was made clear to me that my research entailed a certain degree of risks for the people I contacted. For example investigation of villagers' land area, water use and income. It is not hard to imagine that by simply filling out a 15-minute questionnaire, the villagers will give the official land area, the allocated official water quota and the "conservative" income. This is the reason why this research chose not to do so. It took much longer time of farming and living among villagers on everyday basis to see a clearer picture. By following my landlord's family to his different pieces of lands and helping with farming, weeding, and harvesting, I found and he later acknowledged that he was farming larger pieces of land than officially recorded and he was not alone. It is also by this way that the author managed to collect the different versions of records (one version for official reporting, one that is kept for villagers' own record) of land area and water use within different production teams and villages.

I cannot stress enough the real-world consequences of my work on my informants, whose identities were kept anonymous including the names of the communities and the villages that they reside in. Through writing this thesis, I hope to unravel the everyday water struggles and the water-human and internal-external socio-economic

and political water dynamics that people would find useful. Were the interviewed participants speaking frankly with me or hiding their genuine thoughts? I would argue that the results including water use, electricity use for groundwater pumping and income are trustworthy and have been corroborated by different sources over a very long period. The income of villagers for example, is largely dependent on their land area, the crops they grow and the number of livestock they own. It is not difficult to figure out roughly how they earn after you spend sometime with them and know about their situation. In order to corroborate the data, other sources were used as well so that the data can be more accurate. Moreover the author argues that these uncertainties have actually worked to my advantage as the complexities per se allow me direct access and insights into the sensitivity and significance of contexts and socio-political fabrication of water related issues, which is not easily accessible to other methodological approaches. Instead of focusing on what the "truth" is, it is stresses that the question of whose "truth" it is and why different stakeholders hold different "truths", or why same stakeholders perceive different truths under different circumstances.

Did my presence make a difference in terms of the content or formats of the meetings? My position as an educated, single female researcher in her late 20s from a Western university in a remote, isolated and highly agriculture-based area undoubtedly influenced my own perceptions and analyses, as well as local people's perceptions of me. My presence in the studied villages and communities was never a secret. Overtime, my presence in local meetings and agriculture activities became a routine and it was my absence in these events that became noticeable and people started to ask why I had not participated recently. I can also clearly sense that informants were less guarded and more relaxed and open over casual conversations and interviews. My gender also played an interesting role during my field study. By long-term communication, reciprocal exchange of information and adopting local habits, I managed to build a reliable and open relationship with my participants. This all had helped in my data collection and understanding of local water issues from "localized"

perspectives.

## 6.12. So what now?

While the outlook for major success of IWRM in the studied area looks bleak, it is not uniformly so. There are directions to be followed which can help to bring about better performances, even if short-lived or small-scale. Some potential directions for future improvement may be examined:

One objection to the views taken in this thesis is that increasing government control and imposed reform measures force villagers to mine paleowater (Edmunds et al., 2006) and collectively resist water reforms that aim for their benefit. However there is no precise, quantitative and determining correlation between this cause and effect. It must be demonstrated that a reduction in external water reforms leads to a reduction in villagers' irrigation use per unit. Indeed there were cases when better water pricing benefited the direct producers or led to ecologically unsound groundwater exploitation onto the marginal land. The answer to this objection proves the complexity of the situation and the impracticality of a model which posits one or all causal variables. Exploitative relationships between villagers, the resource base and the environment are manifold, both in economic and socio-political spheres. An increase in externally imposed reforms implies many other changes as well if water conservation is to take place on the ground. First of all, a shared perception of the problem by water-users and institutions or arrangements of their choice to ensure a locally adjusted governance of water resources are both essential- and these are not necessarily ensured by a reduction of government interventions. Second there has to be the technical knowledge of water conservation, which brings water users into direct contact with officials and the officials have to be able to form a benign relationship and offer measures and services in a way that is utilisable in local contexts. Third there has to be collective efforts in implementation and monitoring, making effective use of local social capital and collective action. Therefore water conservation does not imply merely a policy adjustment but an economic adjustment, a transformation of the whole set of relations

between water-users and others.

Water overexploitation and related environmental problems are frequently both a result and a contributory factor for poverty and inequality. It is essential to undertake research and show what the impacts of countermeasures will be upon the livelihood and incomes of the most marginalized as well as upon resource base and the environment and social and political stability. This research has pointed out the wider contradictions between the disadvantaged groups who both directly caused and suffered from mismanagement and misuse of water resources and the more advantaged groups whose decisions failed to change and frequently maintain those inequalities and reproduce if not worsen the situation. These analyses are bound to be unpopular but can be essential for politicians, academics and foreign investors.

Still within the realm of perceptions, practical projects, on a small or large scale are required to change people's mindsets about how they relate to the environment. Control of exploitative water behaviour and improvement in people's environmental awareness are very slow to show results and need painstaking research and follow up. Local organization, institutions, rural customs, and other social capital must be encouraged and appropriately financed, to withstand constant pressures from government and vested interests across different scales. It seems that to make positive results of projects such as IWRM achievable it takes more than government control, funding or technical solutions. They cannot become the answer to water sustainability if they run counter to the interests of the affected groups as in this study. The perceptions and organization of smallholder farmers should be of greater concern and it is a vital element for successful water governance.

On the other hand, the various institutions of government can also have a progressive part to play, in that they have the resources and information to undertake useful research and development in water and agriculture. The fact that why they and their well-intentioned projects seldom do in ways to help poor farmers living in marginal

areas has been discussed in earlier chapters. However, the economic and socio-political conditions from these people will not be strong enough to divert resources and adapt resources and development towards water conservation. There are struggles for power, clashes of interests, and the privileged and the disadvantaged, alliances and collusion and even resistance. These elements can coexist and each of them brings about new problems. The strategic solution of the water crisis in the SRB requires a choice which is both feasible within existing social, economic and political contexts and in step with a future direction of socio-economic change which is acceptable to both policy makers and the affected population.

# Chapter 7 Conclusion

# 7. Conclusion

## 7.1. Introduction

This thesis is a study of people's struggles over water in dryland areas of NW China. It provides a critical introduction to the arid and semi-arid environment with a special emphasis on the human-environment relations and interaction between socio-political and natural worlds. The objectives were to investigate water crises, and related water reform processes and outcomes towards IWRM in the SRB in Northwest China. It then analyzed the social-political relations and interactions within the local environment, particularly relating to water access, water related decision-making, agriculture patterns and local livelihoods. This work is composed of four main chapters, each of which was a peer-reviewed academic paper, either accepted for publication or under review.

This study enriches the knowledge of localized social, political processes involved in the water reforms of SRB, and it is shown how these reforms can affect villagers' water perceptions and behaviour and how human action and the interaction across different stakeholders and levels can affect local water dynamics. As rapid economic growth, urbanization and industrialization continue in China, water crisis in China is projected to get worse. Study of regional water events, water reforms, local perceptions and reactions contributes to addressing the increasing water crisis (Sternberg, 2011). One of the significant results is identifying the hidden localized recent and diverse socio-political processes, lacking in extant studies. The quantitative surveys and qualitative approach employed in this thesis which covered eleven villages (only three were selected for use) throughout the river basin can be replicated in other regions and countries that are facing water and related environmental problems, to identify key stakeholders, factors, conditions and processes of natural resources governance, and seek explanation of observed patterns of reactions and strengthen understanding of the social-ecological system.

Results suggest that implementation itself is not a predictor of policy success; existence of IWRM policies do not necessarily lead to either better income or a decrease in water use; the cost may outweigh the benefits if the effort to IWRM was not properly implemented. Moreover, data shows that even successful implantation of IWRM may have brought burdens to villagers involved. This study illustrates the different fates of IWRM reforms that attempt but fail to achieve integrated and sustainable water governance. IWRM must take off and stay in flight; otherwise the burdens and loss will be greater than if they had not been implemented at all. This study broadens understanding of the causes of IWRM failures and understanding which previously focused incorrectly on institutional reasons.

## 7.2. The nature of the water crisis

The water crisis is an intrinsic part of people's life in the arid and semi-arid regions of northwest China, which is characterized by chronic lack of available water resources, scant and irregular rainfall, low recharge, and high evaporation. This thesis shows how people's perceptions and the prevailing social, political and cultural relationships keep producing and reproducing localized water practice and management. The water crisis has been experienced and constructed within different contexts by different stakeholders. It is the nature of the water crisis or its perceived nature that users hold that made it difficult if possible at all to implement IWRM policies.

Without adequate understanding and attention to the social-political nature of water problems, it may be impossible to effectively address the water crisis, poverty, and related environmental problems. Although it is hard to distinguish human impacts from natural causes to the water crisis, it can be concluded that both are indispensible in the water governance processes. This thesis studied how different physical and socio-political factors and human perceptions and their interplay across a wide range of scales define "the water crisis" and determine the water dynamics and solutions in

different contexts.

Through investigating local perspectives of water crises and government enforced IWRM reforms this thesis presents topical issues regarding stakeholders and forces shaping localized water problems, perspectives and solutions. From the conceptualization of water problems, this thesis has extended to causes of interventions in implementing water policies and their implications. It employed both methods of quantitative and qualitative research methods to evaluate the water conditions. In the arid and semi-arid environment, where conditions represent endemic natural and environmental challenges, human engagement with social, political and ecological systems takes place. Investigation of human and socio-political factors that shape and are shaped by the water crisis, government reforms and outcomes is one of the critical contributions of this study.

Work on human and social aspects of water problems is key to understanding the processes and outcomes of governance processes across a wide range of scales (Mollinga et al., 2008) and this is long overdue in China where water issues were dominantly defined by government and water professionals rather than local endeavour. Due to the technocratic water paradigm (Varis, 2001, Lohmar et al., 2003) and lack of investigation, the distinctive social-political aspects of water crisis in China had been excluded from water research efforts. Water scarcity commonly documented as a natural phenomenon (Jiang, 2009), is a highly social, political process which is shaped and reshaped through localized negotiation, bargaining and manipulation among different stakeholders, exemplifying how human and physical world interact with each other (Yu et al., 2013). Understanding of villagers' ways of thinking and their resource-dependent livelihoods, showed how adverse impacts of water problems can increase when water-saving strategies may not be adopted due to physical (changing climate, rising temperature and decreasing rainfall), institutional (regulation, water management) and socio-political (power relations, external interventions, increasing uncertainty, unstable livelihoods and income) factors and when there is no "life in

farming" or a foreseeable shared future for local people (Yu et al., 2013, Yu et al., 2014). It suggests that disparity among different villages and villagers is growing due to local water crisis and government-led reforms, which if not appropriately dealt with can be an impediment rather than an impetus to local livelihoods, human well-being and sustainable water governance (Yu et al., 2014).

This thesis argues that IWRM should not be seen as an end, which is what most countries and implementers have pursued (Giordano and Shah, 2014), but a means to an end, focusing on issues of framing, public participation, and water control, social capital and collective action. It concludes that successful implementation requires more than existence of IWRM principles or policies, but to what extent IWRM has been understood, implemented and under what circumstances. IWRM like other water policies is transformed through negotiation and renegotiation throughout the implementation processes across different levels and different stakeholder groups.

Based on pervious discussions and results from interviews, group discussions and the author's fieldwork experience and observation (see Chapter 2, 3, 4, 5 and 6), organizations such as WUAs and IWRM reforms did not show higher participation rates or empowerment, indicating processes as such were not as successful as reported (Also see evidence in Chapter 2, 3 and 4). This implied that enforced public participation did not occur and suggests that people's perception of the nature and processes of participation had a major impact on people's participation propensity and behaviour. In other words, when powerful government-enforced reforms such as WUAs are not appropriately implemented, they can induce more adverse impacts rather than positive changes. This is an unusual finding compared to water studies in other countries and it stresses the contribution of in-depth field studies to the global water debate. The difference directly points to the impact of the traditionally authoritarian regime, clientilistic culture (Oi, 1991) and the different use of social capital and collective action that influence the social, political and environmental systems in the communities investigated.

As shown in earlier chapters, water governance is as much about social processes as about physical processes and that the major constraints are not technical but social (Mollinga et al., 2008). Given local socio-political relations, collective action and strategic uses of social capital, this thesis argues that the ways of increasing government water control through mandatory IWRM reforms to fix management mistakes caused by bureaucracy and uncoordinated development has engendered new problems without fixing the old ones (Yu et al., 2014). These findings can be used to propose potential changes and improve current situations and have many implications for local and regional water management and reform in China and elsewhere.

Social capital and collective action are at the core of water resources management (López-Gunn, 2012, Pretty, 2003, Putnam, 2001). These two factors help explain both the success and failures of water governance in studied area. The water crisis and related concerns may be better addressed through identifying the basic elements, forms and nature of collective action and social capital that contribute to local water governance (Ostrom, 1990). People need to acknowledge villagers may not be as backward or incompetent as they have been pictured, and what they decide individually or collectively can have a huge impact, either positive or negative, on water governance (Poteete et al., 2010).

## 7.3. Water framing as an issue

The concept of framing (Mertha, 2008) provides new dimensions that have not been captured in the current water research in China and elsewhere (Sainath, 1996), particularly with regard to the ability of local villagers and government to form a particular water story- "success or failure" to mobilize support from upper and lower levels. Thus, significant players have been able to frame their water issues as an enabler of government support, especially financial support (Sainath, 1996). It demonstrates the growing influence of lower levels and their strategic contacts across different levels

(Yu et al., 2014). The process is strategically calculated to seem consistent with official goals and local needs so as to attract potential recruits from both sides: for instance, attracting official allies by framing the issue as a better way to improve official policy implementation and their hold onto power; while gaining local support through promised results such as government investment, local loans, extra water quotas and better livelihoods. This issue of framing to a large extent is more important than the policy per se in explaining reform outcomes. Successful framing has attracted large amount of government investment and favourable policies (Sainath, 1996). In this view, the implementation and shaping of water policies can be a political instrument relying on the versions of framing that create and explain the types of water reality.

Through comparative case studies and detailed analysis this thesis highlights the ways power, social-political relations, and contexts unfold, operate and become embedded in issue framing, policy implementation and outcomes. As shown the policy processes are a contestation and negotiation among different stakeholders, their imperatives and interests. By looking at their perceptions and their understanding of local water issues, how policy processes are mediated is better understood. It is made clear that studies of water governance cannot be fixed either temporally or spatially, or dominated by a top-down approach. Both the state and society and their interplay account for the dynamics and complexity of how water policies are implemented and negotiated in practice.

## 7.4. Variation in outcomes

The empirical cases presented in the few paper chapters have shown that the intentions of the IWRM reforms may be good but that the outcomes were not equitable. On one hand, this study demonstrates positive outcomes, specifically examples of cases to establish their own effective water rule systems as in Wang, Wen and Xin villages. On the other hand, there are severe problems of monitoring, overdraft and rent-seeking even after the enforcement of IWRM policies, with some cases worse than others.

Stakeholders involved may not have similar social, economic or political endowments to work the system to their maximum advantage or minimum disadvantage. For instance, affluent villages and communities are more capable of generating matching funds for government invested projects, which low-income ones cannot afford.

When asked what they think of the IWRM projects, local people's reactions have been rather mixed. Many people got really confused and became unsure of exactly what was appropriate to say, considering the political sensitiveness of the subject. Others simply do not think related policies are practical. There are still others who just repeated what they had been told- that the projects are for their own good and a better sustainable future. For most people, information sources were very much from village leaders and local government officials. The factors that have contributed to these differences are diverse ranging from physical attributes, to social-political factors. It is suggested that political trust, better understanding and cooperation of villagers involved to schedule and manage water is a necessary condition although alone it may not guarantee governance success. As shown, without any of these, it will be really difficult to enforce government policies and prevent violations in an uncertain environment across all types of stakeholders. In other words, officials may manage to alter the physical structures of water systems without succeeding in obtaining changes in people's perceptions or behaviour. In studied cases, such as Wang village, the top-down efforts to reform water governance and cut agriculture water use have led to worse problems, with people being suspicious of state-promoted IWRM policies, locally developed strategies to manipulate water use records, collective overdraft and rent-seeking behaviour of leaders.

There are various examples of the trouble lower level officials would go to please their superiors (Oi, 1991, Li, 2008). In studied cases the focus had been in absolute implementation of government IWRM policies *per se* at all costs, human or environmental. These local officials' motivation went beyond compliance to impression management, maintaining face (Kwong, 1997) and "project farming".

Taking the greenhouses for livestock for example, when officials and inspectors came, local leaders would pick better educated and behaved villagers and train them about how to react and talk to external officials while "troublesome" villagers were barred from these occasions. To show that people were making great use of the constructed greenhouses, cows, sheep, pig and even geese from households in close neighbourhood would be gathered together to tightly pack the project greenhouses. Once the inspectors left, all of these would disappear and the greenhouses would become empty again when livestock were sent back to different households. There are cases upon cases like these in studied area, where under the name of IWRM concerns either got diverted from intended aims or lands up for the wrong cause, while the real concerns of local people were generally hidden in the piles of statistical data in reports, leaving fundamental issues unresolved.

## 7.5. Future of SRB and its agriculture

Economic development as an integral part of the CCP's power basis still provides the overall context of the political processes in China. Results from this thesis suggest that irrigated-agriculture faces an uncertain future. In the short term, villagers are not holding their breath while waiting for the disruptive intervention and the "policy wind" to blow away for the golden age of agriculture and water exploitation to return. Most of them have shown no hesitation that when the projects and government funding end, they will go back directly to what they had been doing for generations. Local cadres however no longer consider smallhoder agriculture as a possible way to help make the transition from "warmth and fullness" (wenbao) to "a well-off society" (xiaokang shehui), even though no good way had yet been identified to promote both economic development and a sustainable resource use. As a result, the water crises were perceived and dealt with in significantly different ways across the region (Yu et al., 2013). Despite all the differences, there is a general consensus that improvement in water services and governance is key to local economic development, social stability and environmental sustainability.

Although there is no clear answer to the question of the future of agriculture in the SRB, it becomes rather obvious that it will depend on how the state and its agents manage to keep a continuous economic development in a largely resource-dependent, agriculture-based society. This is the foundation of the Chinese Communist Party's governing legitimacy, especially under increasing water and environmental pressures, the process of which requests not just technical innovations but also socio-political changes (Conway, 1991, Chambers, 1997). However, for this to be achieved, there needs to be fundamental alterations in the governance structures and the political organization of water- participatory, transparent and democratic, which the majority of the power-holders are neither ready nor willing to embrace (Chou, 2009).

Although SRB has been widely studied by researchers of natural science, I believe it is important to link the socio-political and ecological processes within the water system. The fact that these issues continue to be approached from a policy and technical perspective by political and academic authorities at national and international levels only serves to make this research timely. In this context it is essential to discuss how to achieve long-term water sustainability while dealing with improvement in the well-being of local resource-dependent populations. Although this challenge is a universal phenomenon, the situation in China is particularly daunting considering its bureaucratic government history and the large number of people living in this very difficult circumstance. In this thesis I have attempted to use the consistently marginalized water understanding of rural residents as an entry point with which to propose more locally-adjusted social and political improvement in solving the pressing water problems (Yu et al., 2013). Water reforms are never neutral (Molle et al., 2009). It is therefore not only about describing how water problems faced by local residents and how their understandings vary socio-spatially, but also about understanding the power relationships that shape and influence them and proposing locally adjusted systems of water governance with the potential to alleviate them.

## 7.6. Policy implications

Effective and accurate evaluation of reform outcomes is especially tricky in a regime such as China where questioning authority is not exactly popular. What consequences (intended or unintended) have been produced for those whose livelihoods depend on local resources and what lessons can be learned from how IWRM water reforms have been implemented and impacted in the Chinese countryside? The effectiveness of water policies is crucial to the outcome of water reforms in local communities. In order to devise or improve local water governance, researchers must understand the rules in use and the governance processes and consequences as well as how and why they are crafted and maintained in specific contexts (Ostrom et al., 1994). It requires exact specification of how and why a certain set of conditions produce a particular outcome. The impacts of mechanisms vary according to the social, political and economic contexts in which they are established and play out and this also varies from one geographical and historical setting to another (Goodin and Tilly, 2008).

Current policies in dealing with water problems in this area ignored the human element (Yu et al., 2013). In other words, the government is fighting the water crisis in isolation from the water-users, if not against them. There has been a severe lack of effective incentive mechanisms for farmers and other villagers involved to better understand and comply with these policies and conserve water. These goals cannot be achieved unless they match the needs and goals of relevant stakeholders. The distance between those who make decisions on water development and management, and the resource-dependent stakeholders should be decreased. A transformation from focusing on the physical forms of water to a focus on different water actors, their perceptions, roles and responses towards the water crisis is required. It is in the messy multiplicity of lived experience that environmental issues are framed, understood and approached. This means a great need exists for the involvement of a human element and human acceptance in water control in China. Successful governance of water commons is more than coercive authoritative power to force resource users to comply. There are

numerous issues affecting water, environment and human wellbeing which can be linked to this forceful implementation. These include, the tendency of individuals to focus on short-term material gain rather than long-term sustainability; corruption, information hoarding and manipulation among bureaucracies; a utilitarian approach to relationships among different levels and groups, and increasing distrust towards governments.

Moreover, there should be increased focus on the interrelations between different levels and within communities and villages in the governing process of the water commons, (Molle et al., 2009). For example, what kind of power relations exist, how are they built and/or maintained, and more importantly how are they related to uses and management of the water commons at various levels among diverse stakeholders. The water governance is not only concerned about providing engineering and technical solutions but a political process (Mollinga et al., 2008, Nickum, 2010). In this study, the contemporary politics of water reform has fuelled an unprecedented degree of political pluralism and clientalism to the water policy processes. Local officials and local stakeholders seamlessly ally themselves with each other or at least superficially, so to gain support and related benefits from each other especially in time of increasing external government water control. This reveals one of the most fascinating developments in state-society relations unfolding nowadays, under the generally accepted Chinese concept "everything is negotiable (Smith, 2010). Lack of trust and organized, planned and premeditated resistance are perhaps not a great surprise given the chasm between what has been promised and what villagers experienced (O'Brien, 1996). They can take on divergent paths with significantly different consequences for villagers' income and burdens (Yu et al., 2014).

Negotiation among different actors and factors is a distinctive feature. Although a policy is issued at the central governmental level, it often turns out differently at lower levels. On one hand, subordinates seldom question the superior's authority or the appropriateness of the policies. "*Politically we cannot offer suggestions. We are not*

*supposed to, but do what we are picked and paid to do- following orders because if you do not, there are dosens of others willing and waiting to replace you."* (Interview, male water official, age 46, N5)." One the other hand, it appeared that local leaders always have to weigh different types of pressure from different ends and act on the most pressing one. In other words, while not necessarily satisfied with its current policies and water reforms, local agents always operate in a direction that appears almost fully consistent with requests from above. Although being aware of their relative powerlessness, local officials do enjoy a certain freedom in terms of policy implementation and manipulation, and funding allocation. Actually local officials on numerous occasions are instrumental in shaping, articulating and legitimizing the local moves and in networking with upper level officials on behalf of local interests as well. These tactical manoeuvres and site specific accommodations such as collective bargaining, between increasing control and resistance is more than obvious. The consequences of this should not be underestimated. The government monopoly of water services has faced a grave challenge despite the reinforcement of regulatory regimes and reform of water institutions as discussed in earlier Chapters. For example, although there have been increasing government water control through recent water reforms, some villagers and officials could always find a way to gain extra water access and manipulate water records. Another example is that more and more cases, officials and villagers who have got accustomed to the bureaucratic governance process can find ways to bargain and/or cooperate with each other and show compliance with government policies even when the situations are otherwise. This has become increasingly prevalent over the past years.

Addressing water problems particularly at local level is only achievable though a continuous and transparent process of monitoring, evaluation and conflict resolution. It is seen that the current policy and related report of policy outcomes is a poor or even false reflection of empirically based realities (Yu et al., 2014), hence only a misleading guide to practical and effective intervention strategies and use of resources. There have been huge discrepancies in the reported project outcomes and the reality in practice

which is due to a severe lack of effective monitoring and evaluation (Yu et al., 2014). Generally speaking the more remote the area is, the more capable local leaders are to control the information. Officials, particularly at local levels, exploit the advantage masterfully, sometimes even through coercion and force. In the absence of credible information, it is easy for the government to downplay the story or even deny that anything unintended happened at all, for example stealing of water, fabrication of water and electricity use record, and misuse of project money. Corruption is rampant and some villagers interviewed are notably outspoken about it. Many participants were interviewed who had been ordered not to say anything negative towards the projects and reforms to outsiders. As an outsider, the author was thrown out of the village for twice. For officials, trust was built only after the author had gained all official permission. It took a much longer time for the villagers to build trust and share their information and stories with the author.

Policy endurance or stability is central to successful policy implementation (Ostrom, 1990). However being stable does not necessarily mean no change at all, but being resilient and adaptive through a learning-by-doing process (Pahl-Wostl, 2002). This should guarantee that the affected population especially those most resource-dependent will not suffer too much from unceratinty- water policy changes have been clearly endemic in modern China (Nickum, 2010). As one respondent commented,

> "*Officials come and go in a short period of time during which they all want to get promoted through making and implementing different policies. The first (official) asks us to plant fruit trees, the next may ask us to cut them all and grow something completely different*." (Interview, male, age 50, Wang villager, N14 ).

Therefore it can be rather difficult for people to take seriously water reforms and policies issued by an authority unlikely to stay or last for three years, or have confidence about it. Short-lived institutions and policy proposals lack credibility no matter how much benefits have been promised (Yu et al., 2014). The public who will make the ultimate sacrifice, in terms of labour, ecnomic income or even livelihods will have no guarantee of ulitmate reward especially in a short period (Deacon, 1994). In other words, faced with instability and increasing unceratinty, people have turned into

opportunists who try to overexploit natural resources to make the most of what they can get access to (Hardin, 1968).

However it is not just about changing leaders, because under the same political atmosphere, present leaders as well as new leaders are all cast into the same vicious circle of satisfying the needs and orders from above. No meaningful changes are going to be made unless there is first political change, for example the ways in which officials are evaluated and promoted. Instead of taking policies or implementation as the end (Giordano and Shah, 2014), reforms and policies should be positioned as a means to an end to influence actors and processes.

A government may yet evolve that is not only responsible but also responsive towards people's needs and voices, backed by improved citizen awareness and understanding of water issues and cooperation for water-related environmental enforcements. Despite the argument of some scholars that authoritarian governments may be in a better position to govern and control public resources than democratic societies, in China, at least in studied regions, top-down water enforcements have not thus far been successful on their own in dictating significantly better water awareness or behavior. Significant support from the public comes from an informed basis of knowledge and awareness which has a critical role in propelling changes in people's water values and action. Yet, few ordinary people understand watershed, conservation and sustainability, not to speak of the consequences of their decades of over-exploitative water behavior. A sustainable water future for China thus partly depends on its capability to improve citizens' water knowledge base and awareness while maintain a stable and growing economic development rather than pure focus on policy implementation as it used to.

One key question of governing CPR is: must resource users depend on external authority to make and impose regulation or can they work together efficiently and effectively for their common good (Hardin, 1968, Ostrom, 1990)? This study of common pool water resources management in NW China is a relevant contribution to

this field and adds essential understanding of the conditions that impact self-governing conditions and collective action, by showing why some cases in one part act collectively to govern their water commons more effectively and efficiently and why others cannot (Yu et al., 2014).

## 7.7. Future direction

Observers of global environmental issues are quick to point out that no solutions to today's environmental problems are possible without involvement of China (Brown and Halweil, 1998, Sternberg, 2012). As a major player in the global issues of climate change , food and water security, population growth, and overexploitation of the CPR (Shapiro, 2001), together with its enormous size, diversity, unprecedented economic growth and increasingly severe environmental problems, China's significant roles to a sustainable future cannot be overestimated.

Although the harsh environmental and related water challenges that people are facing in China is emblematic, the human-environment relations and interaction are rarely studied, resulting in a gap of research, analysis and understanding to the global community. Recent socio-political reforms and economic transitions have created a new dynamic and opportunity of water dynamics that are seldom studied. Expanding the theme of socio-political analysis and evaluation of the roles and impacts of different factors is in order in future academic efforts.

China needs a broader look to better understand its position in the water field, acknowledge its relative strengths and weakness and to fairly evaluate its water reform processes and to learn from previous mistakes and successes either its own or others', for example through comparative studies. A more constructive assessment would help clarify the impacts of historical reasons, government policies and support, economic growth, food security, agriculture intensification and the resulting arid and semi-arid environment and its nature resource bases. This can highlight the potential impacts of

economic planning, government control, infrastructure construction, agriculture policy and chronic lack of capacity building. It is important to note that the development of capacity in relation to participation across a broad range of water stakeholders especially at the local level is a crucial element in successful governance of the water commons.

These issues have implication in terms of how a developing nation and its resource use and management can engage with a larger world and benefit from lessons from other nations with similar challenges. Research that bridges the distance between the social and the physical and engage in multidisciplinary can be of great benefit to both China and elsewhere by incorporating methods that have been successful elsewhere, maximizing the outcomes of government investment and avoiding unintended reform consequences and even failures. This increase of knowledge can engage with a larger world and benefit other nations in similar circumstances. Research particularly by Chinese scholars that bridges distances and histories can be of great value to the country by encouraging approaches that have been successful elsewhere.

When deciding how to effectively and sustainabily govern the water commons, the government can look beyond the policy-implementation mode to more accurately judge the economic, social and political benefits of irrigated agriculture and the implication of increasing water control by cutting down farmers' land area and water quota forcefully. For example the risks include decreased income, lost livelihood security, increased costs for agriculture production, lack of employment opportunity and decreased political trust among other social challenges (Yu et al., 2014). A nuanced understanding of different stakeholders'-especially insiders' perspectives recognizes the implementation challenges in a strong authoritarian state and concludes that investment of projects as IWRM can have limited effects and even threaten water security and social stability especially when livelihoods options are limited, as occurred in the SRB. Research that informs this trend, contributes to local livelihood improvement, and encourages sutainable water use will be most relevant to water professionals,officials and decision-makers.

It also opens an important direction for future research on water policy and decision making, and how to best assist traditionally agriculture-based communities in the transition to sustainable economic activities. Given the scale and pace of the water crisis, academics and decision-makers have to better understand the potential impacts of water reforms on agriculture communities and *vice versa* in order to minimize the adverse and unintended consequences. This includes how communities perceive and adapt to changes in the water commons, what facilitates/hinders collective action, what is the interplay between communities and government, what is the water policy-making process and whether or how to take the human element into this process and can the Chinese government keep sustainability and a continuously growing economy simultaneously in an arid and semi-arid area such as SRB through increasing water control under a government-led IWRM scheme. Future work is needed to complement this effort and offer new insights into both the practice and theories of IWRM, a call for a new intellectual methods and individual and collective action,- something which, by its own approach is deemed not to be enough. Expanding results from empirical evidence in this study both nationally and internationally will be a lasting contribution of this thesis.

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# 9. Appendices

## Appendix 1: Questionnaire for villagers

Survey time: Survey number:

1. Gender Male☐ Female☐
2. Age <20☐ 21-30☐ 31-40☐ 41-50☐ 51-60☐ >60☐
3. Educational level? none☐ primary school☐ secondary school☐ Technical diploma☐ college/ university education☐ Don't know☐
4. Marital status? single☐ married☐ separated☐ divorced☐
5. Are you the head of the family? Yes☐ No☐
6. How many people are in your family? ( )
7. How long have you been in the area? ( )
8. What is your occupation(s)? ( )
9. What is the area of your lands in the unit of mu if there is any?
   <5mu☐ 6-10mu☐ 11-20mu☐ >20mu☐
10. Are there changes of your land areas over the past 10 years?
    Increase☐ decrease☐ No changes☐ Not sure☐
11. Are there changes of the areas of irrigated lands in your family?
    Increase☐ decrease☐ No changes☐ Not sure☐
    If there is any change, what happened? ( )
12. What kind of crops do you plant?
    Cash crops (please name the major kinds)☐ Grain crops (please name the major kinds)☐ Both☐ Neither☐ please specify:
13. Do you get information, guidance, help and training about water uses?
    Yes☐ No☐ , If yes, what type of assistance do you receive?
    1= Financial assistance grant/ loan ☐
    2= technical and skills ☐
    3= others, ☐please specify:
14. What is your overall household agriculture production last year? ( Kg )
15. Is your agriculture production quantity changing over the past few years?
    Increase☐ decrease☐ No changes☐ Not sure☐
16. What is your production mainly for?
    Subsistence☐ Selling☐ Both☐ others☐
17. Is your production enough to sustain your family?
    Yes☐ No☐ Not sure☐
18. Do you think it is possible to produce more with less water on your lands?
    Yes☐ No☐ Not sure☐
19. What types of activities provide the highest income for your family?
    1= Subsistence farming ☐
    2= Commercial farming ☐
    3= Migration remittance ☐

4= Livestock raising ☐

5= Others, ☐ please specify

20. Do people help each other locally with farm and/ or other work? Yes☐ No☐
21. Have these forms of mutual help changed over the past 10 years?
    1=Increase ☐ 2=decrease☐ 3=not change☐ 4=don't know☐
22. What is your annual agriculture income?
    <2000yuan☐ 2000-4000yuan☐ 4000-6000yuan☐
    6000-10000yuan☐ >10000yuan☐
23. What is your total approximate income?
    <2000yuan☐ 2000-4000yuan☐ 4000-6000yuan☐
    6000-10000yuan☐ >10000yuan☐
24. What do you think is the major constraint for your local livelihood? Please mark them from 1 to 5, higher mark means more constraining.
    1= natural reasons (land, water) 1☐ 2☐ 3☐ 4☐ 5☐
    2= social reasons (organization, rules, laws) 1☐ 2☐ 3☐ 4☐ 5☐
    3= physical (infrastructure, machinery) 1☐ 2☐ 3☐ 4☐ 5☐
    4= financial (income, money transfer, loan) 1☐ 2☐ 3☐ 4☐ 5☐
    5= human (knowledge, skills, gender, labor) 1☐ 2☐ 3☐ 4☐ 5☐
25. What of the following do you think is more required locally?
    1= Developing local farming ☐
    2= Better water management and water services ☐
    3= Improving knowledge and production techniques ☐
    4= Improve access to markets and distribution of products ☐
    5= Improving access to credit ☐
    6= Improving infrastructures ☐
    7= Adopting to climate change, managing risks of disasters such as drought ☐
    8= Reducing wastage and loss of farming production ☐
    9= Other types of assistance ☐
26. What is your own happiness ranking (生活满意度) at a scale of 10? ( )
27. Water scarcity index with a scale of 5, 1 means not severe, 5 means extremely severe. 1☐ 2☐ 3☐ 4☐ 5☐
28. If there is a groundwater problem, how serious is it?
    1☐ 2☐ 3☐ 4☐ 5☐
29. If there is a surface water problem, how serious is it?
    1☐ 2☐ 3☐ 4☐ 5☐
30. What water sources are of better reliability?
    Surface water☐ Groundwater☐ Rainwater☐ Others□, please specify
31. Which sources do you prefer?
    Surface water☐ Groundwater☐ Rainwater☐ Others□, please specify
32. How often during the past calendar year did you need water but it was not available?
    Very often☐ Often☐ Not often☐ Not very often☐ Never☐
33. Do you own boreholes? Yes☐ No☐
    If yes, do you get water from it and do you need to pay for it? Yes□ No□

34. What is the major source for irrigation?
Surface water☐ Groundwater☐ Rainwater☐ Other□, please specify
35. Do you irrigate all your crops? Yes☐ No☐
36. What is your major irrigation method?
Flood irrigation☐ sprinkler irrigation☐ drip irrigation☐ mixed□
37. How are your irrigation charged?
Volume □ Household □ Per irrigation □ Per field □
Per hectare □ don't know □ Others, □ please specify:
38. What do you think of the local water fees?
Water should be free☐ very high☐ high☐ low☐ very low☐
39. Do you receive any water or irrigation subsidies?
Yes☐ No☐ don't know ☐
40. Compared to 10 years ago, the irrigation water applied per area land is
Less□ Same□ More□ not sure□
41. Roughly how much of your agriculture income is used for paying irrigation?
1-5% ☐ 6-10% ☐ 10-20% ☐ >20% ☐ Not know ☐
42. Do you use or harvest rainwater? Yes☐ No ☐
43. What do you think is the most possible choice to get more water?
More supply☐ Infrastructure ☐ More pumps and boreholes☐
Better water management☐ Water saving and conservation☐
Technologies☐ Other□, please specify,
44. Does your local community has any plan or projects for water saving, conservation and improving water use efficiency over the past 10 years?
Yes☐ No☐
45. Do you use water saving techniques, technologies, measures of any form?
Yes☐ No☐
46. What do you think of the available water saving techniques and technologies in your communities if there is any?
Very effective☐ Effective☐ Not very effective☐
Not at all effective☐ Don't know☐ others, please specify☐
47. Do you agree that more could be done to save water?
Strongly agree☐ Agree☐ Disagree☐ Strongly disagree☐
48. How much water do you think could be saved according to your opinion?
Nothing☐ 1-5%☐ 6-10%☐ 10-20%☐ >20%☐
49. Do you agree with the following statement?
☐ Water is a finite and vulnerable resource, essential to sustain life, development and the environment
☐ Water as an economic good has economic value in all competing uses
☐ Water development and management should be based on a participatory approach involving users, planners and policy-makers at all levels
☐ Women play a central role in water provision, management and safeguarding
50. How do you consider the following aspects of water management, please tick your choice of mark in the table (the higher the score is, the better the performance is).

| Choices | Marks | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Public participation in water management and decision making | | | | | |
| Gender equity and mainstreaming | | | | | |
| Public awareness | | | | | |
| Infrastructure construction | | | | | |
| Technology, knowledge and skills | | | | | |
| Data sharing and transparency | | | | | |
| Leadership, government support and policies and legislation | | | | | |

51. What kind of water management is in your community?
    WUA ☐ Contracting ☐ Collective management☐
    Mix ☐ do not know ☐ others ☐, please specify
52. Who select the water groups and managers?
    public ☐ water officials ☐ local village leaders ☐ others ☐
53. Do you know about WUA? Heard and know ☐ heard but don't know☐ never heard ☐
54. Do you think WUA improve the water situations in your communities?
    Yes☐ No☐ Not sure ☐
55. Do you know about IWRM? Yes ☐ No ☐, if no go to question 7.
56. Do you think IWRM improve the water situations in your communities?
    Yes☐ No☐ Not sure ☐
57. On a scale of 1-5, what is your score for current IWRM reform? ( )
58. Who do you think should manage local water governance?
    government ☐ water companies ☐ water bureaus and departments ☐
    water experts ☐ community ☐ local water users ☐ others ☐
59. How often do you attend village water decision meetings?
    1= Never ☐ 2= Sometimes ☐ 3= Often ☐ 4= Always ☐
60. Do you think it is necessary for local farmers to participate in water management?
    Yes ☐ No ☐ Not sure ☐
61. Do you think men and women have different water needs, concerns and priorities?
    Yes ☐ No ☐ Not sure ☐
62. Do you think men and women are given equal chance to speak and participate?
    Yes ☐ No ☐ Not sure ☐
63. DO you communicate with water managers and professionals?
    Never☐ Rarely☐ Sometimes ☐ Often☐ Always☐
64. DO you communicate with local water users?
    Never☐ Rarely☐ Sometimes ☐ Often☐ Always☐
65. Where do you get your knowledge and information ABOUT WATER AND AGRICULTURE production usually?
    Media☐ Agencies and training☐ Personal experiences and practice☐
    Communication with other community members☐ Others☐, please specify
66. What processes are YOU included in water governance? (can choose more than one)
    1= Planning and design ☐

2= Implementation and construction ☐
3= Monitoring ☐
4= Assessment ☐
5= Decision making ☐
6= All the process □
7= Others □, please specify

67. What do you think are the factors that affecting current water situation? Please mark them from 1 to 5, higher mark means more important causes.

| | | | | | |
|---|---|---|---|---|---|
| 1= Population growth | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| 2= Resources limit | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| 3= Management problems | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| 4= Human misuses/overuses | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| 5= Natural changes | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |
| 6= Lack of Infrastructure, credit and funding | 1☐ | 2☐ | 3☐ | 4☐ | 5☐ |

68. What is your ranking of current local water management on a scale of 10? (  )

## Appendix 2: Questionnaire for professionals

Survey time: Survey number:

1. Gender: Male☐ Female☐
2. Age: <20☐ 21-30☐ 31-40☐ 41-50☐ 51-60☐ >60☐
3. What is your highest education level?
   1= none ☐
   2= primary school ☐
   3= secondary school ☐
   4= technical diploma ☐
   5= college/ university education ☐
4. What is your work area?
   1=Decision maker☐
   2=Practitioner and technician☐
   3=Water manager☐
   4=Researcher and professional☐
   5=Others☐, please specify ( )
5. What kind of water management form is in your area?
   1= WUA ☐
   2= Contracting ☐
   3= Collective management☐
   4= Mix ☐
   6= other situations ☐, please specify---
   7= don't know ☐
6. Who do you think should govern local water?
   1= local government ☐
   2= water companies ☐
   3= water bureaus and departments ☐
   4= water experts
   4= community ☐
   5= local water users ☐
   6= other situations ☐
7. Water scarcity index locally with a scale of 5, the higher, the more severe.
   1☐ 2☐ 3☐ 4☐ 5☐
8. What do you think of the local irrigation water fees?
   Should be free☐ very high☐ high☐ low☐ very low☐

9. How do you consider the following aspects of water management, please tick your choice with a mark from 1-5 in the table. The higher the mark, the better it performs.

| Choices | Marks | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Public participation in water management and decision making | | | | | |
| Gender equity and mainstreaming | | | | | |
| Public awareness | | | | | |
| Infrastructure construction | | | | | |
| Technology, knowledge and skills | | | | | |
| Data sharing and transparency | | | | | |
| Leadership, government support and policies and legislation | | | | | |

10. How do you think about current local water uses? The higher the mark, the better it performs. 1□ 2□ 3□ 4□ 5□
11. Compared to 10 years ago, the irrigation water applied per area land is:
    Less□ Same□ More□ not sure□
12. What do you think of the available water saving techniques and technologies in your communities if there is any?
    1= Very effective ☐
    2= Effective ☐
    3= Not very effective ☐
    4= Not at all effective ☐
    5= Don't know ☐
13. How much water could be saved according to your opinion?(当地节水潜力)
    Nothing☐ 1-5%☐ 6-10%☐ 10-20%☐ >20%☐
14. What do you think is the most promising choice to get more water for local situation?
    1= More supply ☐
    2= Infrastructure ☐
    3= More pumps and boreholes ☐
    4= Better water management ☐
    5= Water saving and conservation ☐
    6= Technologies ☐
    7= Other ☐
15. Do you know about IWRM? Yes□ No□
16. Do you agree with the following statement?
    - ☐ Water is a finite and vulnerable resource, essential to sustain life, development and the environment
    - ☐ Water as an economic good has economic value in all competing uses
    - ☐ Water development and management should be based on a participatory approach involving users, planners and policy-makers at all levels
    - ☐ Women play a central role in water provision, management and safeguarding

17. Which of the following statements best describe your view of the impact of IWRM in our area?
    1= the problems are too big but the process will improve awareness □
    2= the concept is good but measurable outcomes will take time □
    3= the concept is good but implementation will be really difficult □
    4= the impact will be mixed but there is a chance of success in the place □
    5= the idea will eventually be dropped □
18. Are there water users' associations?
    Yes☐ No☐ Not sure☐
    If yes, who select the water group members and managers?
    1= public☐ 2= water officials☐ 3= local village leaders☐ 4= others ☐
19. Do you think these organizations are helpful in improving local water security?
    Yes☐ No☐ Not sure☐
20. What is the most effective benefit of these groups?
    1= Water saving ☐
    2= Water fees collection ☐
    3= Equity ☐
    4= Efficiency and productivity ☐
    5= Less conflicts ☐
    6= Others, please give details ☐
21. What process are local members included in current water governance?
    1= Planning and design ☐
    2= Implementation and construction ☐
    3= Monitoring ☐
    4= Assessment ☐
    5= Decision making ☐
    6= All the process ☐
    7= None of the above ☐
    8= Others ☐
22. Do you think it is necessary for all farmers to participate in water management?
    Yes☐ No☐ Not sure☐
23. Do you think local farmers are capable and with enough knowledge to participate?
    Yes☐ No☐ Not sure☐
24. Are there any women members in the organizations?
    Yes☐ No☐ Not sure☐
25. Do you think men and women have different water needs, benefits and concerns?
    Yes☐ No☐ Not sure☐
26. Do you think it is necessary for women to be included in management and decisions?
    Yes☐ No☐ Not sure☐
    If there is need for women to participate, do you think it is better to be in the mixed groups of both men and women or in women only groups?
    Yes☐ No☐ Not sure☐
27. How are women represented in current local water management now?

1= Not represented or concerned specifically ☐
2= Number of female members ☐
3= Attending meetings ☐
4= Participation in construction and implementations ☐
5= Others, please specify ☐

28. Do men and women have equal access and participation in water management locally?
Yes☐ No☐ Not sure☐
If no, what do you think are the causes?
1= men are more capable and educated
2= men are physically stronger while women are weak
3= lack of consideration of women's roles and importance
4= cultural barriers
5= there are more men in higher positions
6= others, please specify

29. How often do you communicate with local water users?
Very often☐ Often☐ Not often☐ Never☐ Other situations☐

30. Where do you get your water data, knowledge and information usually?
1= Media☐
2= Agencies☐
3= Personal experiences and practices ☐
4= Trainings and education☐
5= Others ☐, please specify

31. Please mark factors that affecting current water situation from 1 to 5, higher mark means more important causes.
1= Populations 1☐ 2☐ 3☐ 4☐ 5☐
2= Resources base 1☐ 2☐ 3☐ 4☐ 5☐
3= Management 1☐ 2☐ 3☐ 4☐ 5☐
4= Human uses 1☐ 2☐ 3☐ 4☐ 5☐
5= Natural changes 1☐ 2☐ 3☐ 4☐ 5☐

32. What do you think are the ways of water management top-down or bottom up?
Top-down☐ Bottom-up☐ both☐ neither☐ not sure☐

33. What is your ranking of current local water management on a scale of 10?
( )

--- The end ---

Appendix 3: Semi-structured interview guides for villagers

1. What do you think are the major challenges/pressure for local agriculture and livelihoods today? (Physical, socio-economic or political). Are there water scarcities? What do you think are the causes? Has the situation changed compared to past 10 years and why?
2. Do you use water saving technologies/practices? Why or why not?
3. How would you describe villagers' dependence on land, water and agriculture for a living?
4. What are the major water reforms and interventions over the past 10 years?
5. Have you heard about WUA? What it is? Why and when it started, by whom and for what purposes? Is it effective? How to improve?
6. Have you heard about IWRM? What do you think it is, for what?
7. Do you agree that water is a finite and vulnerable resource, essential to sustain life, development and the environment? Why and why not?
8. Do you agree that water is an economic and social good and has economic value in all competing uses? Why and why not? How much do you pay for what water, past and now? Is water charged reasonably and if increase/decrease what might be impacts on users and uses?
9. Do you agree that water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels? Why or why not? What does participation mean to you? Are you participating, and why? If there are real participation opportunities, will you participate? What are the incentives, benefits and costs, same for everyone?
10. Do you agree that women play a central role in water provision, management and safeguarding? What do you think of gender roles, responsibilities and labor division changes in last 10 years?
11. How do farmers make agriculture related decisions, crop patterns, irrigation timing, amount and so on, in the past and now?
12. What are the impacts of these external reforms and interventions on water infrastructure situations, water access, quantity, stability, affordability, use efficiency, public participation and water control and local income and livelihoods? How benefits/costs of external interventions are received/perceived/distributed across different physical socio-economic categories stratification? If adversely affected, how are you compensated?
13. What organizations are doing what kinds of monitoring and evaluation of the irrigation management transfer process? How is data processed and aggregated and presented to and in what forums? What indicators are being used? Do you/all have access to these?
14. Are you satisfied with current amount and services? Is there a system dealing with coordination, communication, and complaints, how? When, from whom and how often? How do you describe your relationships, communication and cooperation with local water org, government and leaders, pros and local members now and the past?
15. How do you describe your relationship with local leaders, officials and water

authorities? Are there communication, assistance and trust with each other? Why?

16. What are current reforms influences on social relations, networks and power dynamics developed by farmers in the changing context at different levels vertically and horizontally?
17. What are your current ways of adaptations and practices to these interventions? What are the roles of formal and informal social networks (guanxi 关系) in the process?
18. What do you think of current water management in your area, for example, water security, water price, equity, water use efficiency, transparency and public participation?
19. What do you think are the most important factors leading to successful water management? What do you think as problems for current water management?
20. Who should manage and control local water resources and how? Can farmers self-govern water resources? Why or why not?
21. Do you consider/expect farming in the community as a choice for you or future generations?

## Appendix 4: Semi-structured interview guides for professionals

1. What do you think is the challenge for local development? Are there water scarcities? What are the causes? How do you think are the situations being addressed?
2. Compared with the past, what do you think of current water management policies (allocation, pricing and institutions) in the area? What are the roles of water saving technologies/practices? Why?
3. What are IWRM and WUA? What drives the water reforms towards it? What are the interests and concerns involved in these and what are the outcomes and implications? What organizations are doing what kinds of monitoring and evaluation of the irrigation management transfer process?
4. Are local water projects participatory? Why or why not? What does public participation mean for you? Do you think it will be the right policy for China and why?
5. In your opinion how have IWRM reforms changed local water resources management for example, water security, water price, equity, water use efficiency, transparency and public participation? What are the major challenges facing in implementing IWRM policies? How can they be overcome if possible?
6. What is the best management way- mandatory top-down made plans and controls to follow or what bottom-up self-governance, participatory cooperation? What do you think are the most important factors leading to successful water management? What do you think as problems for current water management? What are the roles of different stakeholders, such as villagers?
7. How are different stakeholders (water uses, production, incomes and livelihoods and so on) affected by current IWRM water reforms and management in the area? What is being done to assist local adaptations and practices to these interventions? If adversely affected, how are people compensated? Who are the losers /winners?
8. What is your vision for rural china/agriculture/livelihood in the future? Do you consider/expect farming in the community as a sustainable choice?
9. Any other information you would like to provide?

## Appendix 5: Focus group discussion topics for villagers

Date/time: No. of male/female participants:

Location: Group type: Total No.:

1. What are the most important problems (for example resource, labour and environment) of this village? What are the main water concerns?
2. What has changed over the past 10 years in the village? What reforms are there?
3. How were water and land resources managed in the past? How about now? Are there any water related government-led interventions/reforms?
4. What is WUA, the purpose and the effects? What do you think are the main issues about it? What are the effects? Who are benefits from it and who is not and why?
5. What are your perceptions of IWRM (integrated water resources management)? What do you think are the main issues about it? What are the effects? Who are benefits from it and who is not and why?
6. Who are conducting the monitoring and evaluation of these processes and how?
7. Do you think your agriculture water usage/efficiency/equity/stability/access has changed? How and why?
8. What are your opinions about "Water (surface and groundwater) is a finite and vulnerable resource, essential to sustain life, development and the environment"?
9. What are your opinions about "Water as an economic good has economic value in all competing uses"?
10. What are your opinions about "Water development and management should be based on a participatory approach involving users, planners and policy-makers at all levels"? What does public participation in water affairs mean for you? What are the benefits and costs of participation or non-participation? Do you think you should participate or not? Why?
11. What are your opinions about "Women play a central role in water provision, management and safeguarding"?
12. How do you think of your relationships with production team leaders, village committee members and external water authorities and government officials?
13. Who do you think should make decisions about water management (e.g. state, local government, water authorities, village committees and/or villagers)? Why?
14. How could the water crisis in this village be improved?
15. What are your opinions on rural land circulation for example transferring land from smallholder farmers to bigger contractors or other forms?
16. How do you think human should deal with their relationships with nature, resources base, development and a sustainable future? Where will you be or do in the next 5 to 10 years? What is the foreseeable future of you or your village?