



ORGANISING CLIMATE CHANGE ADAPTATION

**An organisation and network perspective to agriculture adaptation in
developing countries**

Abrar S. Chaudhury (ID 453268)

Green Templeton College
Environmental Change Institute
School of Geography and Environment

A Thesis Submitted for the Degree of
Doctor of Philosophy

Michaelmas 2016

To my children - Anushka, Naadir and Kabir

“We have not inherited the earth from our parents,
we have borrowed it from our children”

Native American Proverb

ABSTRACT

Current efforts by nation-state governments to organise adaptation in developing countries are characterised by a broad concern with defining, measuring and governing adaptation efforts, with surprisingly little on how these efforts are organised and implemented through the different participant organisations. In this thesis, I develop an organisation-centred perspective based on the three distinct and relatively independent literatures of climate change adaptation, organisation theory and network analysis to study the emerging adaptation initiatives in developing countries. I use the term ‘organising adaptation’, to focus analytical attention on the organisational architectures and linkages that are critical, to develop coordinated responses, and to move forward from policy and plans to practical action. I present my results in four empirical papers from a detailed study of organising climate change adaptation in the agriculture sector in Ghana, supplemented with analysis from Nepal and Pakistan. I adopt a ‘granular’ and ‘nested’ design, backed by extensive empirical field data to analyse the effect and connectedness of key organisations in adaptation from local to national planning levels. The results show that the planned structures take on an organisational form composed of many component organisations (I refer to them as ‘meta-organisation’), but these structures are out of alignment with the requirements needed to address challenges posed by climate change. The component organisations in turn form implicit sub-groups (I refer to them as organisation-communities) and take on specific roles that are asymmetric and the challenges are often articulated in way that conflicts with, or thwarts, other capacity, leading to gaps in potential adaptation action. The findings of the papers emphasise that organisations and their relationships matter greatly but that it is also important to examine how these organisations work and what they do within the wider networks involved in adaptation.

TABLE OF CONTENTS

ABSTRACT	3
I. ACKNOWLEDGEMENT	6
II. RE-ORGANISING TOWARDS CLIMATE CHANGE – A PERSONAL JOURNEY.....	7
III. MULTI-DISCIPLINARY RESEARCH STRUCTURE	10
1. INTRODUCTION	12
1.1. RESEARCH AIMS AND QUESTIONS	18
1.2. RESEARCH APPROACH.....	20
1.3. RESEARCH OUTPUT	24
1.4. RESEARCH CONTRIBUTION AND USE	32
1.5. STRUCTURE OF THESIS.....	34
2. AGRICULTURE ADAPTATION TO CLIMATE CHANGE IN GHANA	35
2.1. INTRODUCTION.....	35
2.2. AGRICULTURE AND CLIMATE CHANGE.....	36
2.3. GHANA AND AGRICULTURAL ADAPTATION.....	37
2.4. POLICY AND INSTITUTIONS FOR AGRICULTURAL ADAPTATION IN GHANA.....	38
2.5. RESEARCH SETTING IN GHANA.....	43
2.6. CONCLUSION.....	47
3. RESEARCH LITERATURE FOUNDATIONS FOR ORGANISING ADAPTATION.....	48
3.1. INTRODUCTION.....	48
3.2. THREE LITERATURE PERSPECTIVE FOR ORGANISING AGRICULTURE ADAPTATION	49
3.3. CLIMATE CHANGE ADAPTATION	51
3.4. ORGANISATION THEORY.....	57
3.5. COMPARISON BETWEEN ADAPTATION LITERATURE AND ORGANISATION THEORY	62
3.6. NETWORK ANALYSIS.....	64
3.7. THREE LEVEL OF ORGANISATIONAL ANALYSIS.....	67
3.8. CONCLUSION.....	68
4. RESEARCH DESIGN, METHODOLOGY AND METHODS.....	69
4.1. INTRODUCTION.....	69
4.2. EVOLUTION IN RESEARCH DESIGN	70
4.3. GRANULAR AND NESTED RESEARCH APPROACH.....	72
4.4. RESEARCH METHODOLOGY.....	77
4.5. DATA COLLECTION AND RESEARCH METHODS.....	79
4.6. ASSESSMENT AND MANAGEMENT OF UNCERTAINTY.....	81
4.7. CONCLUSION.....	82
5. RESULTS – FOUR EMPIRICAL PAPERS	83
6. EMPIRICAL PAPER 1.....	84
EMERGING META-ORGANISATIONS AND ADAPTATION TO GLOBAL CLIMATE CHANGE: EVIDENCE FROM IMPLEMENTING ADAPTATION IN NEPAL, PAKISTAN AND GHANA	84
7. EMPIRICAL PAPER 2.....	128
TIES THAT BIND: LOCAL NETWORKS, COMMUNITIES AND ADAPTIVE CAPACITY IN RURAL GHANA	128
8. EMPIRICAL PAPER 3.....	170
CLIMATE CHANGE ADAPTATION ‘ON THE GROUND’: A NETWORK ANALYSIS OF ORGANISATION AND POLICY IN GHANA AGRICULTURE SECTOR.....	170
9. EMPIRICAL PAPER 4.....	221
ROBUST ADAPTATION PLANNING (RAP) FRAMEWORK: APPLICATIONS IN GHANA’S AGRICULTURAL ADAPTATION REGIME	221

10. DISCUSSION AND CONCLUSION.....	263
10.1. INTRODUCTION.....	263
10.2. SUMMARY OF CORE CLAIMS AND CONCLUSIONS.....	264
10.3. LESSONS.....	267
10.4. LIMITATIONS.....	273
10.5. WAYS FORWARD.....	274
10.6. CONCLUSION.....	278
REFERENCES.....	281
SUPPLEMENTARY DATA.....	308
APPENDIX PAPER 1.....	308
APPENDIX PAPER 2.....	318
APPENDIX PAPER 3.....	323
APPENDIX PAPER 4.....	325

Figures, Tables and Boxes

Figure 1: The three granular levels of organisations and networks in a nested analysis.....	22
Figure 2: The granular levels of nested analysis and output link.....	25
Figure 3: Ghana's administrative structure for planning and implementing adaptation.....	41
Figure 4: Map of Ghana across administrative scale – Orbili in Upper West Region.....	44
Figure 5: Map of Orbili village, next to Black Volta River in Lawra District.....	46
Figure 6: Three literatures perspective for organising agriculture adaptation.....	50
Figure 7: The three levels of analysis.....	67
Figure 8: Research approach.....	73
Figure 9: Iterative research methodology.....	78
Table 1: Digest of four empirical papers, linkages, and relation to core thesis questions ..	27
Table 2: Comparison between adaptation and organisation theory literatures.....	63
Table 3: Network measures for studying adaptation action.....	66
Table 4: Summary of four emperical papers and key insights.....	265
Box 1: Profile of average household in Orbili.....	46

I. ACKNOWLEDGEMENT

Writing this acknowledgement has made me deeply appreciative of the wonderful people, institutions and places that have made this DPhil a reality. I am extremely grateful for all of the assistance and support I have received throughout this DPhil.

I am deeply thankful to my supervisors, Dr Thomas Thornton and Dr Marc Ventresca for their continual support throughout this DPhil and for pushing me to think better and harder. Dr Ariella Helfgott for her role as a supervisor and project lead, and most importantly as a friend. Chase Sova for being a wonderful companion and field partner across many communities, countries and continents. We have learnt and grown together. Thanks are also due to my fellow team members Jessica, Meghan and Yemi for offering research and the more important emotional support during our adventures in the field and at Oxford. The project teams in Nepal and Ghana for their outstanding on ground support and local insights. The wonderful and resilient local communities across Nepal and Ghana for welcoming me in their homes and sharing their unique knowledge.

I am especially grateful to CCAFS for funding my research and the Environmental Change Institute (ECI) of University of Oxford for housing my DPhil. Green Templeton College for offering a home away from home. Colleagues, friends, and academics in Oxford and around the world that have inspired me over the years to challenge myself and follow my dreams. I am indebted to Mike Kettlewell for his wonderful editorial support throughout my DPhil.

I am thankful for my parents for always believing in me and supporting me to take a plunge into the DPhil in the full prime of my career. I am forever indebted to my wife, Ayesha, for her unconditional love, support and patience, encouraging me to keep going when all seemed impossible. Truly this DPhil is as much hers as mine. My children, Anushka, Naadir, and Kabir for being my biggest cheerleaders and praying every night that I finish this thesis. Your love helped me over the line.

II. RE-ORGANISING TOWARDS CLIMATE CHANGE – A PERSONAL JOURNEY

2010 Pakistani Floods – Eyewitness accounts¹

“The villages are becoming like small islands now. Nobody knows if people are alive or dead.”

“All the roads are blocked and the bridges are down. I've never seen such an Armageddon in Pakistan.”

“I don't know when I will be able to see my native home and property. I may see nothing to be called a homeland.”

“In the worst-affected areas, entire villages were washed away without warning by walls of flood water”

“The government is not helping us,”

Pakistan experienced its worst ever natural disaster in 2010. One-fifth of the country was under flood waters, displacing millions of people and causing damage at scale of billions of US dollars (Aslam et al., 2011). The floods resulted from exceptionally heavy rains caused by strong monsoons and the glacial melt in northern Pakistan. Whilst it is difficult to attribute specific extreme weather events to human-induced global warming, according to the Intergovernmental Panel on Climate Change (IPCC) there is strong evidence that humans are the most likely cause of current climate change (IPCC, 2014d). The Pakistani flooding is widely understood in these terms. Despite promises for better prevention and coping measures by the government, civil

¹ Source: Various newspapers <http://www.bbc.co.uk/news/world-south-asia-10829888>

society, and the global community, there was little evidence of actions to create capacity for rural communities to withstand such environmental shocks and adapt to longer-term environmental change. The country experienced repeated flooding in the two years following, and with no additional capacity or preparation, these floods continued to result in a further loss of life and property.

As a professional accountant from Pakistan, I have worked very closely with private and government organisations for over a decade on numerous development and commercial advisory projects, producing effective social and economic outcomes. My informal research after the floods showed that the country had taken several remedial measures to manage climate change and extreme events. These included establishing a dedicated ministry of environment², setting up national disaster centres and formulating a comprehensive climate policy, in line with global expectations. Multiple research centres, civil society organisations and international development partners are also active in offering relief to those affected by persistent climate threats. Despite institutional and policy progress, the weak response to both exceptional and recurring catastrophic flooding was surprising, especially since Pakistan consistently ranks as one of the most climate-vulnerable countries in the world³.

My experience raised many questions about the lack of preparedness, effective action and leadership, despite the presence of dedicated institutions, organisations and policies. One frequent explanation offered by officials was that the size of the challenge is so great that it was beyond the capacity of single ministry or agency to tackle it, especially when knowledge and resources are scarce and spread widely across many

² The Ministry of Environment was downgraded into a state Department in 2013. In 2015 it was reinstated as the Ministry of Climate Change

³ ND- Gain Index consistently ranks Pakistan high in vulnerability and low in readiness to adapting to climate change - <http://index.gain.org/country/pakistan>

actors operating at different geographic and administrative levels. The result was fragmented and local responses by government and other actors that did not capture the full scale, seriousness and connectedness of the challenge, resulting in often unintended and limited policy outcomes. For example, the government's approach to concentrate on relief for victims of flooding meant that the local population was ill-prepared to take preventive measures for the floods the following year.

The Pakistani floods were an eye-opener to the size and complexity of the climate change challenge in Pakistan and developing countries in general, and the substantial gap in the means for effective responses. The floods underscored the value of a systematic approach, to not only respond to the immediate threats but, more importantly, to build long-term capacity in communities to adapt to these recurring threats. The floods emphasised that effective responses require combined, coordinated, and sustained efforts of many disparate actors, from governments offering strong policy frameworks, experts creating evidence-based knowledge on local threats, local populations implementing strategies on ground, to Treasury and development partners offering complementary assets and resources, and non-governmental organisations (NGOs) improving outreach in areas not adequately serviced by government agencies. Such an integrated response is unprecedented, challenging to deliver, and requires both identifying actors and understanding their specific roles in adaptation. Post-flooding analysis in Pakistan highlighted that recognising the challenge and setting policy is not enough. If efforts are fragmented and uncoordinated, responses are unlikely to be effective, leading to recurring disasters.

My motivation for this research is to explore these challenges at the country level, but also with more granular observation, and to understand the early efforts at organising responses to climate change. This work requires crossing disciplinary

boundaries from natural science (understanding climate change), social science (how people are impacted and how they react) to management science (how responses are planned and organised). My DPhil thesis is part of a multi-disciplinary project and co-supervised within the business and environmental schools at the University of Oxford. The work of the thesis involves devising means of applying these seemingly different theoretical and methodological worlds with different drivers and motivations to study novel approaches for organising adaptation. This thesis is the product of my desire to unpack the complexity surrounding climate adaptation and to bring multiple perspectives to the analysis. In turn, this work touches on the bigger reality of how we can live in and adapt to an unpredictable and changing world with an ever-increasing population.

III. MULTI-DISCIPLINARY RESEARCH STRUCTURE

I have worked as part of a team of Oxford academics designing a ‘Systemic Integrated Adaptation’ (SIA)⁴ framework. The SIA team operates within the CGIAR Research Program on Climate Change, Agriculture, and Food Security (CCAFS)⁵ and is housed at Oxford’s Environmental Change Institute (ECI). SIA is led by an experienced researcher and aims to produce an integrated research programme bringing together DPhil students with backgrounds in sociology, ecology, politics and organisations - SIA’s four lenses. The team explores topics relevant to complex

⁴ Refer to <https://ccafs.cgiar.org/systemic-integrated-adaptation#.VzUej6uRZUQ>

⁵ CGIAR is a global research partnership for a food-secure future. CCAFS focuses on the increasing challenge of global warming and declining food security on agricultural practices, policies and measures through a strategic collaboration between CGIAR and Future Earth. Refer to <https://ccafs.cgiar.org>

adaptive systems charged with improving food security for small-scale farmers while reducing environmental degradation. The SIA field research sites are in Nepal and Ghana. My thesis focuses primarily on the situation in Ghana, with illustrative comparisons to the other countries (Nepal and Pakistan).

Within the SIA project, I lead on the *organisational lens* researching how the emerging current national climate change adaptation policy initiatives are organised to reach vulnerable smallholders. The existing research underscores the critical role of smallholders on local and global food systems by adapting to the impacts of climate change. The organisation focus builds from work in organisation theory, strategic management, networks, public administration, and implementation theory. The overall approach has allowed my research to engage and extend several perspectives. For example, building on the social lens, I have strongly rooted my research in local communities where impacts of climate change are experienced most directly. Keeping a finger on the pulse of local needs, my research studies adaptation actions between local and national levels to understand how different actors across these levels shape and influence action. Similarly, the political lens has helped broaden the approach by identifying and including influential actors in climate change and agriculture in my analysis.

1. INTRODUCTION

“Policies are there and policies are good. It is the implementation that is problematic...we have realised that it is very difficult for lots of policies to reach grass root farmers. Most of the time it is not about policy change—sometimes it is—...but most of the times it is policy implementation and how far it reaches”

Civil Society Organisation (Interview, Ghana 2013)

Climate change has emerged as perhaps the biggest threat facing humanity in the 21st century, backed by substantial scientific evidence (IPCC, 2013, Solomon et al., 2007, Parmesan and Yohe, 2003). But it is also the focus of much public controversy and organised scepticism (Hulme, 2009, Hoffman, 2011, Dunlap and McCright, 2011). The world is heading to surpass a 2°C rise in average temperatures by the end of the century compared to the pre-industrial conditions, with human influence considered to be the most likely ‘dominant cause’ of the warming since the mid-20th century (IPCC, 2013). A warmer world will experience more intense rainfalls, droughts, floods and other extreme events (IPCC, 2013). Although in international discourse climate change is framed as a global phenomenon that transcends national boundaries, its impacts are very local, felt widely within national boundaries from small rural communities to people in large cities. In this thesis, I proceed on the basis of the preponderance of the scientific evidence and the standard interpretations for policy and practice at country level made by credible scholars and others.

The breadth of causes and consequences of climate change affect everyone (Gibson et al., 2000) and the responses exceed the capabilities of any one actor to offer necessary resources and knowledge to tackle it (Ferraro et al., 2015, Lazarus, 2008,

Levin et al., 2012). Hardest hit to date are populations in developing countries whose livelihoods are very sensitive to climate change such as agriculture, forestry and fishing, and have less capacity to adapt to the adverse climate effects (IPCC, 2014b, Adger et al., 2003). Often already burdened with huge development deficits and weak institutions, developing countries lack the ability to meet any additional challenges posed by climatic change (Parry et al., 2009, Stern, 2006). Accordingly, government, organisations, communities and planners in developing countries will have to combine their efforts and put in strong adaptive local initiatives to meet the challenge.

The path to global consensus on adaptation has been challenging and politically sensitive, marked by debates on a range of issues from funding gaps, lack of transparency, repackaging development funding as adaptation, skewed focus on mitigation⁶, to mismatch of funding contributions and historical liability (Schalatek et al., 2013). Many of these challenges are being addressed through scientific research, global negotiations, and experience from the development of policy regimes (IPCC, 2014d). The 2015 Conference of Parties 21 (COP21) in Paris saw, for the first time, both developed and developing countries share a common ambition to tackle the threat of climate change and explicitly link adaptation to the mitigation goal of limiting global temperature rise to below 2°C. The right of vulnerable people across the world to adapt to adverse impacts of climate change is accepted by all development agendas, alongside the more traditional development goals of health, clean water and other basic human needs. The challenge lies in bridging the divide between policy and action (World Bank, 2010).

⁶ The share of the total funds committed to climate change allocated to adaptation is around 15% with 85% for mitigation efforts. The global goal under the Paris Agreement is an equal funding allocation between mitigation and adaptation.

Despite steady progress on the science-policy dialogue, there is only very thin theory and practice on how different actors (mostly organisations)⁷ function and interact across various scales of space, time and social organisation to develop and offer coherent responses (Ford et al., 2011, Biesbroek et al., 2010), what this thesis calls ‘organising climate change adaptation’. This gap in our knowledge partly stems from the early stages of adaptation initiatives in most developing countries that are only now moving towards implementation, and partly because the organisational perspective is largely absent from the adaptation discipline.

The current efforts to organise adaptation in country after country start from the standard focus in the environmental and adaptation literatures: a broad concern with defining, measuring and governing adaptation efforts (Vincent, 2007, Adger et al., 2007, Smit and Wandel, 2006, Hill and Engle, 2013, Lemos et al., 2007), with surprisingly little evidence on how these efforts are organised and implemented (Huiteima et al., 2016, Ford et al., 2013) through the different participant organisations. Organisations are generally complex goal-focused entities that operate within a wider context and environment made up of many other organisations (Daft et al., 2010), and through which collective action occurs (Aldrich and Ruef, 2006). They require external resources to operate, strive on reducing the costs of resources, and forge relations with other organisations to manage the costs and resource dependency, and to control uncertainties (Hillman et al., 2009, Pfeffer and Salancik, 1978, Williamson, 1979). The current climate literature ignores the critical organisational perspective of resource-

⁷ I focus on organisations as key units for observation, analysis, and policy on adaptation in this research. Broadly I refer to organisation as an organised group of people with a particular purpose (Scott and Davis, 2007), such as a business, government department or civil society agency. While some other individual actors such as experts or community members may be prominent in policy debate, organisations offer a stable, manageable and focused unit of analysis thus enabling application of theories and methods from organisation and network disciplines. For the remainder of this thesis I will use the term organisation to refer broadly to the many actors who play roles in all phases of adaptation.

dependency, transaction cost economics, and inter-organisational relations that drives action and which lies in the domain of organisational and network theories (Scott and Davis, 2007, Scott and Carrington, 2011). Arguably, for successful adaptation to climate change, organisations themselves must adapt (Folke et al., 2005).

In this thesis, I develop an organisation-centred perspective and use network analysis for studying emerging adaptation initiatives in developing countries through a myriad of organisations and their interactions. I use the term ‘organising adaptation’, to focus attention on the organisational architectures and linkages that are critical to implement adaptation across state structures, to develop coordinated responses, and to move forward from policy plans to action. I draw from the substantial work in organisation analysis that is available in organisation theory, strategic management, social network theories, and implementation studies. I will describe and make use of models, tools, and theories of organisation and network disciplines to examine the early policy initiatives and plans. This is an analytic approach that provides specific and distinctive ways and means of understanding current efforts to organise policy and practice for adaption.

The extensive scholarship around climate change adaptation and development theory recognises the importance of adopting collaborative and participatory arrangements through which organisations combine their offerings into a coherent solution (Adner, 2006, Chaudhury et al., 2016a, Mikkelsen, 2005, Law, 1992). My thesis extends and re-interprets this work to bring organisational analysis to the fore as part of an integrated approach to policy solution. Network analysis offers a further tool to map available and actual linkages among the wide set of organisations across policy levels and the physical and social terrain of the case (Janssen et al., 2006, Stein et al., 2011).

I present my findings in four empirical papers. My analyses in these papers enables a thoughtful and informed consideration of planned adaptation initiatives, which require conscious interventions and typically constitutes the response to a deliberate policy decision (Fankhauser et al., 1999). This is different from autonomous adaptation that is the result of spontaneous actions taken by actors without explicit planning to address climate change (IPCC, 2014b). Autonomous responses, are however, constrained by institutional processes such as regulations, laws, culture, social norms and rules in common use (Adger et al., 2005, Hoffman and Ventresca, 1999). Formal planning can also deliberately aim to allow space for, to facilitate and support autonomous adaptation.

Many of the planned responses and actions take place within formal state structures as country managers view state structures to be most capable of implementing adaptation. These formal structures assume efficiency and active cooperation among its different units and agencies, backed by formal rules, processes and incentives. In reality, state structures can be formal, rigid and bureaucratic (Pugh, 1973, Weber, 2009), which overlook the roles and actions of the many other organisations outside these structures that are key to adaptation. Ansell and Torfing (2015, p.317) argue that “fixed political jurisdictions are often poorly matched to the scale of problems”. Inter-organisational networks in practice offer one possible solution to address this problem of scale mismatch (Juhola and Westerhoff, 2011). Planned adaptation offers a good base to build the analysis outwards from fixed state structures to actions of organisations in the wider network. This organisation-centred approach changes what we study and how we interpret that data, in turn providing new insights on the early adaptation initiatives.

I study these issues of organising climate change adaptation in the context of the agriculture sector in Ghana (a lower middle-income country), supplemented with analysis from Nepal and Pakistan. Agriculture is key to supporting millions of rural households across the developing world (FAO, 2012) and is the mainstay of the Ghanaian economy. The Gain Index⁸ ranks Ghana as highly vulnerable to the impacts of climate change, especially with regard to agriculture. Adapting to climate change in agriculture is a recognised goal for a country that is confronted by increasingly variable rains, flooding and droughts, threatening the livelihoods and food security of its local populations (McSweeney et al., 2010a). The Ghana case, hence offers us three appealing features for this analysis: high vulnerability to climate change, a developing country and reliance on agriculture. In addition, the public language is English and there is substantial engagement in Ghana with wider international agencies and norms.

I investigate two basic issues in the thesis research: *1) The challenges of early climate change adaptation efforts in the context of a developing country and 2) the challenges of policy implementation, specifically how policy aims reach implementation, or not, through the lens of organisational analysis.* This is an important departure from current research on adaptation and marks a sustained application of organisational approaches. In policy and practice term, and considering the scope and seriousness of climate change, there is also an urgent need to develop robust theoretical and analytical frameworks to improve adaptation initiatives. This covers identifying and studying the organisations, networks, logics, and drivers behind planned initiatives, and drawing practical lessons from the implementation efforts (so far) in various institutional contexts.

⁸ Please see <http://index.gain.org/ranking/vulnerability>

1.1. Research Aims and Questions

I am interested in how large complex policy systems that comprise sets of organisations distributed in space and time, organise and function when faced with a changing climate (Berkes and Folke, 1998, Adger et al., 2005, Cash et al., 2006, Ostrom, 2010a, Souza et al., 2015). This is particularly pertinent for agriculture systems that are defined by a legacy web of inter-linked institutions, organisations and networks **(Coleman et al., 1996, Busch and Juska, 1997)**. The complexity in the design and delivery of effective strategies for adapting agriculture stems from the scale, nature and uncertainty in agriculture and climate change that cuts across sectors, populations and geography (Davidson, 2016). Well thought out adaptation responses may successfully target particular vulnerabilities, but may have unintended consequences in other areas that leads to incomplete impacts and/or future maladaptation (Agrawal and Chhatre, 2011). Tackling this ‘wicked challenge’ requires active participation of many diverse and autonomous organisations from across all levels (Ferraro et al., 2015). These organisations have to identify and evaluate many options and implementation structures, including opportunities and barriers, to maximise the potential for sustainable agriculture (Vermeulen et al., 2012). This entails broad actions ranging from improved practices, access to resources, knowledge and technologies, to data and tools across the whole of agriculture (Foley et al., 2011).

I see adaptation systems as complex organisational fields of activity. The current focus of adaptation is on formal structures, compliance and interdependencies among organisations. This approach ignores the wider environment that provides resources to manage the interdependencies and the institutions offering ideas, meaning and expertise on adaptation. This raises many pertinent questions that are inadequately addressed about planned adaptation for agriculture. These include: How resources and knowledge

are delivered to vulnerable populations (structure and process) and on what scale? Are these existing development structures or new ones? Who are the delivery agents (organisations/networks) and what is the basis for allocating resources to climate vulnerability (logics)? How and in what ways do the independent routines, operational histories and structures of the delivery agents impede adaptation efforts? How does current policy architecture facilitate or hinder action?

Based on these organisation-centred questions, I pose three main questions that frame this research, each of which informs subsidiary questions that I investigate further in the four empirical papers. These three questions make for a good start on an agenda for a developing country, although they do not exhaust the list of theoretical issues that could be explored about organising adaptation. I return to this in the discussion and conclusion sections.

1. How are current policy diagnoses, initiatives, and solutions for agricultural adaptation embodied in organisation-centred terms?
2. What is the organisational architecture of current/early adaptation policy responses?
3. How are current ideas about implementation linked to the actual organisational arrangements in place?

The first question explores how adaptation policy responses take on an organisational form, best viewed under the mature organisational literatures. The second question expands this organisation-centric focus and studies the actual organisation design of adaptation policy responses in the case country. The third question maps these actual organisational structures and studies these in light of the designed or proposed

approaches for tackling adaptation. This leads to the question of how organisations confront new challenges and organise new initiatives (Scott and Davis, 2007, Aldrich, 2008, Daft et al., 2010, Robbins and Judge, 2010). The research is designed to address these questions along with others. While addressing these questions, I do not propose new forms or suggest the most ‘effective’ or ‘ideal’ organisational structures. Instead, I examine an emerging challenge under the established organisation and network lenses. As Bamberger and Pratt (2010, p.666) highlight, unconventional research offers the “best opportunities to observe new organisational phenomena, or view well-known phenomena in a new light”. I treat climate change adaptation as a fresh context for studying organisational and network processes. In turn, the organisation and network disciplines offer fresh insights for organising adaptation.

1.2. Research Approach

I shift the focus of this research beyond the current science-policy dialogue to an emphasis on how responses emerge through a network of organisations. The multiple discipline approach to organisation and networks helps expand the conventional boundaries and scope of the analysis and brings important elements from other disciplines that are seldom considered within the conventional field of climate change adaptation.

Most planned strategies are designed top-down by governments⁹ to meet defined objectives of supporting vulnerable populations who bear the brunt of climate change.

⁹ Developing countries are encouraged by global bodies (UNFCCC) to develop government led national programmes and plans for adaptation. To date 50 of the least developing countries have setup national programmes for adaptation.
http://unfccc.int/adaptation/workstreams/national_adaptation_programmes_of_action/items/4585.php

While these formal models appeal to policy makers because they are consistent with micro-economic models (World Bank 2010), the evidence from related policy domains raises questions of how community needs are captured and respected in the planning process (Chaudhury et al., 2016a, McGee, 2002). At the other end are well-researched demand-based bottom-up approaches, novel tools and methodologies that promote local needs, priorities and knowledge in planning decision-making¹⁰ (Chaudhury et al., 2016a, Füssel and Klein, 2006, Vincent, 2007, Steenwerth et al., 2014). However, these efforts remain fragmented and face challenges of scaling up. Uncertainty about climate change and its long-term impacts adds complexity to all levels of the planning cycle. This is greatest locally where the impacts of climate change are most severe and where resources and capacity to tackle the challenge are so often limited or missing. Planned adaptation strategies are designed to protect communities from adverse impacts of climate change, however, there are gaps in resources and knowledge to support critical needs of the vulnerable.

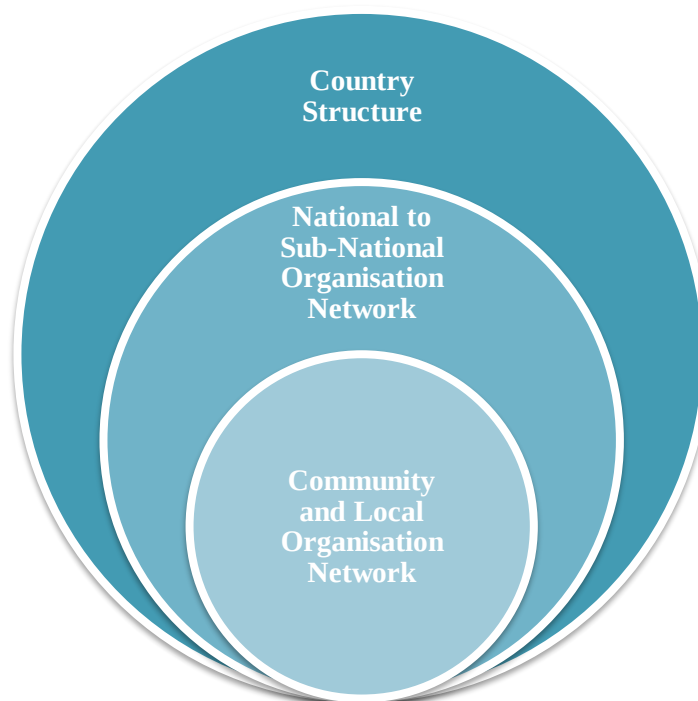
I address these challenges by offering a ‘granular’ and ‘nested’ design approach to study the connectedness of many organisations across different levels. Figure 1 presents this idea in schematic form. In a nested approach adaptation responses are linked and embedded dynamically across levels, such that one level impacts the other (Midgley, 2003, Allen et al., 2014, Berkes and Ross, 2016, Holling, 2001). These responses can be observed separately at different resolutions (levels) using a granular design (Chapter 4 discusses the research design in more detail). The research starts at the country structure level (in this case Nepal, Pakistan and Ghana) and studies the effect of various organisational attributes on planned national adaptation initiatives.

¹⁰ Examples of local planning include the Nepal and Pakistan Local Adaptation Plan of Actions (LAPAs) that build plans based on local community priorities and needs.

These attributes are broad and applicable in various ways, but do not necessarily capture lower level diversity and complexity.

Using the case of Ghana with applicability to developing countries broadly, the research takes a fine-grained analysis to study interactions of local organisations with rural communities in delivering key resources and knowledge for adaptation, and their impacts on the community structures and their capacity to adapt. The research next studies how adaptation responses move across national structures through a network of formal and informal organisations and their role in facilitating and constraining adaption. Together these three more granular levels provide a multi-organisation and multi-level analysis, with each level informing the other and thus offering an integrated view of adaptation processes as a whole.

Figure 1: The three granular levels of organisations and networks in a nested analysis



Source: Author compilation from field evidence, archival reports, secondary data

As I study these emerging and still unsettled adaptation systems, I move away from the usual prescriptive models of top-down and bottom-up adaptation and whether these structures work or not. Instead, I study how and what shapes these early structures that are characterised by a network of organisations spread across wide geographic and planning levels. The questions are not about policy outcomes but about the system's capacity to support or thwart policy intent.

Several key elements are considered in setting up this research. First, the emerging organisation and institution arrangements for adaptation are examined. There is no dominant model at this early stage and hence it is premature to comment on the validity of these emerging configurations. Rather the focus is on their appropriateness for adaptation. Second, a challenge common to most early initiatives is that framing the adaptation challenge is ambiguous and not clearly articulated at all levels. Adaptation definitions can vary, so at the policy level it may take the shape of a strategy for improved productivity while at the local level it may be taken as a specific action, such as better farming techniques that are hard to separate from conventional agricultural practices.

I study patterns in the adaptation structure that, from the outside, appear erratic and meaningless, but upon closer inspection take on organisational form to accommodate efforts to implement the government mandates. The structures and the actions may not be ideal at any particular stage of their development, especially as they are contingent on what happens elsewhere. The analysis, therefore, emphasises what is happening and not necessarily what is missing. This is also consistent with the strength-based approach advocated in the development literature (Helfgott, 2008). This grounded and processual approach dissects, analyses, and discusses the emergence of adaptation action in agriculture. In doing so the research adopts a practical empirical

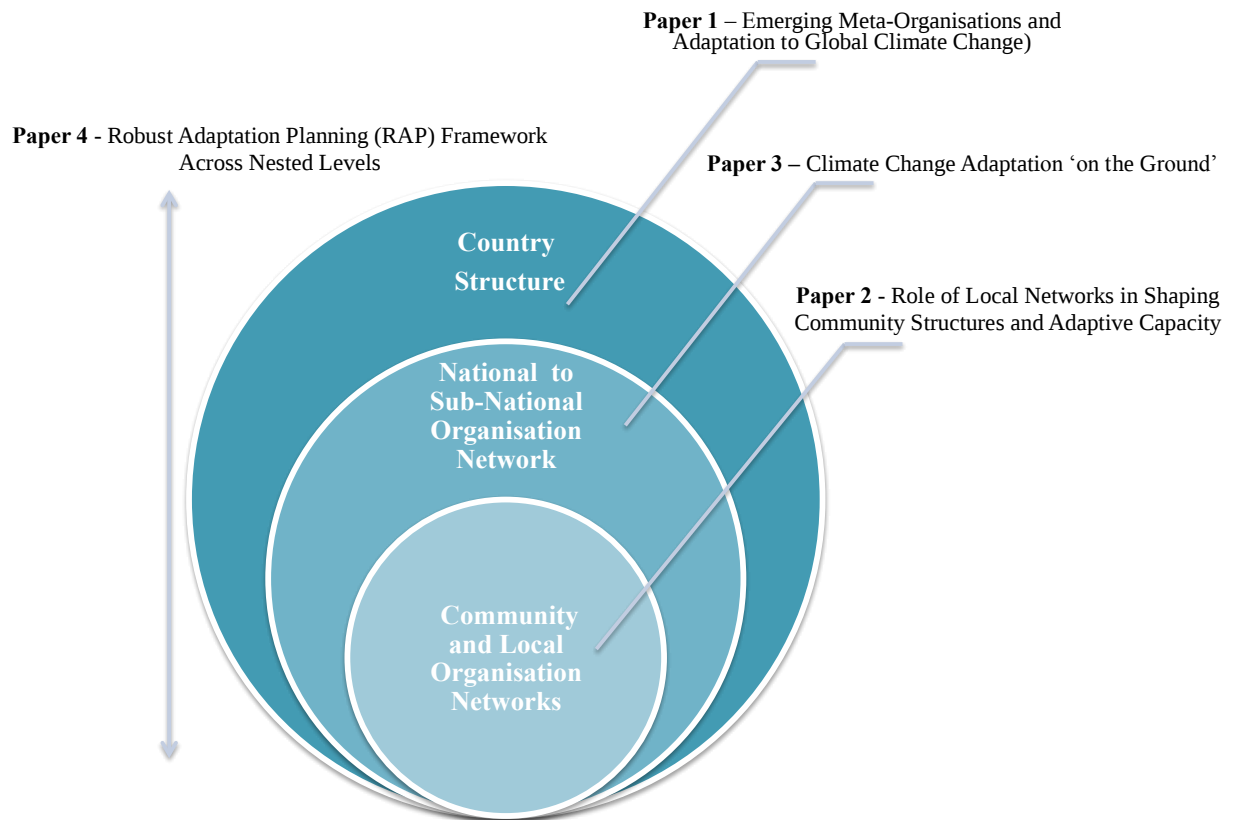
approach based on actual actions and interactions rather than those based on perceptions and assumptions.

1.3. Research Output

This thesis presents empirical results from a detailed study of agriculture adaptation in Ghana, against a backdrop of growing information about adaptation in developing countries throughout the world. It includes additional case sites in Nepal and Pakistan. The results show that the emerging capacity of the systems for adaptation is out of alignment with the requirements to address challenges posed by climate change. The relations between key organisations are asymmetric and the challenges are often articulated in ways that conflict with or thwart other capacity at national, sub-national and local levels, leading to gaps in potential action.

The core of the thesis comprises four empirical papers that have been submitted for publication to peer-reviewed academic journals. Figure 2 and Table 1 provide an overview and summary of the four papers and the link between papers, followed by the abstract of each paper. In addition to these chapters, I provide high-level overview introduction, case site introduction, literature, and methods chapters to set the context for the papers. The thesis concludes with a discussion of the findings from four papers in light of existing research, new insights, and implications.

Figure 2: The granular levels of nested analysis and output link



Source: Author compilation from field evidence, archival reports, secondary data

Paper one, chapter six, reports on a broad analysis of three countries, Nepal, Ghana and Pakistan to assess the impact of the deliberate designed operational structures for adaptation on the planned outcomes of adaptation. This wide-angle approach is a necessary first step to capture an integrated view of adaptation action at the national level, the organisations involved, their motivation and the effect of the deliberate design and the local dynamics upon the outcomes, before delving into the organisations and networks within a country. The paper refers to these operational structures as ‘meta-organisation’. Paper two, chapter seven, builds the analysis from ground level, where impacts of climate change are felt by vulnerable communities and best responded to. It maps the interactions of a rural community in Ghana with proximate local organisations, considered important for resources and knowledge

diffusion. These interactions shape the structure of the local community and inform the link between the network position and adaptive capacity of the members within the community. *Paper three, chapter eight*, then moves to the interactions of identified local organisations with sub-national and national organisations to study how adaptation is evolving across planning levels in Ghana. This paper identifies four network-derived ‘organisation-communities’ and highlights that these communities take on specific roles and activities that may not align with the formal structures set-up by the state. *Paper four, chapter nine*, takes an experimental approach that brings together organisations from across these different levels and organisation-communities in Ghana to foster a shared narrative for adaptation and develop robust plans for future adaptation. This paper develops a novel methodology, namely Robust Adaptation Planning (RAP) for collaborative multi-organisation and multi-level robust action plans for adaptation.

Collectively the four papers offer a granular and nested organisation-centred view of local to national level adaptation responses. This has a wide scope that covers local production challenges on farms to broader national food security issues. The difference from much of the current adaptation literature is this focus on critical organisational capacity, linkages, and patterns of interaction across the four network-derived organisation-communities with distinct roles in the work of adaptation. These papers share common data sources, and draw inferences from the pattern of findings that speak to the overall questions outlined, but draw from distinct theoretical and design features. The accomplishment is four stand-alone papers that together provide comprehensive insights into the frontier of work on climate change adaptation.

Table 1: Digest of four empirical papers, linkages, and relation to core thesis questions

Paper	Linkage with other Papers	Journal
1) Emerging meta-organisations and adaptation to global climate change: Evidence from implementing adaptation in Nepal, Pakistan and Ghana Broad analysis of the planning and implementation structure for adaptation of three countries – Nepal, Pakistan and Ghana. The paper refers to this arrangement as ‘meta-organisation’	From broad multi-country analysis, I narrow down to the case country of Ghana to analyse further the structure of the Ghana ‘meta-organisation’ across national to local levels Local to national level approach to understand and observe how organisational actors impact the adaptive capacity of local populations and take on roles to deliver resources and knowledge (Link to Paper 2, 3 and 4)	Global Environmental Change (Published 2016)
2) Role of local networks in shaping community structures and adaptive capacity: Evidence from rural agricultural community in Ghana Case study of impoverished Upper West Ghana (Orbili Village) to map the relationships of smallholding agricultural community with proximate local organisations. The paper examines the link between network positions of community members and their capacity to adapt	Building from on the ground analysis, I map relationships of identified local organisations from this paper to distant organisations to map the wider network of adaptation organisations. Focusing narrowly on direct relations of local communities with local organisations without understanding their broader relations, offers a partial view of the adaptation. (Link to Paper 3 and 4)	Journal of Rural Studies (Published 2017)
3) Climate Change Adaptation ‘on the Ground’: A network analysis of organisation and policy in Ghana agriculture sector Analysis of emerging implementing structures for adaptation beyond those formally designed by states. Specifically, the paper identifies organisations, their grouping in four distinct ‘organisation-communities’, and their roles and interactions with others in organising adaptation in Ghana	I broaden the analysis from the case study site of Orbili Village to the sub-national and national level organisations (Link to paper 2) The emerging structures for organising adaptation is fragmented and misaligned with the planned structures. This leads to follow up approach of bringing organisations from across Ghana and organisation-communities under a common space to bridge the organising gap (Link to Paper 4)	Academy of Management Proceedings 2016 (Published 2016)
4) Robust Adaptation Planning (RAP) Framework. Application in Ghana’s Agricultural Adaptation Regime Five-step methodology, namely Robust Adaptation Planning (RAP) proposed to develop multi-organisation and multi-level robust plans for agriculture adaptation in Ghana	I bring together organisations and local communities from across local to national levels in Ghana to collaboratively develop shared narrative for adaptation and robust action plans. The organisations and communities are identified through other papers (Link to Papers 2 and 3) The robust adaptation plans use data and ‘baseline’ networks mapped in other papers (Link to Paper 1, 2, and 3).	Sustainability Science (Published 2017)

Source: Author compilation

Paper 1: Emerging Meta-Organisations and Adaptation to Global Climate Change: Evidence from Implementing Adaptation in Nepal, Pakistan and Ghana

Journal: Global Environmental Change - Published

Abstract: *As developing countries move from policy to implementing adaptation to climate change, formal operational structures are emerging that exceed the expertise of any one actor. We refer to these arrangements as ‘meta-organisations’ that comprise many autonomous component organisations tackling adaptation. The meta-organisations set standards, define purposes, and specify appropriate means-ends criteria for delivering adaptation. Using empirical data from the three cases, Nepal, Pakistan and Ghana, the study identifies and analyses six attributes of the meta- and component organisational structures. We argue that organisational structures are crucial to understanding adaptation, specifying policy and implementation. Our analysis demonstrates that while each country promotes similar objectives, the emerging structures are quite distinct, shaped by country-specific attributes and issues that lead to different outcomes. Nepal’s priority for a formal process has come at the cost of delayed implementation. Pakistan’s devolved approach lacks legitimacy to scale up the process nationally. Ghana’s use of existing decentralised structures and budgets relegates adaptation below other development priorities. These divergent structures arise from the different needs for legitimacy and accountability, and the relative priority attached to adaptation against other needs.*

Paper 2: Ties that Bind: Local Networks, Communities and Adaptive Capacity in Rural Ghana

Journal: Journal of Rural Studies – Published

Abstract: *Current models of adaptation to climate change focus on common causes of vulnerability among individuals and communities in an attempt to improve their capacity to adapt. These models tend to neglect the impact on vulnerability of local relationships that include political and economic power structures. We use social network analysis to examine the connectivity and positions of vulnerable rural households and their capacity to adapt. We collected empirical data from a community of 58 small- holders in upper west Ghana on external relations with 'local actors' that are independent, operate beyond the community yet have direct relations with the community. These connections provide important resources and knowledge to build adaptive capacity that would not be generated from within the community. Our results highlight that certain external relations expose households to knowledge and other forms of capital, which in turn strengthen their ability to access and mobilise resources to respond to environmental change. However, not all external relations offer equal opportunities, which results in a stratified community and variation in the households' capacity to adapt. The network approach also identifies points where local actors can link communities and households to remote agencies crucial for planning and implementing effective adaptation.*

Paper 3: Climate Change Adaptation ‘on the Ground’: A Network Analysis of Organisation and Policy in Ghana Agriculture Sector

Journal: Academy of Management Proceedings, 2016 – Published

Abstract: *Governments in many developing countries use formal state structures to plan and implement adaptation. These agencies are bureaucratic, hierarchical, and assume symmetry of information and seamless cooperation. However, they overlook the many organisations that operate at the periphery but are crucial for successful adaptation. This paper uses network analysis to identify four ‘organisational-communities’ within the Ghana climate change adaptation regime and to examine their role in facilitating or constraining adaptation responses. These organisation-communities are diverse, yet exhibit common properties and perform specific roles within adaptation. We identify and classify these four communities as: ‘Agriculture Policy Incumbents’, ‘Climate Change Specialists’, ‘Arbiters and ‘Locals. Our results clearly demonstrate that state structures alone are ill suited to implementing adaptation. Understanding how these organisation-communities operate, what roles they play, how they are composed, and how they interact with others offers a better understanding of how adaptation regimes can progress in Ghana as well as other developing countries.*

Paper 4 – Robust Adaptation Planning (RAP) Framework: Applications in Ghana’s Agricultural Adaptation Regime

Journal: Sustainability Science –Published

Abstract: *In this paper we introduce a five-step framework, namely Robust Adaptation Planning (RAP), to plan and respond to the ‘grand challenge’ of climate change. RAP combines elements from robust action, participatory planning and network theory to capture the different motives, perception and roles of organisations important for adaptation under a unified framework. RAP leverages existing structures and networks and involves diverse organisations to plan, sequence and time strategies across multiple levels. Organisations identify adaptation interventions and important relations to develop wide networks, highlighting potential pathways for connecting action from central policy to local implementation and vice versa. Comparing these proposed participatory structures with the actual structures on ground reveals organisations deemed important for delivering adaptation, and gaps and overlaps in their relations. The result is a robust plan covering many perspectives and local realities for both immediate relief and adapting to the longer-term consequences of climate change. We piloted the RAP framework in Ghana’s agricultural adaptation regime to demonstrate its usefulness as a means of planning adaptation in a climate vulnerable multi-organisation and multi-level setting. The RAP application highlights three important elements for robust adaptation planning – 1) visualising the adaptation space and its constitutive elements and processes makes legible the complexity of adaptation responses; 2) offering shared space to organisations from all levels to think helps create collective narratives for adaptation without demanding explicit consensus and; 3) collaborative planning, as a process, identifies key organisations and actions to allocate responsibility for smooth delivery. This participatory and multi-level application for planning and implementing adaptation makes the RAP framework novel and innovative, and is a major contribution of this research.*

1.4. Research Contribution and Use

The research contributes to two streams focused on complex social-environmental systems. The first is the practical aspect of setting up operational structures for implementing adaptation in agriculture. This stream is important for policy makers, planners, practitioners and others interested in implementing adaptation action across a whole country. The research provides the first ever three cross-country comparison of meta-organisation architectures for climate adaptation. This is part of the motivation for the overall CGIAR research programme spanning multiple countries to allow for comparison, synthesis, and generalizable learning (CCAFS, 2015). Thus, by studying adaptation initiatives across three countries of Nepal, Pakistan and Ghana, followed with a detailed view of Ghana, this research offers empirically based critical insights on the emerging organisational architectures for adaptation in developing countries. The research improves the understanding of operational structures in the light of different national dynamics and highlights institutional factors that shape and influence the organisational designs. It further identifies key organisations and their roles, thus offering valuable insights about organising adaptation. It also identifies points within the adaptation network to direct resources and knowledge where these are needed most and will be most effective for robust action. This research contributes to the broader global agenda on adaptation under the Paris Agreement 2015. This includes identifying and strengthening local organisations and networks focused on adaptation in developing countries, leading to improved regional cooperation.

The second stream makes specific theoretical contributions to climate change adaptation, organisation theory, and network analysis in social and management sciences. The research highlights the links between adaptive capacity measures and networks, thus framing vulnerability in terms of weak, fractured or missing relations

and networks. It develops the network approach to provide an alternative to traditional and hierarchical state planning structures with organisations operating as distinct communities and their roles in organising adaptation. Policy and planning through the formal state structures tends to oversimplify the underlying complexity of adaptation and the many organisations required to deliver robust adaptation, each with its own structures and entailments.

In practice organising adaptation is not linear, but is an iterative process of multiple feedbacks and learning loops. Focusing solely on planned state levels offers only a partial view of the reality and actions required. Using network analysis, the research identifies previously unknown central and bridging organisations crucial to adaptation, which would be missed by conventional adaptation policy analysis. The study delves into organisation theory and applies established organisational concepts to offer structured analysis to an otherwise apparently unstructured assemblage of organisations, thus introducing the concepts of ‘meta-organisation’ and ‘organisation-communities’. This theoretical contribution should be useful to practitioners, policy makers and academics alike as it bases the adaptation implementation process on credible theoretical foundations.

Finally, a major and novel contribution of this research is its inclusive, integrated approach that applies three distinct and relatively independent literatures of climate change adaptation, organisation theory and network analysis. The research uses empirical data and concepts from three bodies of work to develop original analytical and methodological frameworks to study the emergent and complex field of adapting to climate change. The research identifies key organisations, develops first mapping of organisation in multi-organisation and multi-level settings in Ghana. The research also

develops practical methodological and analytical tools for studying adaptation across many scenarios.

Along with the four journal papers, outputs from the research have been disseminated widely through working papers, presentations at local and international conferences, workshops, and blogs. This process has yielded valuable feedback and comments, helping improve the research design, methodology and outputs. Further applications and implications of this research programme and its findings are discussed in the conclusion.

1.5. Structure of Thesis

After introducing the research, the thesis presents the main research site in Ghana (Chapter two), the importance of agriculture and its vulnerability to climate change and the formal structures for organising adaptation in Ghana. Next the research literature foundation to organising adaptation to climate change is introduced (Chapter three). The research foundation is based on the nexus of adaptation, organisation and network disciplines. It discusses the challenges and different governance approaches to adaptation and contrasts these with approaches in organisation theory. The methodology, data collection, and analytical methods applied in this research are detailed next (Chapter four). The summary and four empirical papers that constitute the main results and analysis section are then presented (Chapters five, six, seven, eight and nine). The thesis concludes with discussion of the core and general insights on organising adaptation (Chapter ten). Supplementary data and notes are presented as appendices in support of the main content.

2. AGRICULTURE ADAPTATION TO CLIMATE CHANGE IN GHANA

“In the agricultural sector the issue of climate change is very prominent but the capacity within the sector to deal with it is limited”

Official, Ministry of Food and Agriculture (Interview, Ghana 2013)

“In agriculture, we have a problem with translating policy into action. Although our structures are there, the movement from the policy level to the local level is slow.”

Traditional Authority, (Interview, Ghana 2014)

2.1. Introduction

In this chapter I introduce the current state of agriculture adaptation and organisational structures in the primary research site in Ghana. Although I present some empirical findings from Pakistan and Nepal in this thesis (in Paper one), my research primarily focuses on Ghana, where I conducted most of the fieldwork. Ghana offered a suitable setting for the field research for several reasons. First, the country is ranked highly vulnerable to climate change, and is confronted by increasingly variable rains, floods and droughts, threatening livelihoods and food security (McSweeney et al., 2010a, Maple Croft, 2011). Second, Ghana is a developing country interested in adaptation and has taken several policy and strategy actions in agriculture including formulating policies, institutions, budgets, and laws (Government of Ghana, 2015b). Third, the country has a fairly dense operational environment for adaptation, with multiple organisations pursuing climate change adaptation activities throughout the country. Combined, these factors presented a relevant and excellent opportunity to study the characteristics of adaptation in an emerging, active, multi-organisation and multi-level setting.

2.2. Agriculture and Climate Change

Agriculture occupies roughly 40 to 50% of the earth's land surface and is the single largest source of income and jobs for poor rural households in the developing world (FAO, 2012). Nearly 500 million small farms worldwide, most still rain fed, provide up to 80% of food consumed in most of the developing world (UN, 2012). The sector is not only highly sensitive to the consequences of climate change and extreme events (Howden et al., 2007, Anwar et al., 2012, Battisti and Naylor, 2009, Tai et al., 2014) but is also major contributor to global warming through rapid changes in land use and deforestation (Foley et al., 2011). Higher temperatures reduce crop yields and changes in precipitation patterns increase the likelihood of crop failures and long-run declines in production (Nelson et al., 2009, Battisti and Naylor, 2009). The African continent in particular is already affected by climate change and future impacts are expected to be substantial (IPCC, 2014a). Reliance on natural resources, limited ability to adapt financially and institutionally, low per capita Gross Domestic Product (GDP), poverty, and a lack of safety nets mean that the challenges for development are considerable, particularly for the agricultural systems (Schlenker and Lobell, 2010). Although moderate warming may benefit some crops in the temperate regions in the first part of the century, further warming in the second part will likely reduce yields in all regions (Tubiello and Rosenzweig, 2008). This will probably threaten global food security and push millions into poverty (Nelson et al., 2009, Nelson et al., 2010, Hertel and Rosch, 2010). Consequently adaptation to climate change by the agriculture sector, especially smallholders, is a urgent priority for governments in Africa and the developing world (FAO, 2012), and is the focus of this research.

2.3. Ghana and Agricultural Adaptation

Ghana is a middle-income country with a population of 27.4 million and gross domestic product (GDP) of \$38 billion in 2015¹¹. It has enjoyed over 55 years of independence from colonial rule, and over two decades of stable democracy with free and open elections. This has produced steady and consistent economic growth, with the size of the economy expanding by nearly 97% since 1960 (Government of Ghana, 2015b). Ghana's main exports are commodities and natural resources, including precious minerals, cocoa, timber, and recently, oil and gas.

Agriculture remains key to Ghana's social, economic, and development ambitions (Government of Ghana, 2014). Although, the overall contribution of agriculture to GDP has declined steadily over recent years (Molini and Paci, 2015), it continues to be the largest sector contributing on average 40-45% to the GDP and employing roughly 45% of the labour force, dominated by women (Molini and Paci, 2015, Government of Ghana, 2014). Over 70% of the land in Ghana is used for agriculture, mostly by small-scale producers, with 90% of farm holdings at less than 2 hectares (Government of Ghana, 2015b). These small farmers are made up of some 2.74 million households that produce 80% of the country's total agricultural output with little or no modern technology. Nearly 60% of these households mono crop i.e. one crop on a farm and about 23% intercrop (planting more than two crops on a field) (Government of Ghana, 2012). Other than providing food security, agriculture is important employment, generates foreign exchange, reduces poverty, and buffers economic shocks. The decline in agricultural share of overall GDP is partly due to compositional change, e.g., growth in competing industries, like timber, mining and an emerging oil industry, coupled with

¹¹ World Bank Country Profile - <http://data.worldbank.org/country/ghana>

decline in yields of most crops for a variety of reasons. These include lack of new technology, poor infrastructure, soil degradation, reliance on rain for irrigation, variable rainfall that generally decreases from south to north, poor marketing, little funding, poor services and high illiteracy to name a few (Government of Ghana, 2007, Government of Ghana, 2010).

Increasingly, and of direct relevance for this research, Ghana is facing significant climatic extremes and variability that have resulted in periods of severe drought, low crop yields, loss of livestock and food shortage (Government of Ghana 2010). The mean temperature across the country has increased by 1°C in the past 30 years with a projected rise in Ghana's northern regions of between 1.7 °C and 2.04 °C by the year 2030 (Government of Ghana, 2015b). Changes in rainfall and increased temperatures are likely to bring considerable challenges to agriculture, particularly in northern Ghana (Wossen et al., 2014, Sarpong and Anyidoho, 2012) that is already at risk from an unforgiving climate (Boko et al., 2007, Hulme et al., 2001). The harsh consequences of climate change, coupled with low socioeconomic factors and pervasive poverty, limit the economic development of rural communities, especially in remote areas (Government of Ghana 2010). These growing difficulties comprise the challenge of climate change adaptation in Ghana.

2.4. Policy and Institutions for Agricultural Adaptation in Ghana

Over the past few years, agriculture has become central to the development and climate change policy discussion in Ghana because of its significance to the economy and sensitivity to changing climate. The government has set an ambitious target of 6% growth and 10% allocation of its national budgets to agriculture as part of its

commitment to the Comprehensive Africa Agriculture Development Programme (CAADP)¹². The aims are to modernise, secure food, generate employment, and focus investments to address constraints on productivity, market access, climatic challenges, sustainability and institutional coordination. Implementing these goals is planned through the existing administrative and institutional planning framework with the focal ministries and regional departments playing an important role. The government intends to meet the costs from domestic and international sources.

While setting targets for agricultural growth, the country has also seen a proliferation of policies, strategies and programmes focused on climate change targeting agriculture. These cover the National Climate Change Policy (NCCP), National Climate Change Adaptation Strategy (NCCAS), Ghana Goes Green, Climate Change Implementation Strategy under NCCP and other private projects such as Adaptation Learning Project, to name a few (NCCAS, 2012, MESTI, 2013). In the past there was little interaction among organisations central to agriculture and climate change adaptation. Even within the government, its numerous agencies worked in relative isolation and often competed for funds and resources for projects. The National Climate Change Policy (NCCP), which was officially launched by the President of Ghana in 2014, provides policy guidance on climate change and more recently has followed it up with an implementation strategy proposing good coordination among the various official agencies. The NCCP outlines a multi-sector adaptation strategy, divided into ten principal working programmes that include agriculture. The goal of the strategy is to increase the country's resilience to present and future effects of climate change by

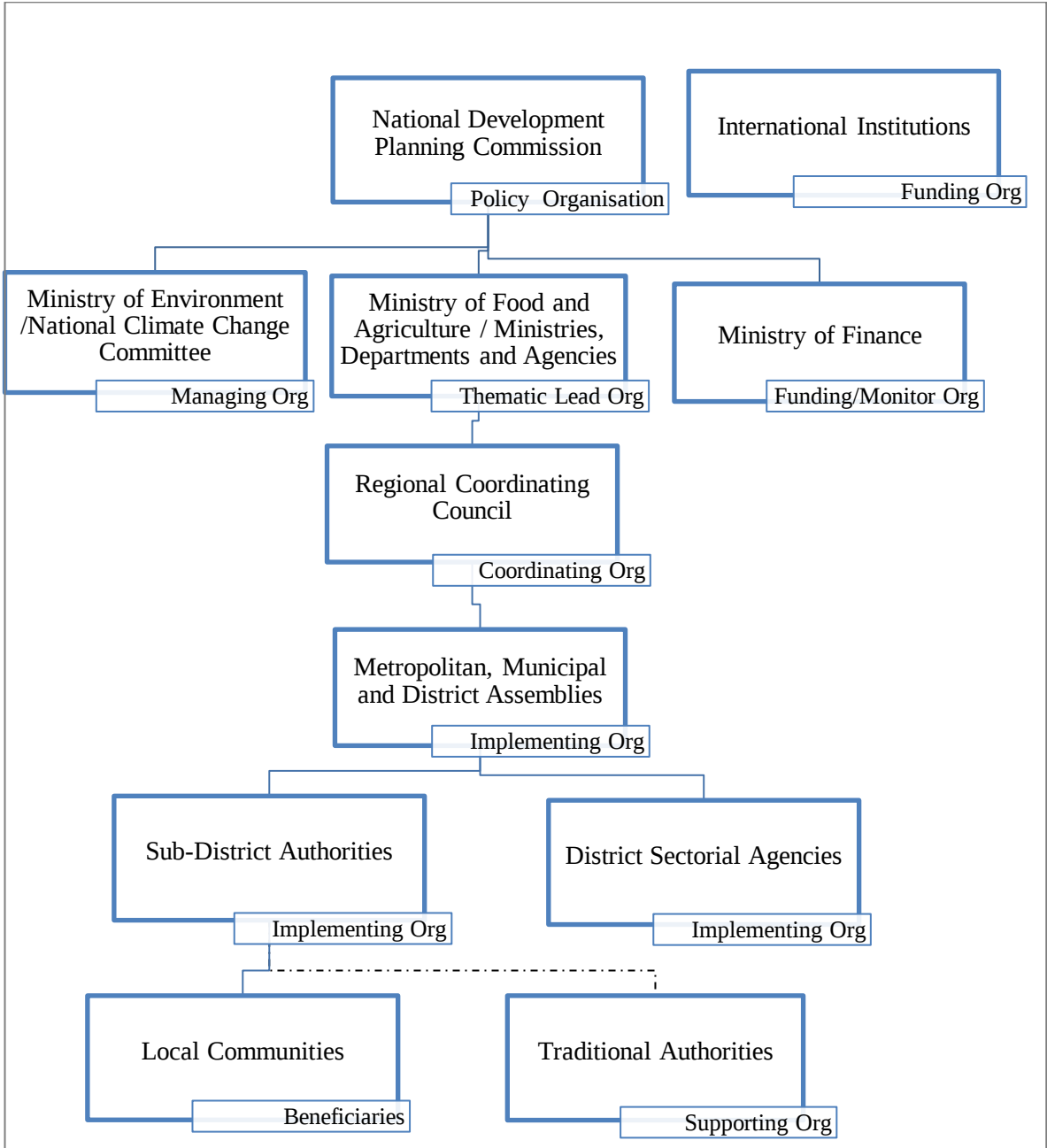
¹² The commitment, also known as the 'Maputo Declaration Target', rallied African governments to increase spending in the sector to stimulate agricultural growth, reduce poverty, and build food and nutrition security. <http://www.nepad.org/resource/au-2003-maputo-declaration-agriculture-and-food-security>

enhancing infrastructure and knowledge, and to reduce vulnerability in key areas, ecosystems, districts and regions. In 2015, the Ghanaian government issued its intended nationally determined contribution (INDC) and accompanying explanatory note (Government of Ghana, 2015a) under the Paris Agreement. Under the INDC, the country's long-term adaptation goal is to increase climate resilience and decrease vulnerability from enhanced sustainable development. This is envisioned through good governance, inter-sectoral coordination, capacity-building, the roles of science, technology and innovation, adequate finance from domestic and international sources, communication and monitoring and evaluation.

Figure 3 illustrates the formal administrative structure for implementing adaptation outlined by the official policy documents and development structures. The Ministry of Environment, Science, Technology and Innovation (MESTI) and the National Climate Change Committee (NCCC) jointly manage adaptation centrally, with the latter charged with day-to-day operation. However, the NCCC has not met since 2012, creating a vacuum in coordination and implementation. The Ministry of Food and Agriculture (MOFA) is the lead ministry responsible for policy and planning for agriculture. Agriculture encompasses activities of several other Ministries, Departments and Agencies (MDAs) as well as many non-governmental organisations (NGOs) and the private sector, so these organisations also play an important role in adaptation. The autonomous Metropolitan, Municipal and District Assemblies (MMDAs), the lowest unit of administrative governance, assisted by decentralised agencies, assume local responsibility for NCCP development and implementation, based on priorities that emerge from the sub-district authorities. The Ministry of Local Government and Rural Development (MLGRD) supports the decentralised administration with coordination from the Regional Coordinating Council (RCC). The National Development Planning

Commission (NDPC) and the Ministry of Finance (MoF) provide detailed planning and budget guidelines to the relevant MDAs and MMDAs for prioritising adaptation within the national development structures. Funding support is sought from international institutions and local treasury. Traditional authorities play a supporting role, as these are generally under resourced and marginalised in the official structures (hence shown with dotted line).

Figure 3: Ghana’s administrative structure for planning and implementing adaptation



Source: Government of Ghana (2015b), MESTI (2013) and author compilation

Ghana has focused on government decentralisation since early 1988, formalised in Article 240 (1) of the Fourth Republican Constitution (1992), which provides that “Ghana shall have a system of local government and administration which shall, as far as practicable, be decentralised.” Of all prevailing factors, this decentralisation offers the greatest challenge and opportunity for Ghana’s climate change adaptation programme. Given the diversity of Ghana’s environment and weather, local planning offers the specific opportunities required to protect rural livelihoods successfully in the face of climate change. This outcome, however, depends on the effectiveness of decentralisation and particularly fiscal decentralisation. Official development initiatives are coordinated by the MMDA’s supported by traditional system of governance. The 1992 Constitution of Ghana guaranteed the establishment of the institution of chieftaincy together with its traditional councils. The chief of the village serves as the traditional head of the community and spiritual leader. A District Chief Executive (DCE), appointed by the Office of the President and approved by the District Assembly, is responsible for administering development funding and priorities identified by the Assembly.

This local government system is a form of partnership between formal government organisations, the chiefs and their people. There are, however, considerable local, political, administrative and coordination challenges. The DCE is a central appointment, whereas the chief is a non-appointed spiritual leader, which often results in a lack of engagement between the two. Ghana’s new budget has, in theory, fortified the MMDAs central planning and coordination role by transferring funds directly through the MMDAs for distribution to agencies under their purview. Yet significant delays in the release of central funds to the MMDAs and the limited capacity of MMDAs to generate funds locally (because of low income and development baselines)

have reduced confidence in the whole system. Despite these challenges and gaps, government organisations still play a central role in organising adaptation. The planned efforts along the formal structures offer an interesting opportunity to study how adaptation is moving from policy to implementation. This decentralised structure allows adaptation to be studied at different levels from community up to national using the nested and granular research approach discussed in Chapter Four - Research Design, Methodology and Methods.

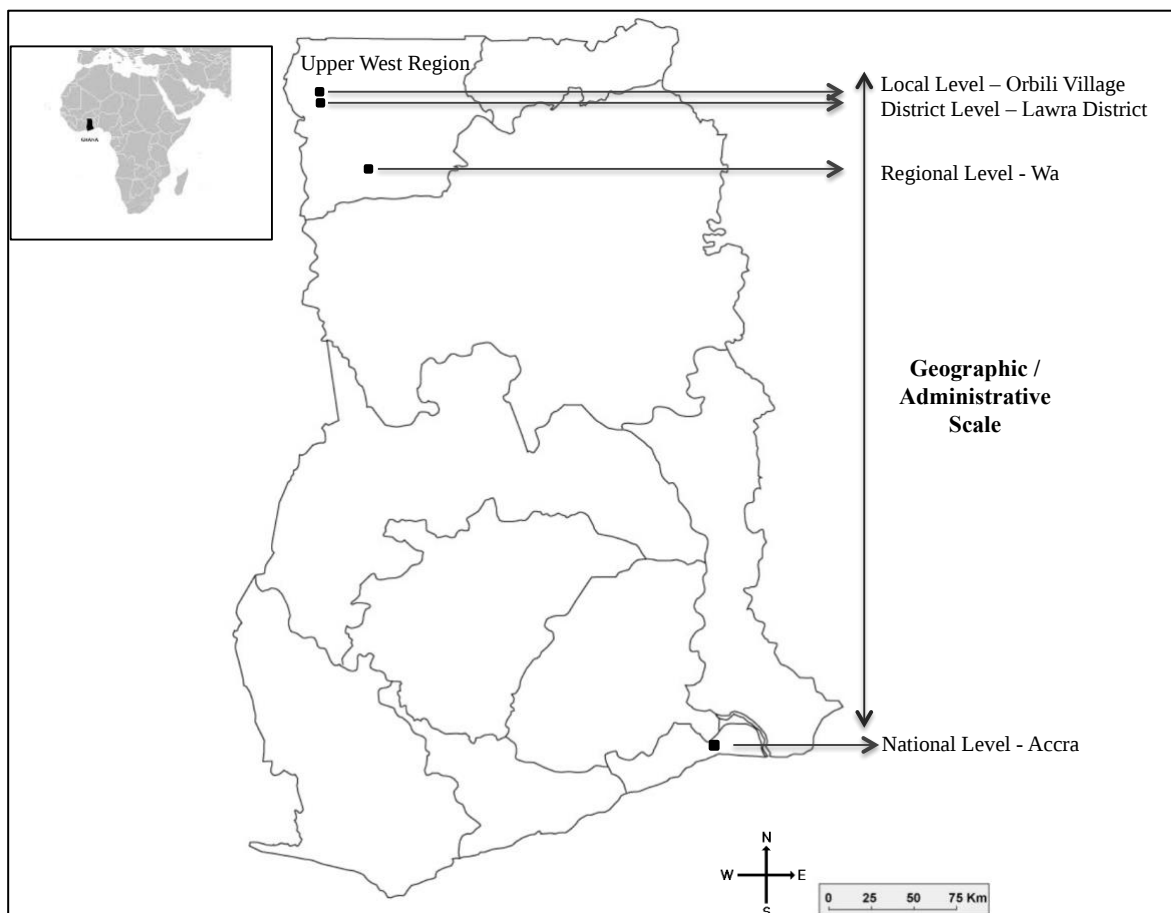
2.5. Research Setting in Ghana

Figure 4 shows the formal/geographic scale in Ghana, spread across the local, district, regional, and national levels, mapped from a focal community. The fieldwork started at local level in Orbili Village in the District of Lawra, Upper West Region of Ghana. The research then moved along the district, regional and national levels to provide a comprehensive multi-organisation and multi-level analysis. By building the analysis from a focal area, I studied adaptation across multiple levels while maintaining direct links and observations to the focal vulnerable community. This linked approach focuses on the broader adaptation structure but is grounded in local realities and challenges.

The region of upper west Ghana was identified as the focus as it was considered to have the lowest adaptive capacity in the country because of low socioeconomic development and total reliance on rain-fed farming (Antwi-Agyei et al., 2012). Several environmental and climatic conditions make the region particularly challenging for farming. Firstly, the rainfall pattern in the north is uni-modal (one rainy season, while the south has two or three rainy seasons) with a short growing season. Most farmers use

manual labour that severely limits production, yield, income and food security. Within the Upper West Region, Lawra District was selected because it is home to several CCAFS baseline sites (Naab JB et al., 2011). Eight possible villages were shortlisted by the SIA research team from within the CCAFS baseline sites. The team visited each village in the first weeks of the field research to evaluate 1) community desire to have researchers present, 2) transportation/logistical considerations, 3) size and social dynamics of the village (a representative population), and 4) livelihoods and production patterns reflective of those in the region.

Figure 4: Map of Ghana across administrative scale – Orbili in Upper West Region



Source: Original Ghana map from: www.mapsoftheworld.com

Orbili Village, located in the district of Lawra, Upper West region of Ghana with a population of 156 adults from 58 households living in 25 extended family houses, was considered a representative community for the research. According to the official district records¹³, Lawra district has 120 villages with an average size of 54 households and a median of 43 households. Orbili village is, therefore, an average village in Lawra and was accordingly chosen for this study based on the team's evaluation criteria. The Orbili community is ethnically and linguistically homogeneous and all residents are smallholders, with few having formal employment. No family farms are sufficiently productive to avoid coping strategies to last the long lean dry season when their grain stores run empty. Figure 5 shows the location of the village next to the Black Volta River that divides Ghana from Burkina Faso. The river enables the community to engage in hand tilled, irrigated dry season vegetable gardens along the riverside. Produce is then sold over 3-4 months of the dry season, at weekly markets. Research surveys and workshops identified many climate stressors such as variable rainfall and soil degradation. The proximity of Orbili to the district capital, Lawra city, offers ample opportunities for villagers to forge relations with formal and informal local organisations to improve agriculture. Existing baseline data on the area allowed triangulation of data to supplement the analysis (Naab JB et al., 2011). Box 1 presents the profile of an average household in Orbili.

¹³ Data on village households in Lawra District were provided by the officials at the Lawra District Assembly

Figure 5: Map of Orbili village, next to Black Volta River in Lawra District



Source: Google map and author contribution

Box 1: Profile of average household in Orbili

The average¹⁴ household is headed is a male farmer (women in very few cases), aged early forties with no formal education. The household owns approximately seven acres of land used for rain-fed farming and has a gardening area on the banks of Black Volta River for growing vegetables in the dry season from December to March. To supplement the household income, the head engages in three or more income generation schemes of farming, dry season gardening, livestock rearing, charcoal trading, contract employment and more formal employment. The main challenges faced are unpredictable rains, lack of machinery and fertiliser shortage. But there are other common challenges of poor soil fertility, high winds, lack of seeds and funding. To overcome these challenges the household focuses on land improvements and crop management activities. Most of these improvements are self-funded with limited support from community organisations, district agriculture department, NGOs and input dealers. The household is aware of climate change through community discussions but has also experienced it first hand through changes in rain patterns and increased wind speeds.

Source: Author primary survey data of households in Orbili (n= 56)

¹⁴ Average profile based on top 2-3 answers or identified by over 50% household heads in Orbili

2.6. Conclusion

The choice of Ghana is important for this research as the country is interested in adaptation and has active policy, institutional, and organisational environments for agriculture and its adaptation to climate change. Despite the recent attention, adaptation efforts are still at an early stage in Ghana and developing countries in general. This offers a unique opportunity to study a field that is emerging in a multi-organisation and multi-level setting, to yield valuable lessons for the future. While the rationale and designs for organising adaptation are relevant, it is important to recognise that policies and actions are also influenced by other agendas, interests and motivations of the various organisations involved (Stone, 1989). However, most policy plans tend to underemphasise or ignore the importance of organisations and their roles in changing agriculture. This research highlights the importance of these organisational arrangements for delivering climate adaptation. By studying adaptation from top to bottom in a case country, the insights gained, and the analysis developed results from empirical data and real insights rather than those based on perceptions.

3. RESEARCH LITERATURE FOUNDATIONS FOR ORGANISING ADAPTATION

“We have to build networks instead of pyramids”.

Colin Ward, 2008, *Anarchy in Action*

“The main problem we have in Ghana is not the lack of ideas, but the implementation of ideas and the coordination of the various ideas in to one basket for effective, efficient and smooth implementation.”

Civil Society Organisation (Interview, Ghana 2013)

3.1. Introduction

This chapter develops an organisation-centred approach and uses network analysis to frame the study of agriculture adaptation efforts across Ghana and developing countries generally. This involves many organisations operating across multiple planning levels. The theoretical foundations are outlined in the framing enquiry on organising adaptation efforts, namely how policy goals arise in organisational terms. This includes detailing the organisational architectures of early policy efforts, how current ideas about implementation are linked to organisational arrangements, and finally how these arrangements are implemented in practice. Studying how adaptation is organised spans micro interactions of rural communities with local organisations to wider interactions among those across national structures.

This chapter serves as a selective literature review covering climate change adaptation, organisation theory, and network analysis to highlight opportunities and resources for research from these disciplines. The four papers in the results chapters also present brief, more focused theoretical foundations and literature reviews in

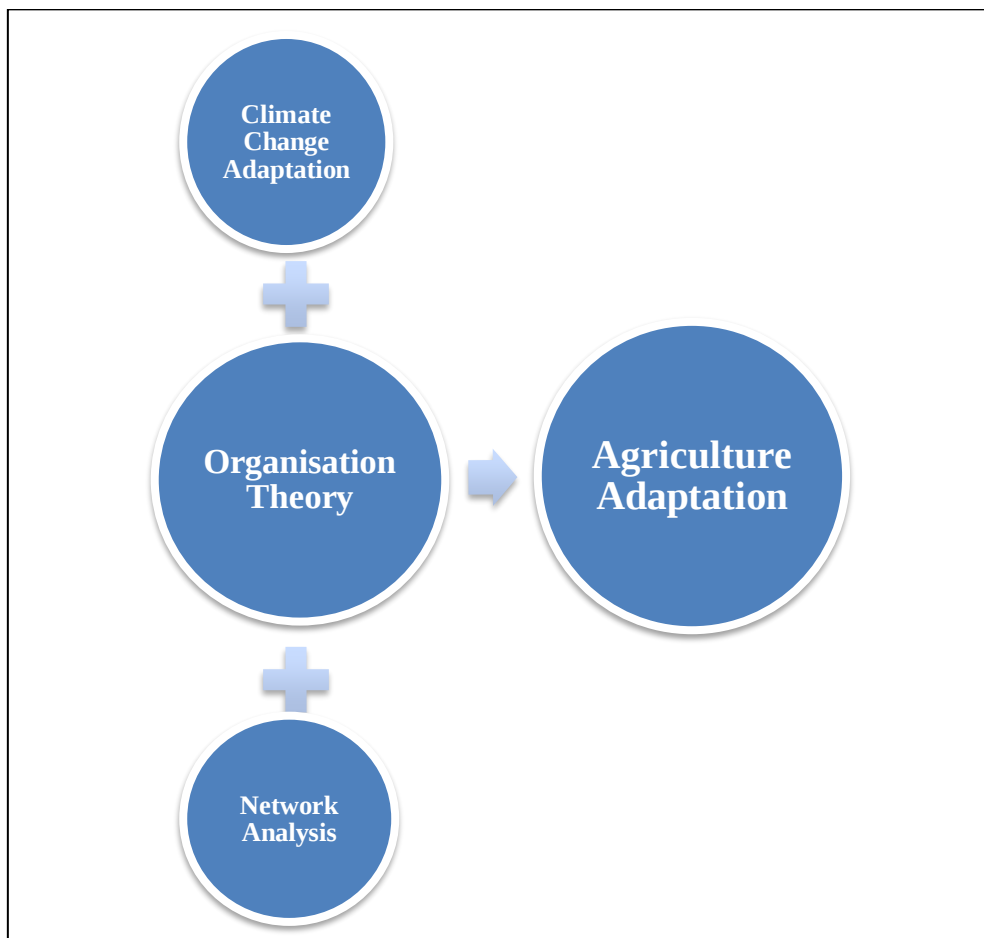
support of specific arguments and results. As these three literatures are mature and well established, I focus on that which is essential to the project.

3.2. Three Literature Perspective for Organising Agriculture Adaptation

This starts with the core strengths of the current literature on climate change adaptation. I compare and contrast the foundation assumptions and approaches in this literature with work in organisation theory and network analysis. Figure 6 reviews the distinctive vantage points, in order to highlight the use of these three literatures in concert and understand afresh the emerging organisation of adaptation in Ghana. The climate change adaptation literature emphasises the complexity and connectedness between human and biological systems in adapting to a changing climate (Smit and Pilifosova, 2003, Adger et al., 2003, Adger et al., 2005, Folke et al., 2005). However, approaches for organising adaptation are new and rudimentary, too often added as a part of the solutions rather than as part of thorough-going analysis (Huiteima et al., 2016). Organisation theory studies how structures and actions are put together to achieve planned objectives, confronted by external environments, interdependencies and resource constraints (Lawrence, 1967, Pugh et al., 1969, Blau and Schoenherr, 1971, Child, 1972, Mintzberg, 1979, Dawson, 1996, Jones, 2004, Daft et al., 2010, Bolman and Deal, 2013, Tsoukas and Knudsen, 2005). The focus is on the actions of organisations and their objectives, in complex institutional and resource contexts, but not necessarily on the wider linkages among the organisations. Network analysis helps expand the adaptation and organisation perspective beyond a unitary state to a constellation of organisations. This work identifies the broader set of institutional and other ties present in a distributed field of organisations, making it possible both to assess embeddedness and its impacts, and also to inform policy and practice to improve

capacity of the system (Marsden, 1990, Hoffman and Ventresca, 2002, Scott and Davis, 2007, Scott, 2013, Ibarra and Andrews, 1993, Wasserman, 1994, Borgatti and Everett, 1997, Hanneman and Riddle, 2005, Borgatti et al., 2009, Scott and Carrington, 2011). Used judiciously and in innovative ways, the three literatures offer a deeper analysis of adaptation.

Figure 6: Three literatures perspective for organising agriculture adaptation



Source: Author compilation

3.3. Climate Change Adaptation

Adaptation is not new, as we have been adapting to a changing climate for millennia. The urgency of the present situation is the scale and speed of change induced by human activity combined with the size of the human population. The widely-cited United Nation's Intergovernmental Panel for Climate Change (IPCC) definition of adaptation is an "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (Smit and Pilifosova, 2001). Simply put, adaptation refers to all actions that can be taken to offset or reduce the negative consequences of climate change. Over the last two decades, adaptation has gained greater prominence in global and national discourse, against the backdrop of a warming planet (IPCC, 2014d). This increased attention is matched with a plethora of research on adaptation, with debates about definitions, science, measurement, funding, policy, and governance (Moore, 2012, Adger et al., 2003, IPCC, 2014d, Parry et al., 2009, Dovers, 2009).

This research has several relevant features. The studies of adaptation point to three key dimensions: Adaptation can be reactionary or anticipatory, planned or autonomous, and hard or soft (Fankhauser et al., 1999). Reactive adaptation measures are likely responses after the impact of climate change, whereas anticipatory adaptation is planned to counter the climate threat (Smith, 1997). Effective anticipatory measures, however, need divergent perspectives of organisations involved in adaptation that also respect local priorities (Chaudhury et al., 2016a, Boyle and Dowlatabadi, 2011). Autonomous adaptation is reactive actions taken by people without planning explicitly to address climate change (IPCC, 2014b). Planned adaptation on the other hand, requires conscious intervention and typically constitutes a response by the state resulting from a deliberate policy decision (Fankhauser et al., 1999). Finally, hard

adaptation measures involve capital intensive technology and infrastructure, whereas soft measures prioritise community control, learning and natural capital (Sovacool, 2011). Adaptation responses and decisions can also be categorised as measures and strategies that contribute either to building adaptive capacity (capacity of system to respond or adjust to climate change) or delivering adaptation actions (actions to reduce vulnerability or exploit opportunities to climate change)(Smit and Pilifosova, 2003).

The literature on adaptation uses research to reach general assessments about the intent, strategy, and impact of climate change adaptation efforts. They do not typically provide more granular analyses of the organisational systems and capacities that accomplish this. The focus is more typically on legal regimes, incentive structures and policy design. In this research, I focus on anticipatory and planned adaptation building both adaptive capacity and offering responses from studying the formal national agriculture adaptation initiatives. Although planned measures also impact reactionary and autonomous responses (Fankhauser et al., 1999) which are important, I keep the analysis focused on the intentional but emerging initiatives. Further, as adaptation is at an early stage in the countries studied, it was not possible to observe the impacts and outcomes of the planned actions within this research period. I, therefore, focus on the responses and implementation of the measures adopted and not their eventual outcomes.

Despite significant research progress in adaptation, there is little consensus in the literature and practice on what adaptation can or should mean. (Smithers and Smit, 1997, Smit and Pilifosova, 2003, Füssel, 2007, Smit et al., 2000, Dovers, 2009). Efforts to implement adaptation face uncertain and difficult to measure outcomes, entrenched vested interests, lack of public engagement and complex environmental and social dynamics (Adger, 2016, Dovers, 2009). This ambiguity about basic definitions, indicators, and ‘what will count’ as effective is common to all complex policy fields

(Haas, 1989, Young, 2002). Adaptation measures are further constrained by complex links between social and ecological systems (Berkes and Folke, 1998) as well as human and biological activity (Thornton and Manasfi, 2010). There is also a real possibility that initiatives for adaptation might exacerbate the consequences of climate-related changes, resulting in maladaptation i.e. have undesirable and unintended outcomes (Burton, 1997, Smit et al., 2000, Magnan et al., 2016).

Adaptation is also seldom an exclusive response to climate change but also interrelated with a wider set of development deficits. (Berrang-Ford et al., 2011). Efforts to distinguish clearly adaptive from development measures are often futile but important to avoid the pitfalls of past failures while promoting positive synergies (McGray et al., 2007, Schipper, 2007, Parry et al., 2009, Lemos et al., 2007, Munasinghe, 2003). Some argue that adapting to climate change needs to be an integral part of any country's planning and funding, because the economy will eventually be damaged by ignoring the issue (Chambwera and Stage, 2010, UNDP, 2007, Ayers and Huq, 2009, Persson and Klein, 2008). Others focus on the double exposure of climate change and globalisation and argue that these two challenges must be examined together to understand their compounding and overlapping impacts on vulnerable populations (O'Brien and Leichenko, 2000, Leichenko and O'Brien, 2008). In fact the mantra 'good development is the best form of adaptation' traced back to Thomas Schelling (1992) is often used in global programmes (Fankhauser, 2010) to create enthusiasm for climate compatible development or climate-smart agriculture (FAO, 2013, Mitchell and Maxwell, 2010, Lipper et al., 2014). Building on existing development structures may avoid duplication but faces challenges of power, politics and corruption (Mosse, 2004, Ferguson, 1990). There is also greater official and research attention at community levels, where most impacts of climate change are

experienced and best addressed (Ostrom, 2010b). Social capital studies offer ways of understanding the role of social attributes of individuals and collectives in building their adaptive capacity to respond to the threats of climate change (Pelling and High, 2005, Pelling, 2010). Research indicates that greater social support leads to improved health, happiness and longevity that in turn promotes improved adaptive capacity (Bulmer, 1986, Unger and Wandersman, 1985, Walker et al., 1993). This has resulted in a steady development of novel tools and methodologies for local action, such as community-based adaptation, vulnerability assessment, participatory tools, impact assessment and other novel methods (Chaudhury et al., 2016a, Füssel and Klein, 2006, Vincent, 2007, Steenwerth et al., 2014). But these often take shape and have impacts that are only loosely coupled to wider national policy initiatives (O'Brien et al., 2007). In addition, many challenges in funding remain that can compromise the best-intended initiatives.

Adaptation is also described or perceived as a big and unprecedented policy, governance and management challenge (Dovers, 2009, Schroeder, 2014). Many developing countries have formulated national climate change policies, adaptation plans, and programmes and established dedicated agencies, ministries, departments, and inter-ministerial committees to respond to the climate challenge. Some countries (e.g. Bangladesh) have established dedicated sovereign funds for adaptation, backed by expected support from global donors such as the Green Climate Fund. However, allocation of funding is not always based on rational economic arguments but political influence (Moore, 2012). Many approaches for governing and managing adaptation have emerged in research and practice, covering setting up institutions, organisations and principles to guide action (Huiteima et al., 2016). These generally suggest that one size does not fit all when it comes to designing methods of governance and management. Invariably existing institutions are considered as an impediment to

adaptation, with the solution lying in modifying or replacing these arrangements to redirect behaviour. This according to Young (2002, p.29) has resulted in “a proliferation of disparate perspectives rather than an emerging consensus concerning the casual role of institutions”.

One prominent stream of governance and management is based on rational economic principles of benefits and costs associated with individual options. Altering incentives and increasing the costs of undesirable action drives positive behaviour change. Examples of economy driven methods include the Collective Action Model (CAM) and market based techniques such as Payment of Ecosystem Services (PES) and Reducing Emissions from Deforestation and Forest Degradation (REDD+) (Redford and Adams, 2009, Gómez-Baggethun et al., 2010, Agrawal et al., 2011, Young, 2002). Another stream argues that organisations behave in ways that they consider appropriate and legitimate. Many adhere to the rules of the regime out of habit or to gain legitimacy because such behaviour is taken for granted as social norms or routines (Powell and DiMaggio, 2012). Examples include Young’s (2002) Social Practice Model (SPM) and Ostrom’s (2005) widely used Institutional Analysis and Development (IAD) framework for managing common pool resources.

Still other governance models advocate open, inclusive, integrated, and holistic approaches covering all levels of human society, such as Earth System Governance (Biermann et al., 2010) or Systems Thinking (Midgley, 2003). Similarly, the adaptive management method (Folke et al., 2005, Pahl-Wostl, 2009) encourages iteratively planning, implementing, and modifying strategies for managing resources in the face of uncertainty and change. Others take a development-centric approach to climate proof investments and incorporate adaptation planning into existing development structures (Mitchell and Maxwell, 2010, FAO, 2013, Steenwerth et al., 2014). Global institutions,

such as UNFCCC, offer guidelines and funding support to encourage governments of developing countries to set-up formal adaptation programmes and plans (e.g. NAPAs, NAPs) to meet their immediate and medium term climatic challenges (UNFCCC, 2002, UNFCCC, 2012)

In short, in 2016, adaptation to climate change as a concept remains under-specified, with many compelling and competing elements. It is also ‘in motion’, the focus of much policy and research interest. This has led to a proliferation of strong national climate policies, institutions and agencies supporting adaptation, and governance models promoting integrated and holistic approaches. Surprisingly, the adaptation literature is quite silent on the next steps for organising these initiatives to sustain impact. Many of the adaptation models require careful consideration to set-up effective implementation strategies and organisational structures that manage the objectives. For example, rational models work better if the objectives are clear but appear too rigid when actions are uncertain, as is the case with adaptation. Adaptive management approaches capture this uncertainty, but require time to mature and develop concrete organisational models. Polycentric and institutional models (Ostrom, 2005, Ostrom, 2010a, Ostrom, 2010b) promote distributed governance to match the scale of challenge and its organisation, but these models work better with well-known challenges like the management of common pool resources such as watersheds or forests. The lack of action in organising adaptation may also stem from the early stages of such initiatives in most developing countries, and lack of systematic data on adaptation actions and outcomes, difficulties in defining adaptation, and challenges in evaluating and measuring outcomes (Ford et al., 2013). Importantly adaptation literature lacks the organisational perspective to suggest the next steps. This work

explores the added value for analysis and impact from organisation theory and network analysis to study adaptation.

3.4. Organisation Theory

Organisation theory offers a useful and relevant set of concepts and tools to study adaptation, in ways that complement and extend the mainstream climate change literature. Organisation theory relates to the study of organisations and their contexts and to the patterns and methods used to solve problems and manage objectives (Jones, 2004). The field is diverse with wide perspectives and theories from role of agency and structure, culture, meaning, to balance between micro and macro views, to name a few (Tsoukas and Knudsen, 2005). This raises complexity but offers opportunities for various applications of the theory to other disciplines. Tsoukas and Knudsen (2005) offer a detailed view of the current state, debates and future outlook of organisation theory.

The term organisation is repeatedly used in everyday life and in this thesis. Hence, it is important at the outset to have a definition and understanding of organisations. Simply, they are defined as social entities that have a collective goal and a deliberate design structure to enable them to achieve their objectives (Daft et al., 2010, Jones, 2004). As stated earlier, I use the term organisation to broadly refer to actors in adaptation including government agencies, NGOs, international bureaus and private firms and so forth. To achieve their goals and objectives and create value, organisations may bring many types of resources together, promote specialisation and a clear division of labour, strive for economies of scale, manage their external environment, and exert power and control (Bolman and Deal, 2013, Daft et al., 2010, Jones, 2004).

Organisations are generally complex entities operating within a wider context and set of conditions that are linked to an external environment made up of many other organisations and actors (Daft et al., 2010). They simultaneously adapt to and shape the environment they are part of. Generally organisations seek continuity but that is not easy because of the central challenge of uncertainty (Thompson et al., 2003). Increased coordination, however, helps manage organisational complexity and uncertainty. Trying to understand what is happening within an organisation is often challenging.

The basic tenets of modern organisation theory can be traced to the rational, production, scientific, bureaucratic and economic goal functions of the late 19th / early 20th century industrial revolution (Shafritz et al., 2011, Taylor, 1914, Weber, 2009, Fayol, 1954). This resulted in concepts and tools that treated organisations as closed systems that were tightly coupled around clear technologies. This reinforced the view of firms and governments as rational, bureaucratic and hierarchical organisations that they could be controlled, shaped and moulded to accomplish given goals (Weber, 2009, Scott and Davis, 2007). More contemporary theories of organisation had increasingly focused on loosely coupled systems and tended to open systems, which recognise complex context and ‘environments’. The aspiration for rational economic efficiency is still acknowledged, but organisation theory has evolved with time from closed systems driven by rules and incentives to more open and natural systems that emphasise human relations, external factors, collective action, and interdependencies within and outside the organisations (Scott and Davis, 2007, Tsoukas and Knudsen, 2005, Katz and Kahn, 1978, Aldrich, 2008). Aldrich and Ruef (2006), for example, review six perspectives of organisations that are based in ecological, institutional, interpretive, organisational learning, resource dependence and transition cost economics approaches. This shift in perspective makes visible many new types of organisational configurations, such as

functional, knowledge, skill-based, virtual, and learning organisations (Daft et al., 2010), but they still carry elements of the rational structures.

This shift also includes more varied kinds of analytic attention to the context of organisations, what is referred to as ‘environment’. In a rapidly changing environment, forms of management and organisation that were effective a few years ago may no longer be appropriate. This is especially true for organisations operating in climate change adaptation, as they constantly have to make sense of an emergent discipline and also have to equip themselves to balance the needs of today with those of the future. There is currently no ideal structure, but what is important is finding the right fit with an organisation’s circumstances and environment (Bolman and Deal, 2013, Lawrence, 1967). A formal hierarchal structure may be appropriate for a mature manufacturing company with well-defined operations, while the same structure may constrain an evolving climate change system. In the current changing landscape, how an entity is organised can be a source of advantage or as Bolman and Deal put it “if structure is overlooked, an organisation often misdirects energy and resources” (Bolman and Deal, 2013, p66).

Current theory and practice emphasises that an organisation needs resources from its environment to survive i.e. from other organisations (Pfeffer and Salancik, 2003). This dependency on resource encourages organisations to engage actively and build exchange relations with others to reduce or control environmental uncertainty (Hillman et al., 2009). The pursuit of external resources through inter-organisational relations is common in adaptation, as resources important for success are spread widely. For example, drought resistant crops may be developed by national research institutions, but funded by international bodies and distributed by local governments. These interactions among state, non-state and global organisations have been the hallmark of

emerging adaptation programmes in most developing countries. Research also acknowledges the important role of institutions (including governance), organisations and networks in agriculture adaptation initiatives (Davidson, 2016).

This includes the way diverse organisations interact within a common framework, manage interdependency, share resources, achieve aims and objectives, and recognise pivotal points for action (Pfeffer and Salancik, 2003, Scott, 2013). A recent review of 201 peer-reviewed articles on adaptation in agriculture published in 2015 by Davidson (2016) identified notable gaps regarding the role of networks, institutions and gender. The study highlighted that while research on the social dimensions in agriculture has increased recently, the focus on networks, institutions and other actors on agri-food systems remains scant¹⁵. The literature underemphasises the behaviour, role and interdependencies of the many organisations vital for adaptation, which are best analysed using organisation and network theories (Jones, 2004, Tsoukas and Knudsen, 2005, Scott and Carrington, 2011). Managing these organisations with their diverse and often competing agendas, structures, and accompanying networks is difficult but essential.

In this thesis, I apply organisation theory from two perspectives. First, I use organisation theory to study country level adaptation initiatives. I argue that these initiatives exhibit many characteristics common to organisations such as aim, goals, and processes and a deliberate design to achieve these. However, country architects and managers do not view these initiatives as organisations and continue to manage them under the conventional policy or climate concepts. I label the initiatives as a ‘meta-organisation’ (Paper one) to benefit from an organisation perspective. While these

¹⁵ Five out of 201 articles identified consisted of networks and 25 focused on role of institutions and other actors on agri-food systems.

lenses are important to understand how adaptation is negotiated and included in policy, they do not address how adaptation policy and plans are made to work in a multi-organisation and multi-level setting. Organisation theory helps to focus on important organisational elements that shape responses such as the prevailing laws, supporting institutions, the nature of vulnerability and operational processes (Donaldson, 2001, Woodward, 1980, Hoffman and Ventresca, 1999, Hoffman and Ventresca, 2002). It is by using the organisational lens on the national initiatives that one can examine these elements and assess their importance for adaptation.

Second, many individual organisations, within the national initiative or meta-organisation structure, play an important and active role in organising adaptation (Papers two, three and four). These organisations, with their multiple interactions, create opportunities and impose constraints on adaptation action. Organisation theory sheds light on their structures, processes, and motivations and in turn helps in understanding how organisations function and operate (Daft et al., 2010, Dawson, 1996). For example, state agencies, by nature, are formal and bureaucratic, whereas NGOs are perceived as flexible and lean, relying on other organisations for support. Under organisation theory, they are resource dependent and interact with others to meet their needs. Outputs of one organisation become inputs of another, resulting in inter-organisational relations and interdependencies, such as collaboration, partnership or services (Cropper et al., 2008) This leads to different operational opportunities and challenges (Johnsen et al., 2008) for organising adaptation.

Despite rapid proliferation of new organisational forms, backed by progress in organisation theory, many developing countries continue to promote conventional state structures for implementing large societal schemes (Skocpol et al., 1999) including adaptation that are bureaucratic, rigid and mechanistic (Pugh, 1973). These structures

rely on rules and incentives to drive and coordinate action among different organisations, which are generally at odds with the emerging, flexible, interdependent and uncertain nature of adaptation and leads to misaligned outcomes. In reality the climate field has not engaged with or benefited from the advances in organisational ideas. Applying organisation theory to adaptation offers novel and fresh insights into implementation. This includes studying the structure of the initiatives and the roles of different organisations active in the field.

3.5. Comparison between Adaptation Literature and Organisation Theory

The brief comparison of adaptation literature and organisation theory in Table 2 shows that while the two literatures are distinct, they have several complementary elements and concerns. Table 2 is a first attempt at contrasting these two rich literatures that are distinct and independent. This is not exhaustive, as many other elements can be drawn out with continued research. As mentioned earlier, adaptation as a concept has matured over the last decades, but requires further consideration. Organisation theory brings many distinct elements to adaptation. Some are complementary, while others help extend adaptation beyond the science and policy realm into operations. For example, both adaptation and organisation theory emphasise interdependencies and external factors as important drivers for action. Adaptation, however, is invariably managed through state structures that use rules and processes to encourage interactions, but overlook the importance of resource dependence and transaction cost economics in organisations that encourage external interactions to reduce uncertainty and manage costs (Pfeffer and Salancik, 2003, Williamson, 1979). Resultantly, adaptation follows hierarchical structures that are generally at odds with its emergent nature. In organisation theory, this constitutes an organisation structure and objective fit

challenge. The failure of adaptation initiatives to recognise these realities often leads to misalignment and challenges in setting up effective structures.

Table 2: Comparison between adaptation and organisation theory literatures

	Adaptation Literature	Organisation Theory
Operational Logics	Rules and incentive based. Focus on internal structures of policy initiative	Open systems. Focus on external environment, meaning, logics and interdependencies
Architects	Typically managed and run by states or state agencies	Mostly private sector led, but other forms of organisations such as non-profit, government
Operational Structure	Formal, hierarchical, and bureaucratic. Typically matches the state structure	No ideal structure, but focus is to find the right fit with the organisation's objectives and circumstances.
Literature Focus	Science, policy, institutions, rules, measurement, governance, tools, metrics, interdependencies	Agency and structure, culture, meaning, learning, environment, micro and macro view, interdependencies
Characteristics	Emphasis on multi-organisation and multi-level characteristics of adaptation	Emphasis shift from closed systems (internally focused) to open system focused on human relations, organisational learning, and external environment
Drivers for Action	Climate challenge creating a sense of urgency to act – global warming, extreme events, uncertainty, variability, compliance	Organisational objectives – economic, social and environmental (triple bottom line)
Source of Interdependency	Wicked problem and grand challenge i.e. no single organisation capable of offering resources or knowledge to offer solution. Need to combine resources and knowledge by many to offer coherent solution	Resource dependency and transaction cost economics, encourages organisations to actively engage and build exchange relations with other organisations to reduce or control cost and uncertainty

Source: Author compilation

3.6. Network Analysis

I apply network analysis to capture and study the interactions of the many organisations active and operating across all levels in adaptation. Network analysis is an appropriate approach because it offers both a theoretical perspective for analysing these organisations and a methodological framework for measuring the relationships among them (Marsden, 1990). Networks are formally defined as a set of nodes (organisations in this case) that are tied by one or more types of relations (Borgatti and Lopez-Kidwell, 2011, Wasserman, 1994). Detailed network maps are created from their interactions, which are then measured applying network metrics (Wasserman, 1994, Borgatti et al., 2009). Networks facilitate access to essential resources, knowledge and relevant information otherwise unavailable to individual organisations (Granovetter, 1973, Newman and Dale, 2005, Janssen et al., 2006, Bodin et al., 2006). This helps spread effective adaptation in agriculture thus facilitating action across all levels and organisations. Network analysis helps to identify central organisations, bridges, gatekeepers, and to recognise essential skills and resources, and where they are located in the adaptation structure.

Networks offer an alternative to hierarchies (in which governing of adaptation is based on rigid structured relations) and markets (in which governing adaptation is based on autonomous supply and demand). In adaptation, networks are often seen as the force that shape, influence, and govern policies. Despite formally designed state initiatives, the wide scope of adaptation makes it difficult for the state alone to manage, design, control or run the evolving network structure. In reality most activities in the network are dependent on what other organisation do. Relations between organisations within networks are relatively flexible and less contractual or determined. Organisations cope by observing and reacting proactively to others in a network. Networks can therefore be

viewed as self-organising systems that do not necessarily need a leader or formal control. This is true in this research as adaptation initiatives designed by states (Ghana) evolve beyond the state structures, encompassing many other organisations and relations. Networks help seeing beyond the design to capture the reality.

A network approach can also be the methodological basis to detect groups of organisations (community structures) and the collective roles they play within the broader adaptation space (Newman and Girvan, 2004). Focusing on community structures and roles helps to identify the overall capabilities and resources available within the network, as opposed to pursuing narrower actions of individual organisations that make up the initiative. The network approach makes it possible to identify diverse organisations across levels and activity that in fact function in similar ways in the overall adaptation process. In a well-functioning system, the network acts as a single block and it disappears to be replaced by action (Law, 1992). Organisations have to coordinate and combine their efforts resources and knowledge effectively to offer coherent solutions, rather than uncoordinated individual efforts that may be ineffective. According to Adner (2006) most innovations don't succeed in isolation. They create new opportunities but also new dependencies and risks. These risks may be internal to the organisation, dependent on other organisations or result from integration with other solutions and processes. Network approach helps identify these risks and capture the emerging structure, which may not be obvious and clear from conventional methods.

In this thesis I make specific use of network tools and methods to identify the organisations involved and to map the interaction among them and de facto the 'communities' that facilitate and constrain adaptation action. The specific network methods used are presented in each paper and in Chapter Four - Research Design, Methodology and Methods.

Table 3 offers some important network measures used in this research to study adaptation. Measures such as network size, density, and centrality help distil the wider network of organisations into more meaningful aspects of relations and actions for organising adaptation.

Table 3: Network measures for studying adaptation action

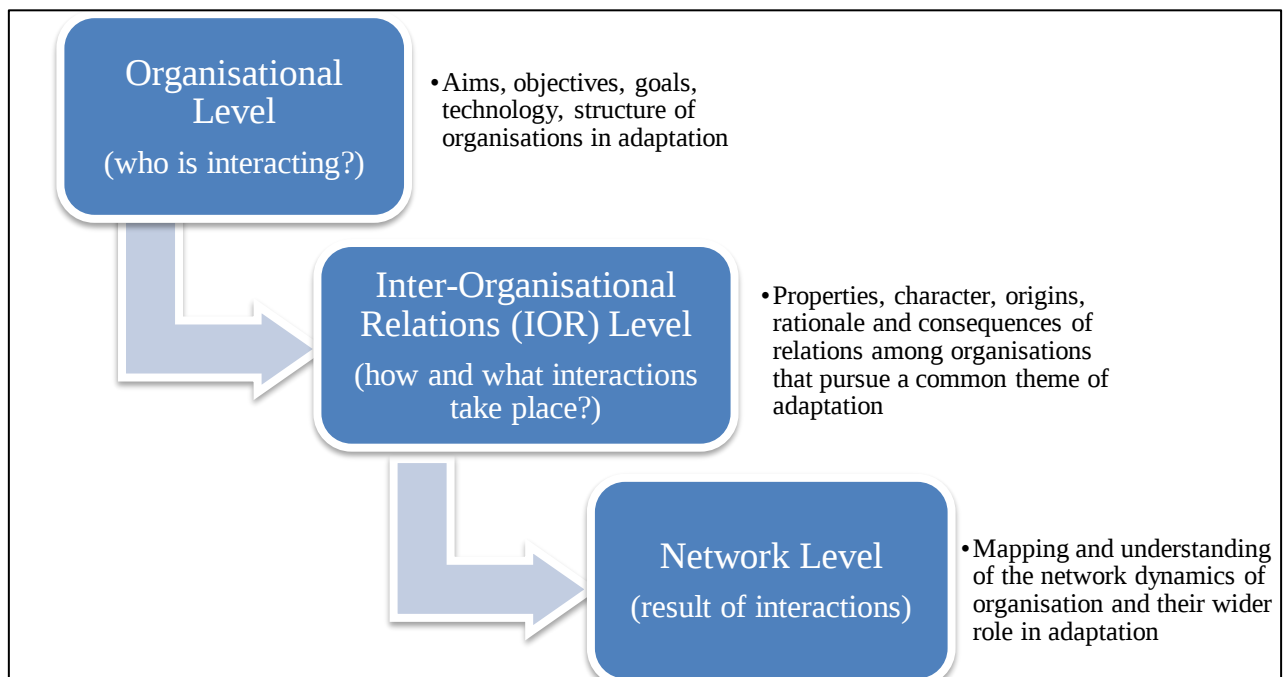
Network Characteristic	Measure	Link to Adaptation Action
Network Size	Network size shows the total number of weighted relations of the organisation within the network, referred in terms of weighted degree	The network size gives the number and types of relation in the network that facilitate adaptation action, such as knowledge, services and resources relations
Density	Density is the proportion of all possible relations that are actually present in the network	The density of a network gives insights on the speed at which information diffuses between organisations within a network. High density is beneficial for spread of information and resources. Too high can also hinder local experimentation and ability to innovate and act because adaptive strategies can become locked in (Janssen et al., 2006, Bodin et al., 2006). High density can also make the loss of single organisation less disruptive to the overall network.
Degree Centrality	Weighted degree centrality ranks organisations based on their multiple relations with other organisations	The degree centrality is a widely used measure that identifies and ranks the most prominent organisations in the network and is typically used as a proxy for power, influence, trust, social learning and prestige (Ibarra and Andrews, 1993, Marsden and Friedkin, 1993, Sparrowe et al., 2001). Centrality is important in times of change and rapid response as it improves coordination ability between organisations (Bodin et al., 2006).
Betweenness Centrality	Betweenness centrality ranks organisations on the number of times they act as bridges along the shortest path between two organisations	Betweenness centrality links different sub groups that allows diversity in knowledge and facilitates social learning (Hanneman and Riddle, 2011a). However a high degree of separation between organisations may undermine trust (Bodin et al., 2006).

Source: Author compilation from literature

3.7. Three Level of Organisational Analysis

The organisational perspective offers opportunities to study adaptation at three distinct levels. These levels as illustrated in Figure 7 are a) organisation b) inter-organisational relations (IOR) and c) network. This covers which organisations (a) are interacting, how and through which type of interactions (b), and resulting in what type of structure for adaptation (c). These levels directly attend to the internal structure for adaptation initiatives and the role the many organisations play in adaptation. See Paper one for a more detailed description of the three levels, the relevant literature, and how they contribute to the overall analysis.

Figure 7: The three levels of analysis



Source: Author compilation

3.8. Conclusion

In this chapter I introduced three distinct disciplines of adaptation, organisation theory and network analysis that underpin the working research literatures relevant to the arguments and approach of this research. Since these three disciplines are well established, the chapter only covers elements relevant to this research. Adaptation to climate change is evolving, but the literature remains silent on the next steps of organising appropriate efforts. The common ground between adaptation and organisation allows the former to be examined through the lens of the latter. For instance, adaptation can be studied in terms of the organisational attributes of structure, processes, funding, external institutions and so forth. It speaks to the underlying framing enquiry on organising adaptation efforts, namely how current policy responses take on an organisational form. This includes the organisational architectures of these current early-stage policy efforts and how current ideas about implementation are linked to the actual organisational arrangements in place. Network analysis offers a concentrated methodology to capture the organisation of adaptation as a set of interdependencies and connections among the many organisations important in the field. Networks highlight the broader structure in which organisations are embedded and its effect on adaptation action. I examined adaptation at different organisational levels to provide a full analysis of the adaptation structure and the various organisations within it.

4. RESEARCH DESIGN, METHODOLOGY AND METHODS

“It is good to have an end to journey toward; but it is the journey that matters, in the end.”

Ernest Hemingway

“Typical implementation cycle in development projects consists of decision making, management and monitoring and evaluation of actions. Reality is that outcomes are cyclical and iterative. Process is the story behind the story”

Anonymous Speaker at University of Oxford (2015)

4.1. Introduction

In this chapter, I introduce the overall research approach and methodology employed for all four papers. I start by highlighting how the research design and methodology evolved over the course of the project, especially through insights gained in the field. I present a ‘granular’ and ‘nested’ means to study adaptation efforts across all the different levels and organisations involved. I collected data over several months of extensive field research from 2012-2014 in Nepal and Ghana. This was supported by archival data and wide-ranging published literature on both adaptation and agriculture. On concluding each field study key experts were invited to Oxford to discuss and offer feedback on the methodology, field activities and empirical data collected. This process helped refine the methodology and increase the depth of the case study in Ghana. Methodology and methods used for generating specific results are presented in each paper. Because the methodology and data collection are shared across the four papers, I report them in each place for completeness.

4.2. Evolution in Research Design

I originally conceived the research to study adaptation initiatives in agriculture and track the flows of funding across formal governance structures in a developing country. This approach was motivated by my desire to understand the design, logic and motivation behind adaptation structures undertaken or planned by states for their most vulnerable. My underlying belief was that despite best intentions, funding invariably fails to reach the most vulnerable. I considered conducting a comparative country study exploring the question - “what needs to happen to get adaptation funds effectively, efficiently and equitably (E3 lens) from state to smallholders”. This covered a top-down approach of tracking funds from national policy level to community, through a network of delivery agents, and then to understand the basis of allocation of these funds.

The research started with Nepal’s state managed National Adaptation Programme of Action (NAPA) and Local Adaptation Plans of Action (LAPA). This was to be followed by comparative studies of state programmes in West Africa (Ghana) and Central America (Honduras). The research was aimed at informing theory and practice on the metrics and logics of what makes adaptation effective and equitable, based on empirical and archival data. However, early on in the Nepal field work it became evident that tracking funding through the national structures and applying the E3 lens for adaptation was problematic. First, Nepal NAPA and LAPA were at an early stage, hence it was not possible to observe or trace the financial flows or outcomes. This was common to programmes across many developing countries that were at the same stage, with little evidence of progress (UNFCCC, 2014). Second, even where Nepal formalised some actions, funding did not necessarily follow the plan.

Tracking adaptation funding, however, quickly pointed to the need to understand more complex and distributed patterns of organisational linkages. Adaptation action

emerged in an uncoordinated and organic network, with interactions of many organisations for different activities. For example, local communities sought funds from national budgets for support but also reached out to local NGOs for implementation. This support from NGOs was not captured in the formal structure, but was key to successful adaptation. The networked approach revealed that tracking funds through the planned structures without capturing the broadest role of organisations and their interactions with others was inadequate. Finally establishing a boundary for the analysis was challenging as many important organisations operated beyond the official structures or did not formally label their activities as climate related. Without including them the analysis offered a limited view of adaptation that could lead to false conclusions.

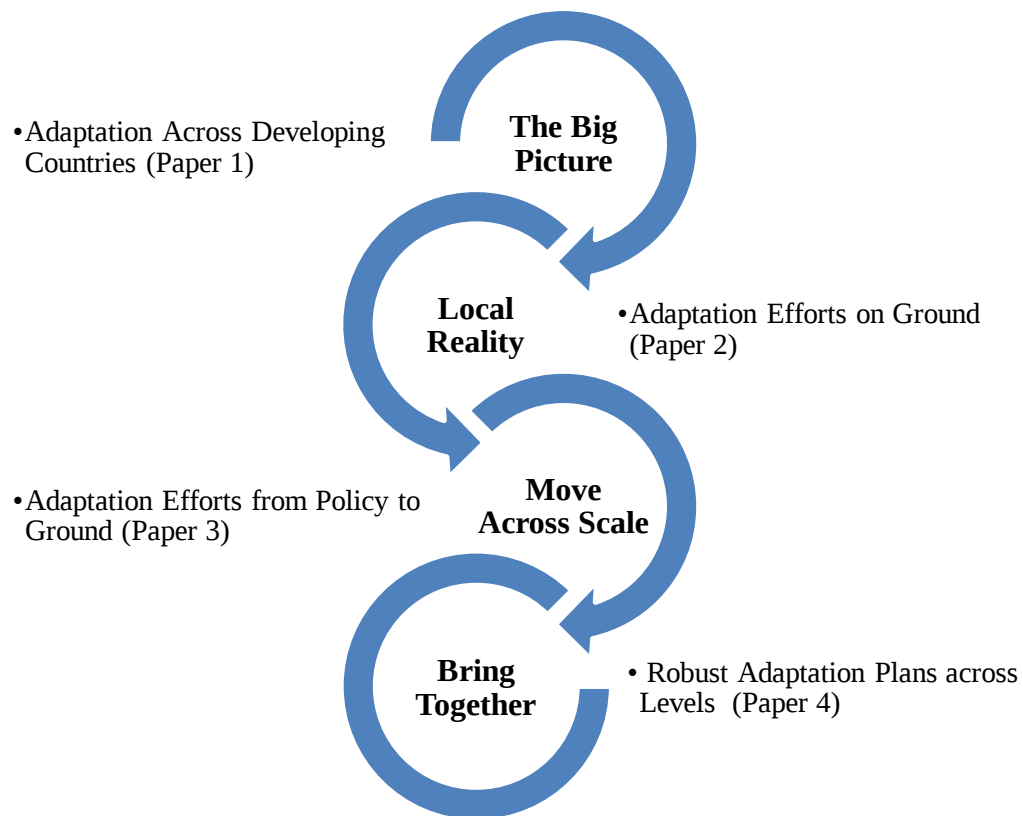
Based on these very early, but vivid findings I altered my approach from the narrow focus on tracking funding to a broader attention on how adaptation was organised as a network of organisations and their interactions. This wider approach and dynamic view made possible detailed analysis that provides fuller evidence from which to expect outcomes of the planned implementation, without actually having to wait to observe the outcomes. A second important adjustment to the research design was to broaden the focus from funding to other critical resources for adaptation including knowledge, services, and connections. Focusing on funding alone typically does not take into account all of the relevant ‘sociotechnical’ components that make funding productive. This is based on theory as well as on the views of crucial elements by local organisations. The research approach deepened its focus from simply identifying organisations in adaptation to mapping their interactions and classifying the diverse roles, such as knowledge providers, or policy setters. I applied established organisation theory and network analysis to study how adaptation was pursued through the many organisations working for adaptation. This evolution offered a more complete and

innovative analysis of adaptation based on stronger theoretical and methodological foundations.

4.3. Granular and Nested Research Approach

The study is setup in four sections illustrated in Figure 8 to match the four empirical papers. It starts with the ‘big picture’ to present the broad state of adaptation across several countries and the factors that shape adaptation efforts (Paper one). The research then moves from the level of the country to focus on the ‘local realities’ with a detailed analysis of local structures, networks and relations that are crucial elements for building adaptive capacity in Ghana (Paper two). The research next ‘moves across scale’ to study adaptation through the national structures that connect the local reality to national policy. This covers studying the interaction and roles of the many organisations crucial to adaptation across the whole country (Paper three). The research ultimately ‘brings together’ organisations from across different levels in Ghana to plan and organise adaptation, with each level informing others and offering an integrated and nested approach to adaptation (Paper four). Combined the approach offers a multi-organisation and multi-level perspective of adaptation.

Figure 8: Research approach



Source: Author compilation

This multi-organisation and multi-level approach offers a granular and nested view of the whole process. By granular I mean viewing adaptation at different levels of resolutions along the national structures, whereas nested assumes that organisations and activities are linked and embedded dynamically across different domains, which is very different from a hierarchy¹⁶ (Gunderson and Holling, 2002, Allen et al., 2014, Berkes and Ross, 2016). Scales and levels are fundamentally important in developing robust

¹⁶ Gibson et al. (2000, p.219) defines hierarchy in the policy sphere as “a conceptually or causally linked system for grouping phenomena along an analytical scale” and adds that “hierarchy is frequently limited to a system of personnel ranking that defines the authority of individuals dependent upon their formal position within a hierarchy”.

adaptation responses (Gibson et al., 2000)¹⁷. Careful and flexible planning clearly becomes essential to meet the aims of the many organisations required to deliver appropriate adaptation.

This approach is challenging because most adaptation measures are usually planned and implemented by national public organisations within structures that are rigid, bureaucratic and hierarchical (Pugh 1973, Weber 1978). Hierarchies are preferred by states, as it is much simpler to spread decision-making across existing national and local planning structures. However, they often underestimate the interconnected and interdependent nature of adaptation and the role of many other essential organisations.

The adaptation literature identifies several approaches that frame adaptation as a linked or nested system with concepts of ‘inclusive hierarchy’, ‘systems thinking’ or ‘panarchy’ (Midgley, 2003, Allen et al., 2014, Berkes and Ross, 2016, Holling, 2001, Gunderson and Holling, 2002). These nested approaches offer a more complete and connected analysis, where groups within one level (lower) are also part of another level (higher) (Gibson et al., 2000). Although single level studies offer insights, they tend to miss the constraints and benefits that lie outside the scope of analysis (Midgley, 2003). Gibson et al. (2000, p.5) state:

¹⁷ The terms levels and scales are frequently used interchangeably. In this paper I adopt Gibson et al. (2000, p.218) definition of scale as the “spatial, temporal, quantitative, or analytical dimensions used to measure and study any phenomenon”, and levels within the scale “as the units of analysis that are located at different positions on a scale”. This definition is appropriate for the research, as it is broad and encompasses scales and multiple levels suitable for agriculture adaptation

“Phenomena associated with global change are linked together in constitutive hierarchies. Individual humans are contained in families that are contained in neighbourhoods, which are contained in villages or cities, which are contained in regions, which are contained in nations, which are contained in international organisations. In such systems, there is no single ‘correct’ level to study.

Phenomena occurring at any one level are affected by mechanisms occurring at the same level, and by levels below and above. Thus, research on global change processes should examine the world from a multilevel perspective.”

At the heart of the nested approach is the idea that successful strategies for adaptation require careful matching of the scale for action and management (Cash and Moser, 2000, Termeer et al., 2010), along with effective coordination of all organisations involved. In national planning, levels may map onto the geography of nation, region, and village. Timescales may be short (days), medium (months) and long (years). Adaptation at each level requires different strategies and focus areas. For example; at local level, strategies may focus on short-term agriculture production issues, whereas at the national level it may emphasise goals for developing infrastructure. Global policies also need credible local level evidence that takes into account microeconomic dynamics and any limitations of data collection. These differences of scale and levels make it impossible to tackle adaptation in a hierarchical way.

Organisation is central to the nested approach because adaptation (similar to other large policy sectors) is shaped by network structure, linkages, and feedbacks (Berkes and Ross, 2016, Laumann and Knoke, 1987, Selznick, 1949). The extent to which organisations are identified and their interests accepted largely determines the sustainability of proposed actions (Mermet, 2011, Bryson, 2004). Examining the

network helps capture these interactions and interdependencies among the organisations involved and the constraints and opportunities that arise. Some interactions between organisations are formal, as between government departments, while others are informal and outside government. Importantly the nested approach acknowledges the interdependency of both formal and informal structures. James Scott (1998, p.310) in *Seeing Like A State - How Certain Schemes to Improve the Human Condition Have Failed*, eloquently captures this dynamic dependence between formal and informal structures.

“Formal order, to be more explicit, is always and to some considerable degree parasitic on informal processes, which the formal scheme does not recognise, without which it could not exist, and which it alone cannot create or maintain”

Nesting allows for a granular analysis based on different levels or combinations of levels within a selected scale. Gibson et al. (2000, p.4) stress that “patterns that appear at one level of resolution or extent may be lost at lower or higher levels”. Taking a macro view, the analysis is broad, covering many nested levels. At this level, as Ostrom (2005) and Cox (2008) suggest, the focus is on the design principles that are generic and broadly applicable in various circumstances and contexts, without being contested (e.g. from country to country.) As the analysis moves to specific sub-national and local levels, it faces multiple variables affecting implementation that makes predicting outcomes accurately a considerable challenge. In short, as the resolution increases predictability also increases; at the same time, it renders it less meaningful. There is then a trade-off between accuracy and meaning that depends on the granularity

of analysis. My research overcomes this trade-off by setting up and studying adaptation action within levels at different resolutions and then across the nested levels.

4.4. Research Methodology

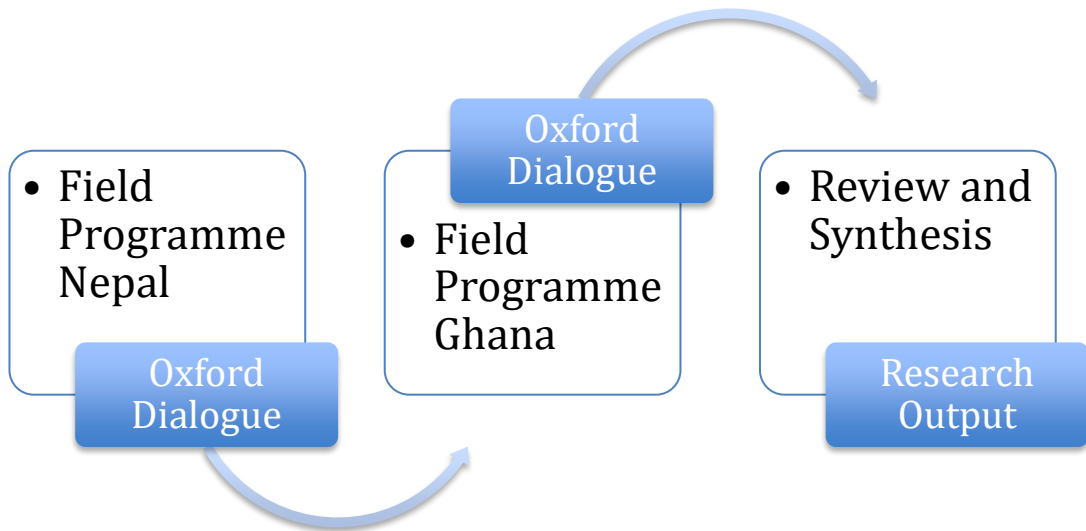
There are many ways to study adaptation from comparative studies across countries to single country detailed analysis. I used the case study because it offers a holistic and 'in-depth' approach and uses data from multiple sources and perspectives (Orum et al., 1991, Tellis, 1997). This approach makes it possible to collect data in the various forms needed to observe and assess adaptation. A frequent criticism of case studies is that single cases make a generalised conclusion problematic. Yin (2009) argues, however, by applying the methodology systematically, general insights and principals can be established from a single case (Yin, 2009, Eisenhardt, 1989). This study added rigour to a single case with detailed fieldwork, community visits, interviews, network analysis and archival data to undertake a structured analysis.

The methodology followed an iterative design over the two field studies (Figure 9). The first site in Nepal served as the pilot for the methodology and to test specific data collection and analysis methods for subsequent application in Ghana. On conclusion of each field study, a three-day discussion was held in Oxford that brought together members of the SIA multi-disciplinary research team, academic supervisors, research funders and other relevant experts, to reflect, discuss, critique and develop the findings. This presentation and feedback mechanism was central to integrate the many streams of the SIA project and to improve focus.

In each field site, a key local partner organisation was engaged to assist in local logistics, select community sites, organise workshops, introduce organisations and other

actors and facilitate data collection. Time spent on the field site was appropriately distributed between local, regional and national levels to gain a thorough understanding of all the challenges. Through a network of collaborative relationships, the fieldwork design ensured that field programmes were embedded in locally important and desirable challenges and that effective channels existed for translating research results into policy and practice. The output of the field research programs includes a suite of participatory tools, applied integrated frameworks, research papers, working papers, conference presentations and blogs.

Figure 9: Iterative research methodology



Source: Author compilation

The role of the key organisations in design and delivery of adaptation is imperative. Starting with applying actor-mapping and name generator tools (Burt, 1984), key organisations (agents) were mapped and interviewed to understand their role and contribution to specific initiatives. As discussed earlier, organisations broadly comprise actors, groups and entities that have a stake, or an interest in adaptation, and

can affect or be affected by a decision or an outcome. While the literature may differ on the exact wording of the definitions, it agrees with the need for organisational support to encourage successful analysis, to create winning coalitions, and to ensure the long-term viability of organisations, policies, plans, and programs (Bryson, 2004). In general, organisations should be involved if they have information that cannot be gained otherwise, or if their participation is necessary to assure successful implementation of initiatives built on the analyses (Donaldson and Preston, 1995)

This is a staged (iterative) process that can be stopped at any point when enough information and support has been collected, timelines are short, the analyses are too sensitive, or for some other good reason. The process is designed to gain information, build political acceptance, and address at least some of the questions about legitimacy, representation and credibility. It is also important to recognise that vocal opposition to a plan can come from organisations outside the area of interest (Mermet, 2011). The research methodology identified such peripheral organisations through interviews and data analysis techniques. In short, multi-organisation approach is crucial, both to finding ideas worth implementing and to assessing and enhancing political feasibility (Van Horn et al., 2001), especially when it comes to articulating and achieving the common good (Bryson et al., 2002).

4.5. Data Collection and Research Methods

I applied mixed methods of network and qualitative analysis supported by direct field observations (King et al., 1994) in this research. Two methods were, in particular, extensively used throughout the study to capture adaptation efforts through multiple organisations - network analysis and semi-structured interviews. Network analysis helped capture the social and organisational structures through the use of networks and

graph theory (Wasserman, 1994). Primary relationship data was collected through a detailed interaction protocol. The protocol acted as name generator (Burt, 1984) to produce a comprehensive qualified list of organisations active in adaptation with tangible relations (Campbell and Lee, 1991). The protocol captured the main aspects of the relations among organisations: length, frequency, category, types, and usefulness. The interaction protocol was followed by an extensive semi-structured interview of individuals within the organisation to explore the relations identified and their role in adaptation more deeply. The interview questionnaire was built using critical and reflective questions based on ‘critical systems heuristics’ (Ulrich, 1987) to understand deeply the role and links of organisations.

I collected empirical data on the organisations in adaptation and their relationships over several months of extensive field research from 2012 to 2014 in Nepal and Ghana, through workshops, surveys, detailed semi-structured interviews and network mapping. I conducted over 100 interviews in Nepal and 150 interviews in Ghana of key national, regional and local organisations engaged in adaptation. Snowballing and network techniques and key informants were used to identify key organisations to interview. I triangulated the data using multiple interviews in the same organisations, network analysis, surveys, physical visits, and content analysis. Translators were used for village interviews. The research approach and design was also reviewed and approved by the University of Oxford Central University Research Ethics Committee (CUREC) to ensure that the procedures respect the dignity, rights, and welfare of the interviewees.

I supplemented the empirical data with extensive review of published literature, country reports, policy/programme documents, literature on climate change, adaptation, agriculture, development, finance, local governance, decentralisation, national and

district budgets, laws, newspapers and other documents to support the research and analysis. In some cases, authors and owners of policy/programmes were interviewed to understand better their perspective on design and implementation.

I used Gephi version 0.82¹⁸, an open-source network analysis software to visualise and analyse the data collected. I obtained training on the use of the software to conduct detailed analysis. The software creates network maps to represent relations graphically and generate statistical data to quantify these relations. The interview data obtained were transcribed and Nvivo version 10 qualitative data analysis software was used to code the objectives, activities and characteristics of organisations to supplement the analysis. Please see each empirical chapter of detailed accounts of the informants, data collection and processing, and analysis specifics such as primary theme coding and community detection algorithms.

4.6. Assessment and Management of Uncertainty

Having a well-designed methodology is important for generating credible and useful data, hence special attention was given to develop thoughtful and robust methods. Despite this, social and management sciences methodology carries a set of potential and inherent errors with any kind of data collection, especially questionnaire based interviews (Silverman 2005). Since most of the empirical network data was collected through interviews, I identified risks and setup mitigation strategies to minimise the risk of errors, omissions and mistakes. The risks involved characteristics of the interviewee, design of questionnaire and interaction protocol, interview process, language and translation. Mitigation strategies included triangulation of data through

¹⁸ Software available at <https://gephi.org>

physical observation, pilot interviews to test and refine the questionnaire, use of skilled translators, audio recording of interviews (with consent) and use of independent translators to transcribe interviews. Use of software helped keep the data processing objective and transparent.

4.7. Conclusion

Developing a strong methodology was imperative to provide depth to the analysis and credibility from a single case study. My research approach evolved from a narrower focus on tracking funding for adaptation through state structures to studying the broader and evolving structure of adaptation composed of many organisations. I used the Nepal field site, with support from experts to refine and develop the methodology and data collection to study adaptation efforts in Ghana. I applied organisation and network theories to extend the questions and answers available from mainstream adaptation research. I collected empirical data through extensive field research, interviewing and following organisations within the national structure. This generated a first list of organisations in adaptation across multiple levels, which alone is a novel contribution to organising adaptation in Ghana. I pioneered the application of a 'local' to 'national' approach and tools to gather and analyse relationship data from organisations and activities that materialises research issues across the policy and practice of organising adaptation.

5. RESULTS – FOUR EMPIRICAL PAPERS

Policy is there, they just talk in the air and don't see how it translates on the ground.”

Traditional Authority (Interview, Ghana 2014)

In this section of the thesis I present the four empirical papers that report on the pattern of results and comprise the results for the thesis. Each paper addresses a particular aspect of the research and the overarching research questions - 1) How are current policy diagnoses, initiatives, and solutions for agricultural adaptation embodied in organisation-centred terms? 2) What is the organisational architecture of current/early adaptation policy responses? 3) How are current ideas about implementation linked to the actual organisational arrangements in place? Collectively the four papers present the view of adaptation under the organisational lens and apply network theory to study it.

6. EMPIRICAL PAPER 1

Emerging Meta-Organisations and Adaptation to Global Climate Change: Evidence from implementing adaptation in Nepal, Pakistan and Ghana

Abrar S Chaudhury^{*1,2}, Marc J Ventresca³, Thomas F Thornton¹, Ariella Helfgott^{1,2}, Chase Sova^{1,2}, Prajwal Baral⁴, Tahir Rasheed⁵ and Jasper Ligthart⁶

¹ Environmental Change Institute, University of Oxford, South Parks Road, Oxford OX1 3QY, UK

² CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), University of Copenhagen Faculty of Science, Department of Plant and Environmental Sciences Rolighedsvej 21, DK-1958 Frederiksberg C, Denmark

³ Saïd Business School and Wolfson College, University of Oxford, Park End St, Oxford OX1 1HP, UK

⁴ The Global Climate Change Policy Team (GCCPT), The World Bank, Washington, D.C., USA

⁵ Leadership for Environment and Development (LEAD), LEAD House F-7 Markaz Islamabad, Pakistan

⁶ University of Humanistic Studies, Universiteit voor Humanistiek Postbus 797 3500 AT Utrecht, The Netherlands

*Corresponding Author

Global Environmental Change 38 (2016): 243-257: Published
<http://dx.doi.org/10.1016/j.gloenvcha.2016.03.011>

*Abrar Chaudhury

Environmental Change Institute, University of Oxford,
South Parks Road, Oxford OX1 3QY, UK

abrarchaudhury@gmail.com

+(44) 786 1478411

Abstract

As developing countries move from policy to implementing adaptation to climate change, formal operational structures are emerging that exceed the expertise of any one actor. We refer to these arrangements as ‘meta-organisations’ that comprise many autonomous component organisations tackling adaptation. The meta-organisations set standards, define purposes, and specify appropriate means-ends criteria for delivering adaptation. Using empirical data from the three cases, Nepal, Pakistan and Ghana, the study identifies and analyses six attributes of the meta- and component organisational structures. We argue that organisational structures are crucial to understanding adaptation, specifying policy and implementation. Our analysis demonstrates that while each country promotes similar objectives, the emerging structures are quite distinct, shaped by country-specific attributes and issues that lead to different outcomes. Nepal’s priority for a formal process has come at the cost of delayed implementation. Pakistan’s devolved approach lacks legitimacy to scale up the process nationally. Ghana’s use of existing decentralised structures and budgets relegates adaptation below other development priorities. These divergent structures arise from the different needs for legitimacy and accountability, and the relative priority attached to adaptation against other needs.

Key words: Adaptation; climate change; implementation, meta-organisation, organisational structure; emergence; Nepal; Pakistan; Ghana

Introduction

Significant progress has been made since the Rio Earth Summit of 1992 in expanding our understanding of the adverse effects of climate change and the links between human and ecological systems (Berkes and Folke, 1998, Folke, 2006, Adger, 2006, IPCC, 2013). As policy moves from theory and diagnosis to implementation in developing countries, solutions that have been negotiated globally are unlikely to work well unless they are owned locally (Ostrom, 2010b, Adger et al., 2005). Developing countries now have the added responsibility of designing effective national and local adaptation strategies consonant with local institutions and environments as well as meeting their substantial development deficits (Conway and Mustelin, 2014, Adger et al., 2003, Meyer and Rowan, 1977, Soysal, 1994). This responsibility is important and urgent because direct funding from international agencies, such as the Green Climate Fund, place developing countries in the driving seat for identifying and implementing solutions.

The adaptation response of developing countries is emerging slowly through a variety of formal and informal initiatives. Many of the least developed countries (LDCs) have formulated a National Adaptation Programme of Action (NAPA) under the guidelines of United Nations Framework Convention on Climate Change (UNFCCC) to meet their most urgent and immediate needs (UNFCCC, 2015). Some countries are taking longer term approaches by prioritising adaptation within existing development programmes (Mitchell and Maxwell, 2010, FAO, 2013) or by developing National Adaptation Plans (NAPs) exemplified by Bangladesh and Kenya. Others focus on stand alone, donor-funded projects that target specific problems.

Despite variation across countries, a characteristic common to all the adaptation initiatives is the uncertainty and complexity of climate change, which exceeds the

expertise and capability of any one organisation, discipline, or policy authority. Tackling this ‘wicked’ challenge (Rittel and Webber, 1973, Ferraro et al., 2015) requires active participation from many diverse and autonomous actors, such as policy makers, government, private sector, international/local non-governmental organisations (I/NGOs), donors, local communities and researchers. To manage these actors along with their complex relationships, and to seek legitimacy for climate action amongst competing priorities, authorities are inclined to establish formal goal-driven implementation structures (Meyer and Rowan, 1977, Ahrne and Brunsson, 2011). These structures have many of the features that characterise formal organisations, such as aims, rules, reporting systems, monitoring and evaluation procedures, to align all their activities. Yet they rely on autonomous actors (typically other organisations) to implement these initiatives while each has a different organisational scope, agenda, measures of success, language, and approach. This paper refers to this operational arrangement as a ‘meta-organisation’ comprised of autonomous components.

This usage of meta-organisation starts from the premise that states are complex organisations (Evans et al., 1985), to emphasise that the intentions of national governments and their agencies are realised with difficulty through early prototype policy initiatives such as versions of NAPAs and NAPs. Our use of the meta-organisation concept in this paper, adapted from previously published work, displaces national government from the conventional starting point used most commonly. The meta-organisations often work by setting standards, defining purposes, and specifying appropriate means-ends criteria for inter-organisational and community design (Ahrne and Brunsson, 2005, Ahrne and Brunsson, 2011, Gulati et al., 2012). They seek effectiveness by encouraging the component actors to adapt to their objectives, structure and relations, whilst also striving for legitimacy with international and national agencies (Meyer and Rowan, 1977).

Gulati et al. (2012) suggest that these meta-organisations may be more formally and tightly-coupled through hierarchies and incentives. We argue that the meta-organisation is a looser arrangement of diverse organisational actors, often convened by a national government authority but extending beyond that authority. The meta-organisation is also a source of complexity because its overarching objectives may conflict with the usual internal goals and criteria of each component actor (Donaldson, 2001) and so provide both opportunities and incentives for actors to resist, co-opt the initiatives, or implement in ways that serve other agenda and that have unintended consequences (Selznick, 1949). For example, government agencies faced with budgetary concerns often prioritise programmes that meet short-term goals at the expense of better long-term initiatives. Sharing information is also time consuming and costly for many private sector actors, which may cause conflict. Country and project managers often fail to recognise these operational arrangements as organisations let alone meta-organisations. This lack of recognition further increases the difficulties of managing adaptation initiatives across agencies. This framework has important implications for policy and implementation as the meta-organisations invariably extend their influence to actors and activities well beyond those identified in any formal design (Scott, 2013).

This wider influence of meta-organisations may produce unforeseen responses and effects that are important when viewed in the large. These emergent patterns of behaviour are complex. Emergent in this sense means that they cannot be predicted by simply studying the individual parts of the system (Cilliers and Spurrett, 1999). Furthermore, these patterns can arise without intent or overview. Analysing adaptation initiatives, without attending to the role and influence of the component actors limits the view of the implementation challenges. In many respects designing effective

implementation presents a classic collective action problem (Imperial, 1999, Olson, 1965) and is well suited to analysis under the organisational lens.

Research Gap

We have some research-based knowledge about the intend and aspirations of national initiatives (Conway and Mustelin, 2014). Despite the importance of such initiatives, there is little research on how emerging organisational structures in climate adaptation evolve and function, which is why we have integrated theory with empirical evidence against the background of published work. This includes the way diverse actors interact within a common framework, innovate, manage interdependency and information flow that produce capacity, develop aims and objectives, and recognise pivotal points (Pfeffer and Salancik, 2003, Scott, 2013). Contemporary literature characterises arrangements of actors much as we define meta-organisation; for example, loosely-coupled systems, networks, regimes, communities, ecosystem, co-management, clusters, ecologies and constellations (Slater and Narver, 1995, Folke et al., 2005, Scott and Carrington, 2011, Moore, 1996, Berkes, 2009, Agrawal, 2010, Campbell, 1998, Haas, 1989, O’Riordan and Jordan, 1999, Ostrom, 2005). Empirical research on these actor arrangements, however, is still preliminary, with scant systematic study from which to extract practical lessons (Gulati et al., 2012). At best the lessons learned, recommendations and advice offered from current adaptation practice and the development of national programmes are rudimentary (Conway and Mustelin, 2014, UNFCCC, 2014). Even where initiatives have been formally designed, their effectiveness is unknown because they are new (Huntjens et al., 2012) and need prolonged follow-up to allow considered responses (Pierson, 2004).

The meta-organisation represents a stronger structure than informal networks that have no hierarchy or organisational element (Ahrne and Brunsson, 2011) but not so strongly unified as to become a formal institution. They are the ‘solutions’ to new commitments and strategies for climate change interventions and hence are novel. Our attention on assemblies of active actors as an organisation or partial organisation (Ahrne and Brunsson, 2011) allows us to make use of the structural features of meta-organisations in a systematic way using established analytical methods. The research focus on these meta-organisations is also relevant and timely because their designs and impacts on implementation are still at an early stage. The structures tend to be ad hoc and contingent on complex contextual conditions, hence provide little data on their effectiveness.

In addition to the paucity of research, there is little consensus on what adaptation can or should mean, which highlights the complexity involved (Smit and Pilifosova, 2003, Smithers and Smit, 1997). This ambiguity about basic definitions, indicators, and ‘what will count’ as effective is common in complex policy fields (Haas, 1989, Young, 2002). However, as this process matures through repetition and iteration, a recognised field for adaptation is likely to emerge (Fligstein and McAdam, 2012), leading to strong norms and conventions, to guide implementation strategies and outcomes (DiMaggio and Powell, 1983, Giddens, 1979). The meta-organisations are the site and focus for these developments. These early solutions and settlements have implications for a tipping point, when global norms and conventions for climate change adaptation are likely to consolidate and become widely adopted (Suárez and Utterback, 1995) without necessarily offering improved performance (Meyer and Rowan, 1977) or the best fit with the local institutions (Ostrom, 2005). However, once established the momentum of such policy conventions often persists, the modern equivalent of Weber’s (1978) ‘iron

cage’: Structures of authority and accountability that remain after their intent, meaning, and purpose has shifted (DiMaggio and Powell, 1983).

Research Approach

This study seeks to understand better the form and activities of these emerging meta-organisations by drawing on existing literature from organisation, strategy, and social network theories, confronted by empirical evidence from our research sites in Nepal, Pakistan and Ghana. Adapting to climate change is a recognised goal in these three countries, each of which is experiencing increasingly variable rains, flooding and droughts, with threats to the livelihoods and food security of their local populations (McSweeney et al., 2010b, Aslam et al., 2011). Our analysis focuses on the planning and early implementation stage rather than the long-term outcomes; the observation period allowed for this initial study could not include long-term follow-up and so we emphasise the early stages.

We argue that organisational structures have recognisable impacts on how adaptation is understood, decides policy, and implementation at many levels. The assembly of organisations that comprise ‘meta-organisations’ each become small moments of structuring action that accumulate and affect the outcomes of any initiative. The three country cases illustrate that the emergent structures of meta-organisations vary, shaped by individual country governance, even when the underlying policy/programme environments are remarkably similar and that, in turn, lead to a variety of structures, alignment, and impact (Campbell, 1998, Pierson, 2004). Efforts to replicate successful adaptation initiatives, without analysing these structural dimensions within the local context, may be futile and costly for policy makers and disastrous for communities. In this way, we offer valuable insights on the challenges in organisational

designs and implementation pathways for policy makers and project managers embarking on developing local initiatives.

Organising Adaptation Initiatives

Organisations and Institutions

In this paper, we distinguish between institutions and organisations as these terms are often used interchangeably, which can lead to confusion (Scott, 2013). Institutions, we define as the underlying rules or constraints that shape human interactions, hold society together and provide a sense of purpose (North, 1990, O’Riordan and Jordan, 1999), whereas organisations are defined as social entities that have a collective goal and a deliberate structure to enable them to achieve objectives (Daft et al., 2010, Jones, 2004). Simply put, institutions comprise the rules of the game and ordering principles, while organisations are the players and locus of actions (North, 1990) that implement these actions within the rules. Our focus is on the organisational perspective of implementing adaptation.

To achieve their goals and objectives, organisations create intentional structures to bring many resources together, promote specialisation with clear divisions of labour, propose structures of authority and governance, strive for economies of scale, manage their external environment, economise on costs and exert power and control (Bolman and Deal, 2013, Daft et al., 2010, Jones, 2004). Although there is no ideal ‘one size fits all’ system in the dynamic landscape of adapting to climate change “if structure is overlooked, an organisation often misdirects energy and resources” (Bolman and Deal, 2013, p66). Ultimately the organisational structure enables and empowers the generation of solutions to problems by providing processes and cues that are legitimate

(Campbell, 1998). However once established, these organisational structures often evolve beyond the planned design of a stand-alone means of coping with adaptation (Selznick, 1949). Hence, acknowledging organisational structures is imperative for effective implementation.

Three Approaches in Organisational Analysis

The study of organisations is well established in theory and empirical study (Scott, 2013, Bolman and Deal, 2013). This rich approach creates three standard options for analysis depending on the scope and interest of the researcher: a) analyses that start from a focal organisation: b) from inter-organisational relationships: c) from social networks. The first treats the stand-alone organisation as the unit of analysis. This highlights the intended goals, core technology, and strategies and structures of an organisation and how these effect performance and impact (Blau and Schoenherr, 1971, Mintzberg, 1979, Dawson, 1996, Jones, 2004, Daft et al., 2010, Lawrence and Lorsch, 1967).

The second approach moves beyond the single organisation to consider its direct relations with other organisations, described as inter-organisational relations (IOR). IOR is concerned with patterns and sources of interdependencies among organisation jointly implicated in common outcomes. This includes empirical attention to the properties, character, origins, rationale and consequences of relations among organisations that pursue a common interest, while also retaining separate interests (Cropper et al., 2008, Johnsen et al., 2008, Oliver, 1990). However, IOR as a research tradition is primarily concerned with the direct resource and authority relationships of an organisation (Johnsen et al., 2008).

The third approach starts from the structure of the network linkages that embed and configure the activities of organisations (Dacin et al., 1999), rather than examining a single organisation or even an organisation set. This approach explores kinds of direct and indirect linkages and the broader structuring of connections. The emphasis is on documenting and understanding the interconnectedness of the network actors and actions, focusing away from any single organisation to how network dynamics condition future action options of the other organisations (Scott and Carrington, 2011, Ritter and Gemünden, 2003, Wasserman, 1994).

We developed our analysis of adaptation initiatives using elements from all three approaches. Any one of the approaches provides partial insights. Meta-organisation as we are defining the concept directs attention to the organisational features of adaptation structures. For instance, focal organisation approaches directly attend to the internal structure of the organisation and the role of formal authority in holding the organisation together. Similarly, use of IOR and network perspectives allow us to evaluate linkages among the component actors and the use of informal authority to encourage action.

Firstly, we treat the designed initiative (whether a project, programme or a strategy) as the instrument for setting the scope of the activities and the boundary for including organisations in the adaptation agenda. Second, we are interested in the role and impact the actors have on how designed initiative develops and operates; such as how the architects, managers or funders and the diverse resource, political, and institutional relationships of these actors are encouraged by the initiative. Finally, because implementation has specific form, pacing, and impact within this inter-organisational space (Selznick, 1949), comparison across the three country cases is instructive.

Meta-Organisations in Early Adaptation

We propose to view this complex interplay between assemblies of organisational actors linked through focal adaptation initiatives as a ‘meta-organisation’. The meta-organisation is comprised prominently of other organised actors. The authority and intent of any one actor is conditioned by the links among members of the meta-organisation. This is the core claim of work on meta-organisations and shifts from a focus on single autonomous organisations and their participants, to constellations of organisational actors (March and Simon, 1958, Ahrne and Brunsson, 2005). The concept of meta-organisation is gaining traction with several examples in manufacturing and services (Gulati et al., 2012, Ahrne and Brunsson, 2005). The meta-organisation makes more precise the classic Scott and Meyer (2012) concept of a ‘societal sector’ that includes all actors and actions within a particular field, such as adaptation. In contrast to formally self-organised systems, meta-organisations emerge when focal actors, referred to as ‘architects’, attempt to influence external actors despite absence of formal authority (Gulati et al., 2012). We incorporate this insight on meta-organisation in the case of climate adaptation initiatives where meta-organisations comprise members, hereafter called ‘component organisations,’ such as government entities, I/NGOs, private sector and community groups, which are considered key in facilitating implementation.

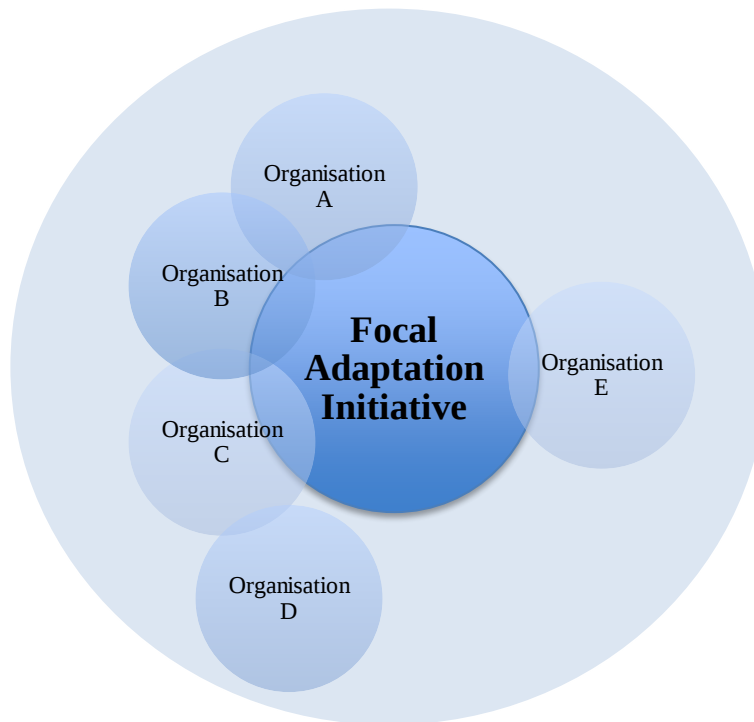
The position and role of the Gulati et al.’s (2012) ‘architect’ in our framed meta-organisation is dynamic rather than static. Architects may have many aims while the assemblage of organisations moves to implement using their various capabilities. The nature of adaptation is uncertain and distributed therefore the goals of the adaptation initiative are likely to evolve and be influenced by the various interests of component organisations within the meta-organisation. For example, funding organisations may

influence the sectors eligible for investments, such as urban versus agriculture adaptation. Accordingly, actors that are on the periphery may become more influential and take on the role of the architect. Furthermore, while there is no formal authority or contract binding the component organisations within the meta-organisation, authority can be rooted through expertise, reputations, or control over resources (Gulati et al., 2012). In a hierarchical structure, government actors as architects, may be perceived to have greater control over component agencies through legislative authority, but the practice is that many such government agencies operate with relative autonomy, often with competing agendas (Evans et al., 1985).

We observed this in our studies where external funders would often choose to work with government ministries with aligned interests rather than those with a formal mandate. In this way the meta-organisation may incorporate some self-organisation, but within the boundaries drawn by the architects. Different actors may then assume the role of the architect and so the boundaries may change. Figure 1 offers an illustration of a meta-organisation as an assembly of component organisations. The focal adaptation initiative, designed by the architects, encourages interaction between the component organisations through rules, policies and procedures to deliver the desired objectives. The members and their relationships therefore have an important affect on how the meta-organisation functions and its potential outcomes even at this early stage.

Figure 1: The meta-organisation and its component organisations. Some component organisations interact directly with others outside the domain of the focal adaptation initiative (organisation D) while others have indirect relationships through sharing system level goals of the focal adaptation initiative (organisation E).

Meta-organisation



Source: Author compilation

There is no ideal or necessary structure of the meta-organisation. In design terms, it may take on different structures depending on the purpose of action, but must include some procedure for linking the component organisations. For Gulati et al (2012), self-selection, competition or incentives generally drive the participation of component organisations in the meta-organisation and offers a natural boundary for analysis. Often this entails some form of resource or knowledge dependency (Pfeffer and Salancik, 2003, Aldrich, 2008) between the component organisations and the meta-organisation. The participation by component organisations in our case studies is driven more by their expertise and capabilities in supporting the system level goals of planning and implementing adaptation. In this design, Gulati et al (2012) proposes meta-

organisations structures based on two dimensions of uncertainty: The boundaries of membership and internal stratification. For example, open boundaries for membership and low stratification lead to open community meta-organisations. While closed boundaries and high stratification offers greater control to the architect and lead to extended organisations based on the architect's organisation. In dynamic, complex situations open system and heterarchical governance might be more appropriate, while in more predictable and structured environments a closed membership and more hierarchical form might be better.

Termeer et al (2010) suggest establishing a diversity of institutional forms to deal with cross level issues such as policy networks, polycentric systems and institutional interplay, forming cross-level institutions. While these are expected to be more effective than top-down or bottom-up approaches, they need to deal with the complex behaviour of social-ecological systems that arise from uncertainties caused by unpredictable behaviour among component organisations. Challenges also arise in getting the relevant component organisations to participate, cooperate and coordinate in pursuit of common goals, especially against the backdrop of changes in central and local governments. Further epistemic uncertainties about the impact of climate change and trajectories, common in developing country adaptation plans, create ambiguity about the goals of policy and allow component organisations to diverge and pursue their own ends. Coordinating and aligning divergent organisations is a challenge for the architects of meta-organisations per Gulati et al. (2012).

We make use of inductive cases and a more 'natural history' approach, not to prescribe the work of a purposeful architect but to observe and report on the diversity of meta-organisation dynamics. In our cases for example, several agencies considered essential for encouraging adaptation, such as Nepal's agriculture ministry, have a narrower focus that takes limited account of climate change and therefore do not seek

an active role in adaptation. This tension between the formal structure and the actions of component organisations often leads to problems of capacity, duplication or complete inaction. The operational structure of emerging meta-organisations and component organisations are also shaped by numerous organisational attributes (discussed further in Section 3: Methodology) such as the prevailing laws, supporting institutions, the nature of vulnerability and operational processes, which add to the complexity (Donaldson, 2001, Woodward, 1980). This in turn influences the selection of participating component organisations, their roles, interactions and outcomes. This ultimately feeds back into the overarching meta-organisation to create a learning loop. The most effective organisational structural designs are considered to be those that display these attributes (Van de Ven and Drazin, 1984, Donaldson, 2001). For example core organisational processes aid in managing complexity as “clear and well-understood roles and relationships and adequate coordination are essential to performance” (Bolman and Deal, 2013, p44).

This is one of the challenges of a ‘design’ approach to organisation: A structural fit in the meta-organisation may not translate into a fit among component organisations, the activities of which are also shaped by other structural factors and actors. This can cause misalignment that adversely affects outcomes. It is difficult to pinpoint exactly which organisational attribute is the most important in determining the structure or how the fit between attributes and structure may be the result of some explicit choices or other constraints (Dawson, 1996, Schoonhoven, 1981, Drazin and Van De Ven, 1985). Detailed descriptive analysis of these early operational meta-organisations makes visible the ideas and assumptions behind their design and evolution.

Methodology

Our objective is to analyse the emerging meta-organisational structures of Nepal, Pakistan and Ghana adaptation initiatives through a common analytical lens. We do not seek a universal approach to emerge from this study. By using a common approach in Figure 2, we can evaluate variations and establish general insights with wide applicability (Yin, 2009, Ostrom, 2005, Eisenhardt, 1989). Further, the adaptation initiatives in the three countries are at different stages, therefore a narrow comparison is not appropriate. Instead, we identify and examine the key organisational attributes that affect the meta-organisational structures of each country and their effects on the component organisations and planned outcomes. A descriptive and qualitative approach is used to introduce the focal initiatives in each country (Section 4) and to analyse the meta-organisation.

We collected empirical data on the meta-organisation and component organisations over several months of field research from 2012 to 2014 in Nepal and Ghana, through workshops, surveys and detailed semi-structured interviews. We conducted over 100 interviews in Nepal and 90 interviews in Ghana of key national, sub-national and local actors engaged in the adaptation process. For Pakistan, secondary data was secured through the project managers of the focal adaptation initiative on the project development process, stakeholder interactions, and documentation. [Refer to Supplementary Data for interview details and structure].

The data obtained were transcribed and coded to identify the key attributes of the adaptation initiative in each country (Table 1). These data were supplemented with original work on network and content analysis of the adaptation framework and policy documents from each initiative (Sova and Chaudhury, 2013, Chaudhury et al., 2017,

Sova et al., 2014). This list represents the first compiled set of attributes and features; further attributes may come from other countries.

Table 1: Common organisational attributes of the adaptation initiatives identified through case research

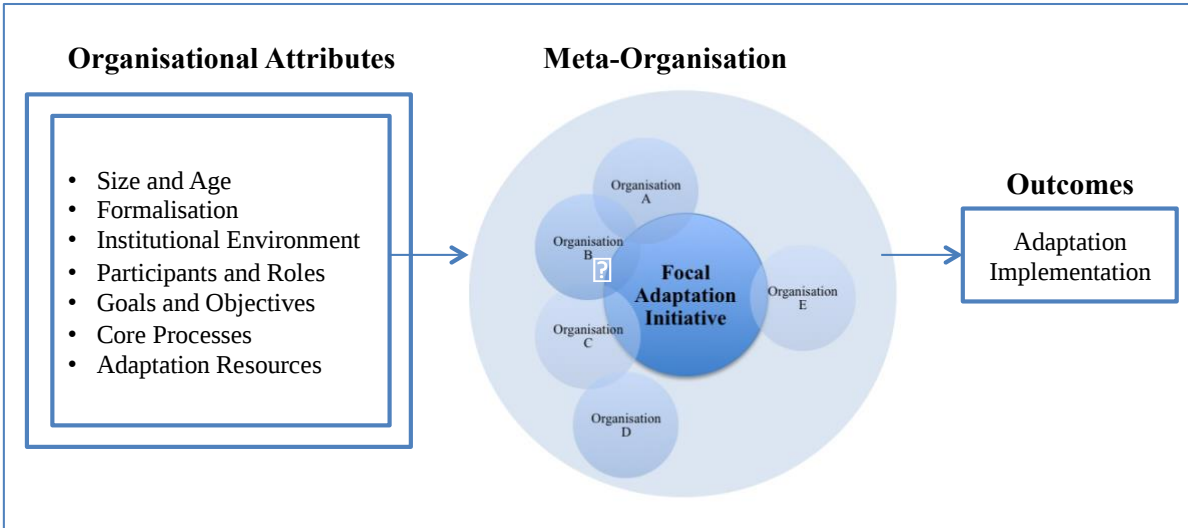
Meta-Organisational Attributes	Impact Analysis of Organisational Attributes on Meta-Organisational Structure
Size and age of initiative	Early stage initiatives, less than 5 years - Impact not observable
Formalisation of initiative	Legal form of the initiative. Is it government or private backed
Institutional environment	Number of policies, initiatives and actors in adaptation field in country
Participant organisations & their roles	Number of organisations active in the initiative with roles
Goals and objectives of initiative	How adaptation is defined and perceived by organisations across scales
Operational core processes	Formal processes designed for planning and implementing adaptation actions
Funding source and availability	Commitment of secure funding for the initiative and funding sources

The adaptation initiatives in each country are less than 5 years old and provide the start point for analysis. This is the basis of our focus on ‘early moments’ and accordingly we do not assess the effect of age and size on the meta-organisational structures or their long-term forms and impacts. Organisation literature typically shows that complexity and formality usually increase with size and age and lead to more rational and hierarchal legal structures (Gooding and Wagner, 1985, Greiner, 1997, Child, 1972, Blau and Schoenherr, 1971). How these findings inform meta-organisation is a further useful research question.

Figure 2 illustrates a framework for analysing the implementation process of the adaptation initiatives. The meta-organisation, reflecting the focal adaptation initiative, and component organisations interact to implement the planned objectives. We focus on the impact of organisational attributes on the meta- and component organisation structures and their interactions in producing the desired objectives. Participant component organisations take on specific or indirect roles within the meta-

organisational structure, such as managing, coordinating, implementing, supporting and funding the adaptation initiative.

Figure 2: Meta-organisation structure analysis framework



Source: Author compilation

Overview of Case Country and Focal Adaptation Initiative

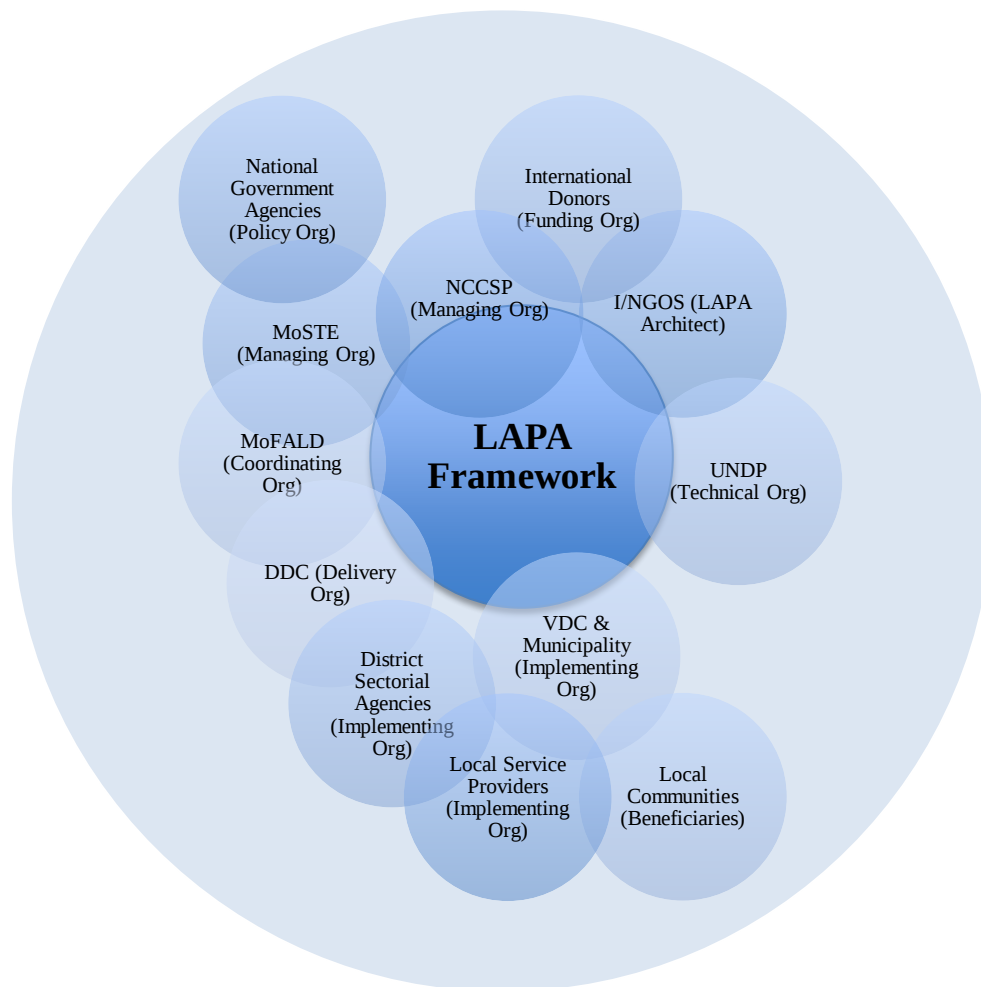
The three case countries of Nepal, Pakistan and Ghana were selected for analysis because they offer cultural and institutional similarities (in case of Pakistan and Nepal) yet with contrasting political, economic and geographic problems when planning for and implementing adaptation. The Gain Index¹⁹ ranks all three countries as highly vulnerable to climate change, especially with regard to agriculture. All have adopted some form of local adaptation planning and implementation strategies. Table 2 describes the focal adaptation initiatives in the three countries, along with specifics about relevant institutional elements suggested by our discussion about emerging meta-organisations. This section reports on original research by the lead author, based on extensive fieldwork, interviews, and observation from 2012-2014.

¹⁹ <http://index.gain.org/ranking/vulnerability>

Nepal

In 2011 the Government of Nepal (GON) launched the Local Adaptation Plan for Action (LAPA) framework to activate the UNFCCC guided NAPA (GON, 2010). The LAPA, with support from international donors, United Nations Development Programme (UNDP) and I/NGOs, aims to integrate “climate adaptation activities into local and national development planning processes and to create a situation for climate-resilient development” (GON, 2011, p6). The LAPA framework focused initially on the 14 most vulnerable districts and deemed village and municipalities, the lowest official administrative unit, as the most appropriate units for planning and implementation. Figure 3 illustrates the meta-organisational structure of the LAPA. The Ministry of Science, Technology and Environment (MoSTE) manages the LAPA process through the Nepal Climate Change Support Programme (NCCSP), with coordination responsibility lying with the Ministry of Federal Affairs and Local Development (MoFALD). Delivery of the LAPAs is vested in the autonomous local government units of District Development Committees (DDCs) and implementation with Village Development Committees (VDCs) with support from local agencies and private service providers. The government agencies of the National Planning Commission and Ministry of Finance provide policy and budget guidelines to DDC and VDC for prioritising adaptation in local development planning.

Figure 3: NEPAL - Meta-organisation structure of LAPA and the component organisations involved in adaptation. The figure shows significant component organisations and their relationships. The component organisations also have independent relationships outside the scope of the LAPA.



Source: Nepal LAPA Framework (GON, 2011) and authors analysis 2015

Nepal has been embroiled in persistent political conflict, with violence, frequent changes of leadership and delays in finalising the constitution. Proliferation of climate change policies and institutions, since 2010, has allowed multilateral donors and I/NGOs to fill the official void. In the LAPA framework, this has led to tension between the government and various I/NGOs, over their role in LAPA implementation. MOSTE, the central level coordinating body, has no bureaucratic or political representation beyond the capital city. Consequently, it relies on support of DDCs and VDCs, under

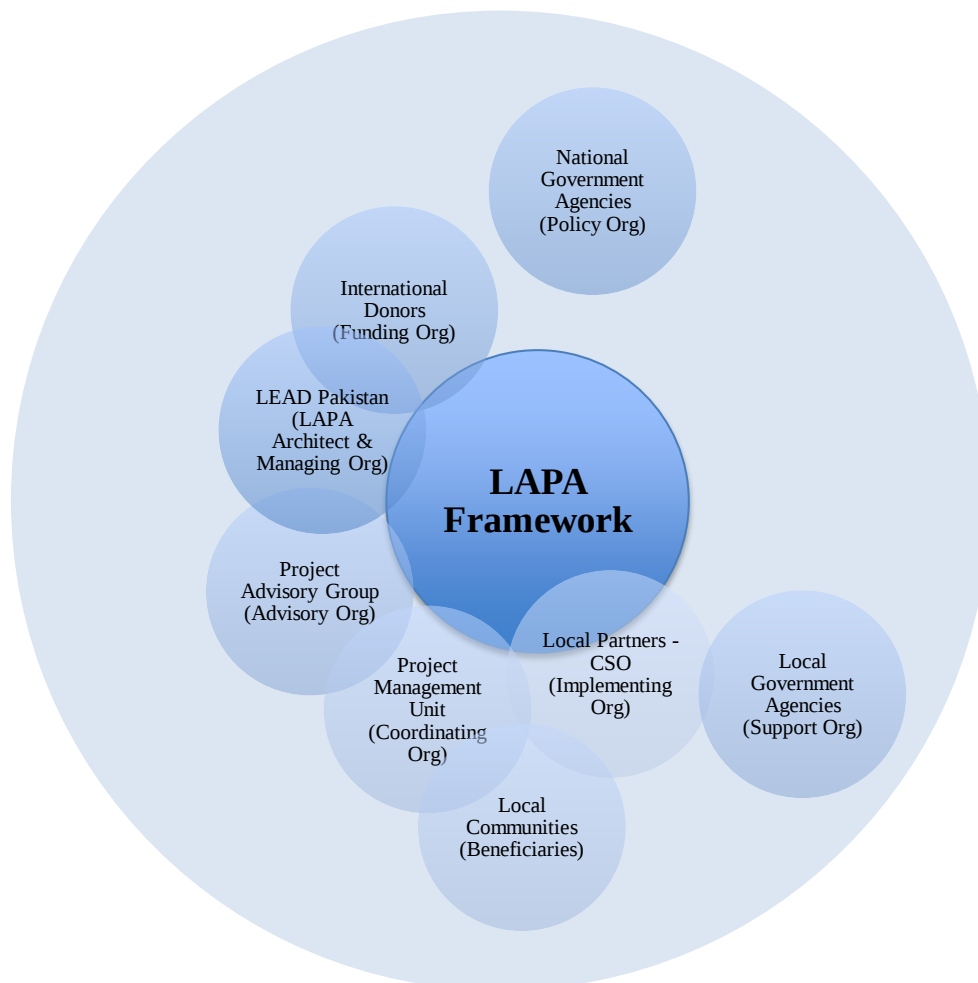
the purview of MoFALD to deliver LAPA's financial and human resources. Yet the roles of such local bodies have never been clear in Nepal's constitution, which leads to power voids in local administration (Rai and Paudel, 2011). A critical assumption for the delivery of LAPAs is that sufficient capacity exists within, DDC and VDC offices, but spread thinly from lack of local elections (abolished in 2002) and interference from local politicians in selecting development projects, VDC staff are unable to deliver LAPA effectively.

Pakistan

Pakistan, a lower middle-income country, has yet to initiate a NAP encouraged under the UNFCCC guidelines for its medium to long-term adaptation responses. After the massive floods in 2010 and 2011, a multi-year private sector led LAPA project was initiated by LEAD Pakistan, a non-profit organisation with international donor support to fill the void left by government inaction. The LAPA project aims to create conducive policy, legislative and financial framework for communities that potentially can be scaled up to a national programme. The LAPA project operates through union councils, the lowest official administrative unit, in 13 vulnerable districts in the south that are most prone to floods, cyclones and drought. Figure 4 illustrates the meta-organisational structure of the LAPA project. The LAPA is decentralised by engaging local Civil Society Organisations (CSO) as development and implementation partners, in collaboration with selective community beneficiaries and local government agencies. The CSO's presence in the LAPA districts and close proximity to communities helps capture local realities and cultural intricacies. LEAD manages the project and provides training and support to CSOs through a dedicated project management unit and guidance from project advisors focused on issues about policy, collaboration and

performance. The national and local government agencies do not have formal ownership in the LAPA project but are engaged as consultative stakeholders to encourage collaboration and future uptake of LAPAs in official development structure.

Figure 4: PAKISTAN - Meta-organisation structure of LAPA and the component organisations involved in adaptation. The component organisations also have independent relationships outside the scope of the LAPA.



Source: Pakistan LAPA Framework 2012 and authors analysis 2015

Climate change ranks low on Pakistan's list of priorities in sustainable development because immediate returns appear low. Political tension from sectarian and religious conflict has led to divisions within the leadership that hinder progress and development. The passing of the 18th amendment (Article 140A) to the Constitution by

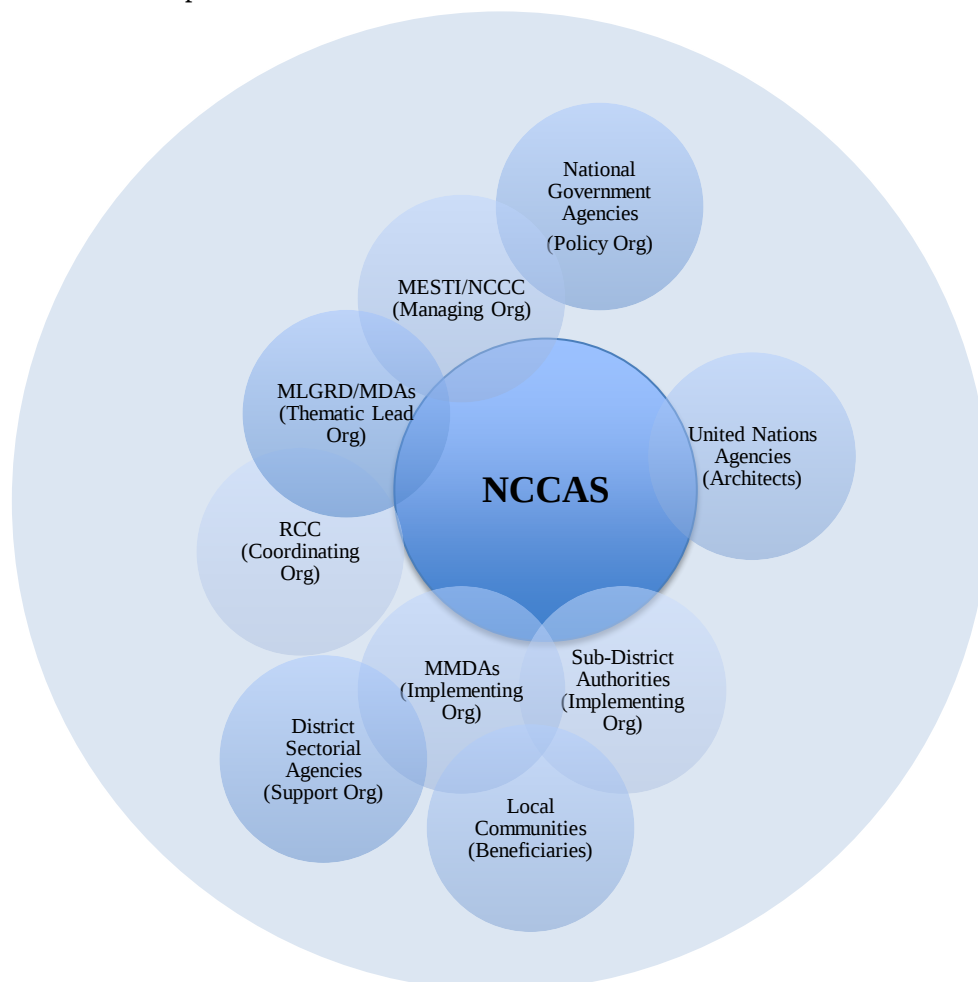
the Government of Pakistan (GOP) in 2010 led ‘environmental pollution and ecology’ to become the legislative domain of the provincial assemblies. As a result the Ministry of Environment was cut to a division in 2013 (only to be reinstated as a Ministry of Climate Change in 2015) with a meagre funding commitment of only USD 250,000 in 2014 (Shahid, 2014), which demonstrates the GOP’s failure to recognise climate change as a serious threat. Disasters, particularly floods, that ravaged the country in 2010 and 2011, spurred the GOP to develop the National Climate Change Policy. Whilst this was a landmark event, the policy has yet to yield results, although plans are being formulated. Therefore the role of I/NGOs and donors in shaping climate change policy is important while government officials lack capacity and resources.

Ghana

Ghana, another lower middle-income country, has also yet to initiate the NAP process. In 2012, Ghana released the National Climate Change Adaptation Strategy (NCCAS) that outlines a multi-sector adaptation strategy, divided in ten principal working programmes. The basic goal of the NCCAS is to increase the country’s resilience to current and future effects of climate change by enhancing infrastructure and knowledge systems, and to reduce vulnerability in key areas, ecosystems, districts and regions. Figure 5 illustrates the meta-organisational structure of the NCCAS. The Ministry of Environment, Science, Technology and Innovation (MESTI) and the National Climate Change Committee (NCCC) jointly manage the NCCAS centrally, with the latter charged with day-to-day operation. However, the NCCC has not met since 2012, creating a vacuum in coordination and implementation. The autonomous Metropolitan, Municipal and District Assemblies (MMDAs), the lowest official administrative unit, assisted by decentralised agencies, assume local responsibility for

NCCAS development and implementation, based on priorities that emerge from the sub-district authorities. The Ministry of Local Government and Rural Development (MLGRD) supports the decentralised administration with coordination from the Regional Coordinating Council (RCC). The national government agencies of planning and finance provide detailed planning and budget guidelines to the relevant national Ministries, Departments, Agencies (MDAs) and MMDAs to prioritise adaptation into Ghana's national development structures.

Figure 5: GHANA - Meta-organisation structure of NCCAS and the component organisations involved in adaptation. The component organisations also have independent relationships outside the scope of the NCCAS.



Source: Ghana NCCAS (2012) and authors analysis 2015

Ghana has enjoyed over two decades of stable democracy with free, open elections. It has focused on decentralisation since early 1988, formalised in Article 240 (1) of the Fourth Republican Constitution, 1992. Of all prevailing factors, this decentralisation offers the greatest challenge and opportunity for its climate change adaptation initiative. Given the diversity of Ghana's environment and weather, local planning offers the specific responses required to protect rural livelihoods successfully in the face of climate change. This, however, depends on the effectiveness of decentralisation, and particularly fiscal decentralisation. Ghana's new budget has, in theory, fortified the MMDA's central planning and coordination by transferring funds directly through the MMDAs for distribution to agencies under their purview. Yet significant delays in the release of central funds to the MMDAs and the limited capacity of MMDAs to generate local funds (because of low income and development baselines) have reduced confidence in the whole system.

Table 2 describes the institutional variation in adaptation planning and implementation strategies across the three countries. We notice three things in a review of these comparisons: 1) Focus on local adaptation action, 2) Framework/strategies developed by non-governmental organisations as architects, and 3) Decentralised implementation approaches. These and other aspects are discussed in more detail in Section 5.

Table 2: Overview of focal adaptation initiative and the institutional elements in the three case countries of Nepal, Pakistan and Ghana

Features	Nepal	Pakistan	Ghana
Country status	Least Developed	Lower Middle Income	Lower Middle Income
Focal adaptation planning initiative	Local Adaptation Plan for Action (LAPA). Implementation of 100 LAPAs in 14 districts, covering 69 VDCs and 1 municipality in the least developed regions of Nepal	Local Adaptation Plan for Action (LAPA). Implementation of 13 LAPAs in the southern districts of Pakistan affected by flooding and drought	National Climate Change Adaptation Strategy (NCCAS). Implementation of NCCAS country-wide
Structure of adaptation planning initiative	Government-ratified national framework on LAPA, 2011, with focus on prioritising LAPA in official local and national development plans	Standalone donor-funded LAPA project, 2012 to develop proof of concept solution for inclusive and low cost adaptation and climate resilient interventions	Government programme, 2012, with focus on prioritising adaptation in country's existing national development structures
Funding commitment and source	USD 21.5 million – donor funded	USD 0.72 million – donor funded	Existing budgetary sources–No specified funding threshold
Duration	Perpetual (contingent on continuity of funding)	3.5-year project	10 years from 2010-2020
Framework architects	Developed by international and national organisations under Climate Adaptation Design and Piloting Project	Developed by Leadership for Environment and Development (LEAD) Pakistan – Local non-profit organisation	Developed by United Nations Environment Programme and United Nations Development Programme via Climate Change and Development–Adapting by Reducing Vulnerability Programme
Local adaptation planning framework	Seven-step process - sensitisation, vulnerability assessment, prioritisation of adaptation options, LAPA formulation, integration of adaptation plan in planning process, implementation and progress assessment	Six-step process - vulnerability assessment, capacity building, research, scientific verification, LAPA formulation (prioritisation of adaptation options), LAPA implementation and annual assessment	No specific framework but decentralised planning and implementation approach at district and community levels. Multi-sector adaptation strategy approach. Key elements include-sensitisation, capacity building, monitoring and evaluation
Rules linkage (Policy and governing rules)	The LAPA Framework, 2011 guided by National Climate Change Policy, 2011 and NAPA Framework, 2010. The LAPAs integrated in local and national plans under Local Self Governance Act, 1999 and guided by principles of bottom-up, inclusive, responsive and flexible planning	Standalone project with informal policy linkage, but guided by priorities under First National Climate Change Policy, 2012 and reporting rules of bilateral funder, though not explicitly mentioned	Broad links to Ghana's commitments to UNFCCC, Hyogo Framework for Action and National Change Climate Policy, 2014

Analysis and Discussion

We report the empirical findings, organised in the six sets of attributes developed in Table 1 and Figure 2, supported by the meta-organisational profile of the three cases in Section 4.

Organisational Attribute I- Formalisation of Adaptation Initiative

Formalisation refers to the legal structure or intent of the initiatives. How an initiative is formalised determines the types of component organisations attached to meta-organisation and the spectrum of the possible actions and outcomes.

All three countries have designed particular adaptation initiatives, with varied degrees of formalisation. The Nepal LAPA is a government led initiative under the formal LAPA framework 2011; the Pakistan LAPA has been organised as a stand-alone private project with engagement of local government agencies; while Ghana NCCAS is a more loosely organised overarching government initiative. Both Nepal and Ghana promote the use of existing official decentralised structures for local implementation.

Government organisations are generally more bureaucratic and hierarchal because they strive for order and control (Pugh, 1973). The government led meta-organisations in both Nepal and Ghana are indeed formal hierarchies that link the numerous government component organisations horizontally and vertically, from national to local levels, wherever relevant, such as the national ministries (e.g., environment, local development, agriculture, planning), local departments and agencies. Each participant component organisation operates with its own formal bureaucracy, mandate, reporting and accountability framework, which adds complexity. This, according to Young (2002), is the horizontal and vertical interplay that aims to reduce complexity by forging structural coordination linking independent units.

Embedding adaptation initiatives in the existing hierarchy, while avoiding the creation of parallel bureaucracies, means inheriting many deep-rooted structural, political and operational challenges. This may improve legitimacy in Nepal and Ghana by conforming to existing arrangements, but increases costs and complexity in managing the network of the component organisations. The challenges of integration and poor capacity at local levels means that adding climate change initiatives imposes an additional burden on local plans and budgets, which in turn means adaptation has a low priority. A survey in Nepal of representatives of I/NGOs, development agencies and government ministries, by one of the authors (Baral, 2013), on the key challenges in LAPA implementation (n=33) identified serious gaps in the information captured by LAPA and its mismatch with the designed organisational structure. These include poor local knowledge about climate change, risks of implementation, political patronage, corruption and irregularities in the system.

The Pakistan LAPA's set-up, as a stand-alone project with fewer participants, results in a much flatter structure with few reporting lines. This 'simple configuration' (Mintzberg, 1979) is currently less complex than the Nepal and Ghana initiatives, because it delegates control and supervision to the project manager with relatively independent implementation control to the local partners. However, as the Pakistan LAPA project matures and scales up nationally, it will need to add horizontal and vertical layers to connect with other relevant official and local organisations. This is likely to increase operational and structural complexity and therefore, may no longer be suitable for these new national-level challenges.

Organisational Attribute II- Institutional Environment

The Institutional environment comprises all institutions, laws, policies and forces that operate outside of the organisation structure but potentially impact the meta-organisation's performance and actions (Powell and DiMaggio, 1991, Daft et al., 2010). In a complex and broad field such as climate change adaptation, knowledge and action often reside outside individual organisational boundaries (Young, 2002, Powell et al., 1996). Hence, understanding the impact of the wider institutional environment is directly relevant for effective implementation.

Both Nepal and Ghana have a dynamic and evolving climate change environment involving many institutions, actors, projects and policies. Nepal and Ghana are signatories to many multilateral conventions, protocols and agreements and both have seen a host of environmental and climate change policies and programmes. As a result, adaption has gained significant attention, notably through its inclusion in the national and local development plans. In addition to government departments in both countries, there are official research units, I/NGOs, private sector, multi-stakeholder platforms, all active in climate change. These actors and initiatives interact and influence the meta-organisational structures, bringing in their own expertise. One NGO head in Nepal involved in the LAPA development described the environment as consisting of parallel and competing mechanisms from central government, local priorities and external development organisations, each pushing the LAPA structure to align with their own objectives and structures.

This complexity in the meta-organisation of managing and balancing all these competing interests has resulted in a push towards embedding adaptation in existing bureaucracies in Nepal and Ghana. While the formal structure provides legitimacy to both Nepal LAPA and NCCAS, more time is devoted to maintaining the ritual

conformity within the institutions (Lawrence and Lorsch, 1967, Meyer and Rowan, 1977) than to action. This formality in structure also restricts entry of non-government organisations and, as Gulati et al (2012) describe, leads to a closed organisation structure with hierarchical decision making. However, to operate in a dynamic and complex environment, organisations need to be flexible (Robbins and Judge, 2010). This mismatch between the formal meta-organisation and the more organic approach of including and managing the many needs of all actors causes tension and delays in implementation. Thus, the closed meta-organisation may become increasingly unfit as implementation progresses. In Nepal, project managers initiated a further planning cycle of 30 LAPAs instead of moving towards implementation upon completing the start-up phase of 70 LAPAs. Although more recently some projects identified under the LAPAs have moved to implementation using local service providers and budgetary support of the government. This skewed focus on planning nonetheless risks impeding the LAPA momentum. Analysis of climate organisations in Nepal (n=24) by the authors revealed that approximately 70% of stated objectives relate solely to policy, advocacy and planning.

Pakistan has few climate change actors, activities or policies and a weak climate change ministry, lacking status, power and resources, normally enjoyed by other national ministries (Shahid, 2014), which places adaptation programmes way behind other national priorities such as health and education. With little incentive to link up with any government department, the meta-organisation takes on a fragmented, donor-driven, project approach focused on particular people and places. The risk of expertise remaining restricted to few component organisations within the meta-organisation is high. While this allows the LAPA meta-organisation to become more proactive, it suffers from low legitimacy within government and will face integration challenges when scaled up.

One approach to offer a better fit with the institutional environment is to expand the boundary of membership to include non-government organisations at strategic points within the implementation structure, especially locally. Non-government organisations can offer expertise and resources missing in the official structures, without necessarily challenging government.

Organisational Attribute III- Participants and Roles

A central element of the meta-organisational structure is approaching appropriate decision-making component organisations to participate in the initiatives and matching them with roles for effective action. This is a demanding task because climate change adaptation cuts across so many organisations with a stake in the process. It raises questions about who should be involved, whose interests match the objectives and at what stage should they be involved. A typical starting point is to build a collaborative model by involving all relevant stakeholders. However this can lead to overcrowding, creating an unduly complex inter-organisational network riddled with conflicts, competition and bureaucratic turf wars. The meta-organisation architects greatly influence this participation structure. If governments are the architects then the meta-structure can be viewed as bureaucratic, formal and lacking balance. This, in turn, may inhibit participation by non-governmental organisations, and reduce the legitimacy of the meta-organisation in the eyes of valuable non-government organisations who may play critical roles.

Figures 3 and 5 show that the bureaucratic control of the meta-organisation in both Nepal and Ghana has indeed resulted in overcrowding and domination by government organisations with limited entry points for NGOs that could offer strong support (Mandell and Keast, 2008). As one LAPA adviser (Rijal, Personal

Communication, 2012) stressed, “we are also trying to convince the government that the definition of government [for LAPA] should include other delivery agencies like civil society, NGOs and private sector.” The alternative standalone meta-organisation in Pakistan has passive government organisations but attracts too few categories of participants therefore lacks legitimacy. Another challenge common to all three countries is the frequent inter-ministerial transfers of key personnel, which results in a disruptive loss of expertise.

Timing the inclusion of participants in the adaptation process is another key challenge identified by several interviewees in all three countries. The district officials in Nepal and Ghana complained about their lack of participation in developing the adaptation framework despite their central role in implementation and coordination. As a result the districts have little ownership of a process entrusted to them. Similarly the government entities in Pakistan have shown little interest in the LAPA, due to their lack of involvement, raising the question of the LAPA’s sustainability. Finding space for all the component organisations to participate and engage usefully in the meta-organisation is challenging but imperative for effective implementation.

One possible approach to ensure fair inclusion, promoted by Laurent Mermet (2011) in his Strategic Environmental Management Analysis, is to identify and include only those stakeholders that offer benefit for promoting adaptation and have a direct interest. For example, the traditional system of chieftaincy in Ghana offers an additional layer of local governance and control, but is not represented in the official decentralised structures, which leads to underutilising a potentially important institution. There is the potential for encouraging an open system by incorporating strong coordinating actors and roles. These coordinators provide reputation, status, resource or knowledge that could cause I/NGOs and other civil society organisations to self-select. The LAPA project management unit in Pakistan works closely with local partners to train and

empower them for effective implementation. This train the trainer approach encourages local organisations to proactively participate in the LAPA.

Organisational Attribute IV - Goals and Objectives

Goals and objectives are purposes to be achieved and their methods set an organisation apart from others, (Galbraith, 1995). Design has important implications for the organisational structure (Robbins and Judge, 2010). High-growth-oriented organisations, for example, tend to be different from those oriented towards stable-growth. Hence, a major task for any meta-organisation is to have clear and consistent goals for implementing adaptation that fit its structure (Amburgey and Dacin, 1994, Chandler, 1990).

All three cases have defined explicit goals and objectives for implementing their adaptation initiatives. Although these initiatives have focused on urgent country priorities, it is unclear if these reflect the same urgency and consistency across different component organisations. Both Nepal and Ghana have made concerted efforts to further align these goals with the national development goals by setting up inter-ministerial committees and climate desks in key ministries. However, in both countries, the lead component organisation, the ministry of environment, is policy-setting only with no presence on the ground, hence it has to rely on others for implementation. Formal coordination of these decentralised bodies is often harder to achieve as local component organisations may be unwilling partners and their own goals, priorities and strategies may not always coincide with the defined adaptation goals.

This creates challenges in consistently translating goals and objectives into planned actions across all levels. Furthermore, in demand driven planning systems, immediate development needs of local communities, such as lack of infrastructure,

generally take precedence over important long-term goals about climate risks, especially in the absence of knowledge about climate change. One VDC secretary in Nepal (Srisa, Personal Communication, 2012) aptly summed this limitation: “If the community does not demand adaptation interventions, how can we provide these in our plans”.

Another associated challenge is the time pressure to complete the adaptation development process within official annual planning and budget cycles, which leads to short-term actions and often disregards the gradual consequences of climate change. As one government official in Nepal highlighted, that if not given enough time for the development process, solutions are limited to the capabilities of the facilitator, community and the technical team, which may not fulfil the long-term objectives of adaptation. Although adaptation has gained more attention and action in Ghana by being framed as a development challenge to fit within the existing national planning goals, it continues to be broadly treated as an environmental issue that lacks any link between planned activities and climate change. This undermines the attention and allocation of resources, articulated by a senior national planning official. The simple Pakistan LAPA project structure, overcomes some of these alignment challenges through close coordination and oversight of the implementing component organisations. Despite these efforts, there is a risk that expertise bias in the implementing organisations seeps into the LAPAs’ goals. For example, if a component organisation has expertise in health, the chances are that health related adaptation actions might be prioritised unjustifiably. Accordingly, the meta-organisations need to be aware of alignment challenges early in the implementation process to counter the risk of distorting goals and objectives.

Organisational Attribute V- Core Processes

Core processes are the written documents, rules, procedures, communications and others that enable the emerging meta-organisations to translate inputs into actions and outcomes. These must align with the structure of the meta-organisation and component organisations to offer stability and enable them to deliver stated objectives (Henderson and Clark, 1990, Christensen, 2013). As adaptation is multi-scalar and multi-actor, output from one component organisation become input of another. These interactions increase complexity of information exchange, which may lead to formal hierarchical structures emerging to standardise and manage these interactions (Meyer and Rowan, 1977). However, better information flow and improved processes also reduce uncertainty, which allows for flatter, flexible and decentralised structures with fewer levels of management than traditional command and control systems (Pugh et al., 1969).

Both Nepal and Pakistan have developed detailed standardised core operating processes and toolkits for the meta-organisations, based on participatory approaches (Chaudhury et al., 2016a) to capture the complex nature of local information and translate it into meaningful implementation (see Table 2). By contrast, Ghana promotes existing budget guidelines, specifically the Functional and Organisational Assessment Tool (FOAT), to drive local action. FOAT is a performance-based tool for securing district development funds, however only 5% weighting is assigned to climate change activities within the planning performance metrics, therefore action is insignificant.

As adaptation helps address risks and uncertainties, a high degree of flexibility of meta-organisation structure and core process is needed to find the best fit. The Nepal LAPA for instance, is termed a 'living document' that sees this realignment as an iterative learning process. However, the operational structure, core processes and

participating components have been formalised under the government framework before roll out of the LAPAs. Flexibility is also often harder to incorporate in the “established and locked in bureaucratic structures that are comfortable with the way things are done”, according to an NGO head in Nepal (Dixit, Personal Communication, 2013). Tension and misalignment in meta-organisational structure and processes is evident during local implementation, where local administrative staff are expected to push the environment ministry’s agenda for which they are not accountable. Ghana’s transition from central to a decentralised fiscal and administrative system has also resulted in serious misalignment between the core processes and operational structure, especially in sector departments. The 2012 budget was the first attempt at a ‘composite budget’, in which the local government took a central role in coordinating and funding sector activity. However, the centre continues to exert control on the sector departments, such as agriculture, that results in multiple lines of authority between districts and the centre. This duplication, labelled by a district coordinator as ‘having two bosses’, results in competing structures that lead to misaligned and delayed outcomes. The FOAT performance requirement is also often met by mislabelling as adaptation many challenges, such as sanitation, that are already enacted. The stability and leanness expected of the meta-organisational structure is, paradoxically, managed by adding layers of oversight. The Pakistan LAPA’s project on the other hand, with few component organisations, offers great flexibility and autonomy to the project manager without external influence. However, this flexibility and discretion is likely to reduce when the project scales up and links with other actors. Core processes need to incorporate periodic review, to maintain alignment with the objectives and operational structures of the meta-organisation and component organisations. The cases studied demonstrate that this is not simple but necessary for successful implementation.

Adoption of core processes by component organisations is also more likely when these are viewed as credible and legitimate (Cash et al., 2003). However, challenges arise in communicating and translating the objectives of the adaptation initiative among the many experts and decision makers. Here, role of bridging or transboundary organisations (Cash et al., 2003, Berkes, 2009) that interact with component organisations to communicate, translate and mediate (Cash et al., 2003) information across levels is valuable for uptake of adaptation initiative. We see several potential bridging organisations in our cases that could improve information asymmetry, build confidence, and resolve issues, yet remain underutilised. In Ghana, the regional government agencies are well positioned to bridge between national and local levels, but lack resources and mandate to be effective.

Organisational Attribute VI- Adaptation Resources

The distribution of global funding is viewed more as a political decision than one based on rational economic theory (Moore, 2012). Organisations, therefore, claim legitimacy by adapting their structures to meet the funding covenants of donor and global initiatives (DiMaggio and Powell, 1983).

The Nepal NAPA, despite securing dedicated UNFCCC and donor funding was termed superficial by several interviewees involved in its preparation because the funding was considered insufficient to develop a comprehensive national plan based on evidence. The LAPA, although better prepared, builds on the NAPA priorities and hence, incorporates many NAPA limitations in its design. The LAPA is also supported through international donor funding, which has influenced it to create structures in line with the stringent reporting covenants of foreign funders. However, the global funding for adaptation is a fraction of that required by developing countries (Schalatek et al.,

2013). Despite this obvious gap, Nepal's continued dependence on foreign funding may adversely affect LAPA's momentum and may render the meta-organisation redundant should alternate funding sources (with separate reporting requirements) have to be sought.

Conversely, the focus of global climate funding for non-LDCs, such as Pakistan and Ghana, is skewed towards mitigation with only 10%-15% of the total committed to adaptation (Schalatek et al., 2013). Mitigation is justified by international agreements and national policies, but most adaptation is independent and privately financed and is driven by the interests of those most affected. This poses a challenge for Pakistan and Ghana in securing committed, adequate long-term global and local funding. Chronic delays in releasing annual district budgets by the Ghanaian government, and the low revenue base of poor districts have meant that climate measures are low priority. There is also the risk that adaptation initiatives in these countries lose direction and mould their structures to fit activities that attract greatest funding, rather than address the most pressing needs of vulnerable people.

Another challenge faced by the meta-organisations is the capacity and readiness of local component organisations to manage adaptation funding. The Nepal LAPA has committed 80% of the adaptation funding to local implementation. The estimated budget for LAPA activities ranges from USD 0.2 million to USD 1.1 million per VDC (UNDP, 2012), whereas the average annual government budget for each VDC is approximately USD 15,000–30,000 (GON's VDC Block Grant). VDCs managing budgets tenfold larger creates serious operational challenges and hence must be carefully managed to match the funding flows.

Organisational Attributes and Structural Fit

We observe the structural tension exerted by each of the six organisational attributes on the meta-organisations in each country (Figures 6, 7 and 8). At one end of the spectrum is the formal, central, mechanistic structure, while at the other is the informal organic structure that is flexible and able to adapt to changes.

There is no single universally applicable structure, but several tailored to local and regional circumstances that produce effective outcomes. Governments, being bureaucratic, favour mechanistic structures linking the numerous government agencies so institutionalising the delivery of adaptation, which is the case in Nepal and Ghana. However, layering bureaucracies with rigid processes may be counterproductive because flexibility is needed to manage the needs of the many participants seen in Nepal. Formal organisations are too complex and a solution is to keep organisations loosely coupled by offering flexibility at the core, to manage any conflict between practical activity and institutional conformity.

Alternatively, a void in the institutional arrangements narrows the organisational structure to the point that it loses legitimacy as observed in Pakistan. The Pakistan project appears flexible and impact driven, but has no official patronage and remains unnoticed, lacking credibility and scalability. In apathetic institutional environments, such as Pakistan, component organisations' show little interest and are motivated by routines, rituals and scripts (Campbell, 1998) embodied in LAPA's core, which leads to a mechanistic structure. Most noticeably, our analysis shows that organisational attributes do not act independently but act in combinations that complement or constrain emerging structures. This tension between mechanistic and organic structures in each country (Figures 6, 7 and 8), is the result of the different organisational attributes and pressures.

Figure 6: Pressure of organisational attributes on the meta-organisation structure

NEPAL

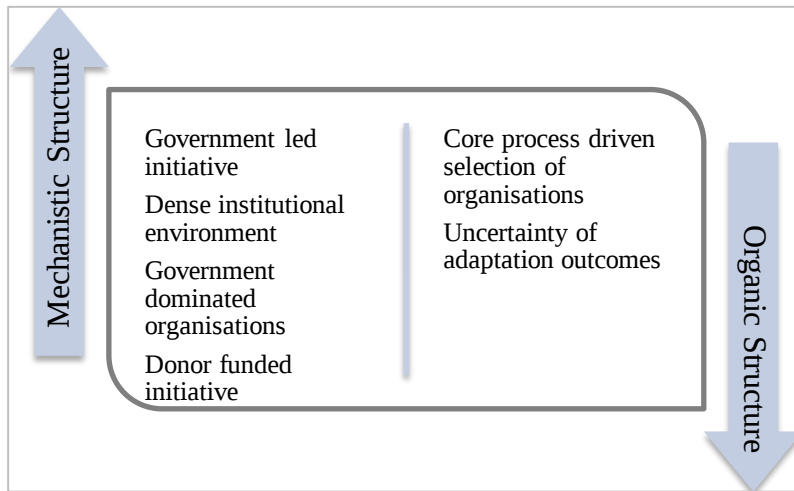


Figure 7: Pressure of organisational attributes on the meta-organisation structure

PAKISTAN

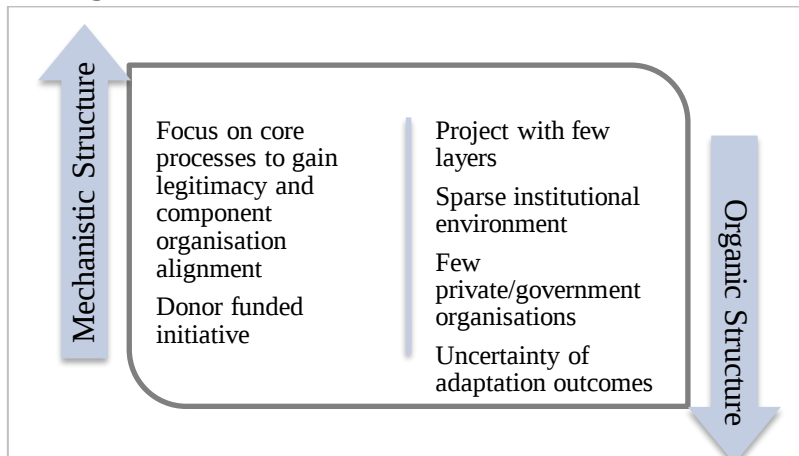
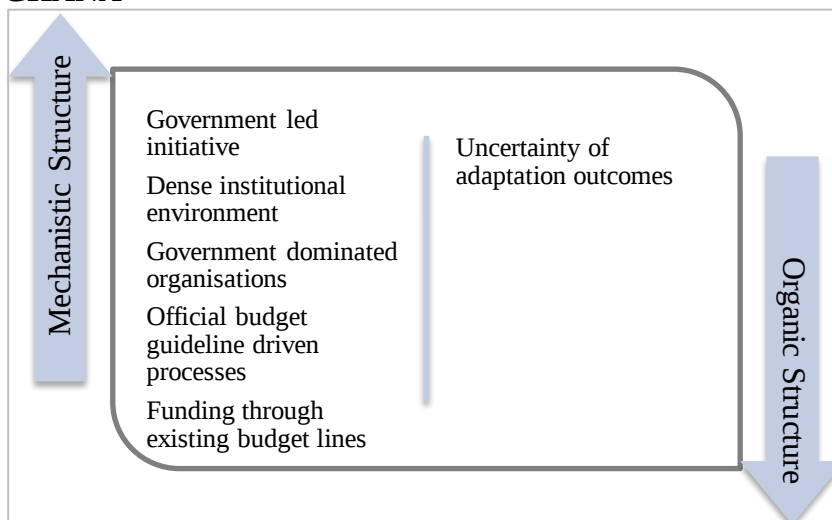


Figure 8: Pressure of organisational attributes on the meta-organisation structure

GHANA



Source: Author compilation (Figures 6,7 and 8)

Conclusion

This study reports on the early stages in the development of adaptation initiatives in three countries. These initiatives take on different forms, structures and pathways and are therefore harder to analyse using standard tools for assessing mature operations. We develop the analysis of these meta-organisations with their component organisations, to propose a common analytic framework. This naming allows us to describe better the underlying complexity and their extensive relationships. We use the rich empirical evidence to identify six common organisational attributes to describe meta-organisations. Our analysis highlights the opportunities and constraints these attributes impose on their implementation structures.

The analysis also shows that all three countries start with similar objectives for climate adaptation; however, the organisational structures of these initiatives are distinct, which leads to different pathways. Nepal's priority for an official formal process comes at the cost of delayed implementation. Pakistan's devolved implementation- approach lacks legitimacy and official acceptance to scale up nationally. In Ghana, the use of existing decentralised development structures and budgets relegates adaptation below other development priorities. The layers of legitimacy and accountability account for these differences, as well as the priority attached to adaptation relative to other development and political needs in each case.

Furthermore the emerging meta-organisations have different characteristics, namely rational, process-driven or bureaucratic (Allison and Zelikow, 1999). Each of these can increase legitimacy, as well as allowing space for bargaining and negotiation. The Pakistan LAPA project adopts the rational approach as it operates through a central project developer (Figure 4), with consistent preferences about the goals and actions to be taken by each component organisation. This is an attempt to gain legitimacy for its

design by demonstrating implementation success in a country with weak institutions and where climate change is a low priority.

Ghana's reliance on the existing decentralised development structures aptly falls under the bureaucratic model made up of multiple official actors (Figure 5) with different aims, who cannot deliver adaptation alone. This reinforces Ghana's efforts towards decentralised governance but means that action still requires much bargaining and negotiation by all the decentralised organisations. The unifying driver is the fiscal guidelines. However, those implementing continue to be heavily reliant on the central government for finance, which results in trade-offs between the wishes of central organisations and local needs.

Finally, the Nepal's LAPA meta-organisation can be considered a hybrid between the process driven and bureaucratic models, with a mix of private and official organisations (Figure 3). The procedures in the LAPA are guided by the appropriateness of participants and allocating roles. Nepal's attempt to drive action through the existing bureaucratic structures is to consolidate and centralise action and funding within the official system. There are many disparate streams for adaptation in Nepal, that operate through a network of NGOs and donor projects, which undermines the legitimacy of the official structures and leads to duplication. Private project managers justify this duplication as necessary to bypass the rigid and slow official systems to deliver desired results. These structures may have to become more open and flexible meta-organisations to cope better with complexity, goal ambiguity and provide greater participation.

The challenge for effective implementation lies in developing flexible, robust, systems that address complexity and uncertainty, the long-term nature of adaptation, and the variety of actors, roles, and local country dynamics. Our aim is not prescriptive. Indeed, we caution against prescription based on the evidence. Instead we propose the

analytical approach as a starting point to explore the nuances required to implement climate change adaptation. Focusing narrowly on design, without considering the delicate relations among components of a meta-organisation, leaves any initiative vulnerable to misalignment, and other barriers to implementation. Our structural analysis approach offers another tool to support national policy makers and planners in designing effective means of adjusting to climate change. As the adaptation field matures, we are likely to see greater homogeneity and predictability in the designs and outcomes. However, the challenge remains: how do we put in place the right incentives, measures, feedback and selection to ensure that adaptation initiatives are responding to real and diverse needs? We invite fellow researchers and practitioners to take up this challenge.

Acknowledgement

This paper would not have been possible without the project and financial support of CGIAR Research Program on Climate Change Agriculture and Food Security (CCAFS). We would like to thank our colleagues from the Environmental Change Institute, University of Oxford and LEAD Pakistan for their invaluable feedback on the paper, and Michael Kettlewell for his editorial assistance.

7. EMPIRICAL PAPER 2

Ties that Bind: Local networks, Communities and Adaptive Capacity in Rural Ghana

Abrar Chaudhury^{*1,2}, Thomas Thornton¹, Ariella Helfgott^{1,2}, Marc Ventresca³, and Chase Sova^{1,2}

¹ Environmental Change Institute, University of Oxford, UK

² CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

³ Said Business School, University of Oxford, Wolfson College, UK

*Corresponding Author

Journal of Rural Studies 53 (2017): 214-228: Published
<http://dx.doi.org/10.1016/j.jrurstud.2017.05.010>

*Abrar Chaudhury

Environmental Change Institute, University of Oxford, UK

abrar.chaudhury@ouce.ox.ac.uk , abrarchaudhury@gmail.com

+(44)7861478411

Abstract

Current models of adaptation to climate change focus on common causes of vulnerability among individuals and communities in an attempt to improve their capacity to adapt. These models tend to neglect the impact on vulnerability of local relationships that include political and economic power structures. We use social network analysis to examine the connectivity and positions of vulnerable rural households and their capacity to adapt. We collected empirical data from a community of 58 smallholders in upper west Ghana on external relations with 'local organisations' that are independent, operate beyond the community yet have direct relations with the community. These connections provide important resources and knowledge to build adaptive capacity that would not be generated from within the community. Our results highlight that certain external relations expose households to knowledge and other forms of capital, which in turn strengthen their ability to access and mobilise resources to respond to environmental change. However, not all external relations offer equal opportunities, which results in a stratified community and variation in the households' capacity to adapt. The network approach also identifies points where local organisations can link communities and households to remote agencies crucial for planning and implementing effective adaptation.

Key words: Adaptation; Adaptive Capacity; Rural Agriculture; Climate Change; Rural Community, Social Network Analysis; Vulnerability

Introduction

The design and delivery of effective strategies to improve the capacity of vulnerable rural populations in developing countries to adapt to climate change is complex. This complexity originates from the scale and nature of both climate change and adaptive capacity that cuts across sectors, populations and geography (Berkes and Folke, 1998, Adger et al., 2005, Cash et al., 2006, Ostrom, 2010a). It is particularly important for agriculture (Sage, 2013), which is the largest source of income and jobs for poor rural households, supporting 40% of global population and providing 80% of food consumed in most of the developing world (UN, 2012). Higher temperatures in many regions reduce crop yields and changes in rainfall increase the risk of crop failures and poor production (Nelson et al., 2009). Consequently, the many actors within agriculture must collaborate and combine their expertise and resources to tackle the threat from climate change. This requires specific strategies for the rural vulnerable as well as active cooperation among independent bodies (Chiotti and Johnston, 1995). In this paper, we focus on rural agriculture communities and their interactions with outside actors to study adaptation to a changing climate.

Managers in developing countries are increasingly emphasising human vulnerability and strategies for increasing capacity to adapt to climate uncertainties (Heltberg et al., 2009, Adger and Kelly, 1999). Community action, especially in a rural setting, has emerged as the preferred level for most initiatives as this is where the main impacts of climate change are experienced and thus where the most effective and timely responses are required (Schipper et al., 2014, Ostrom, 2010a, Lyle, 2015, Satterthwaite, 2011). While community action is gaining attention, it often underemphasises the role of variation within a community. Communities can face similar threats, but the capacity of any individual or household to cope and adapt to these threats largely depends on

their personal networks, attributes, livelihoods and capital bases (Vincent, 2007, Notenbaert et al., 2012). Rural farmers, faced with drought, that have alternate sources of income may make the difference between ruin and survival. It is, therefore, important not only to examine action at the community level but to also delve into the community to target help. Strategies that fail to recognise individual differences and the contingencies and synergies between different adaptive processes and pathways (Thornton and Manasfi, 2010) may be unproductive and even exacerbate vulnerability.

The progress of adaptation in developing countries from theory and policy to implementation depends upon the important role of actor networks (Yaro et al., 2015, Agrawal, 2010). The scientific literature recognises that strong networks are essential for improving everyone's adaptive capacity (Füssel and Klein, 2006, Bodin and Crona, 2009, Cassidy and Barnes, 2012, Cleary and Hogan, 2016), but there is very little published about the methods and analysis of such human systems or complex local networks required for adaptation. This paper uses social network analysis (SNA) to examine community relations with outside actors to understand better how they influence social structure and in turn adaptive capacity, which would not otherwise be apparent from traditional community-based research. We draw attention to relationships, network structures and network positions as crucial to understanding the adaptive capacity of both households and the community. Social network analysis (SNA) is an innovative theoretical and methodological approach for analysing community structures through visualising and measuring members' relations with outside actors (Marsden, 1990, McCarty and Bernard, 2003).

We apply SNA to the external relations of a rural community of 58 smallholders in Upper West Ghana with 'local actors'. We define local actors as those that are independent, operate beyond the community yet have direct relations with households. These local actors provide important resources and knowledge that would not be

generated from within the community. Our research has two key objectives. First, we seek to understand the potential effect of external relations upon community structure and the network positions of households with the community through local actor networks. Second, we seek to map the association between the network positions of households and their capacity to adapt by using selected household adaptive capacity indicators and network measures.

Theoretical Development

In this study we apply a multi-disciplinary approach, using ideas from climate vulnerability, adaptive capacity and networks to study adaptation in rural communities. The concepts that underpin our research are often subject to wide interpretation both in practice and in theory. Our focus is on the broad climatic challenges faced by agriculture in rural communities and the role of local networks in shaping capacity to adapt to these challenges.

Vulnerability and Adaptive Capacity

Human adaptive capacity and vulnerability are interrelated and have been widely discussed in the literature (Smit and Wandel, 2006, Adger, 2006, Ribot, 2010). The often-cited United Nation's Intergovernmental Panel for Climate Change definition of vulnerability is the "degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes" (McCarthy et al., 2001). Simply, vulnerability is exposure and sensitivity of a system to hazardous conditions. Adaptation is a manifestation of the capacity to reduce the vulnerability of a system, region or community to survive the consequences of climate

change or exploit beneficial opportunities (IPCC, 2014c). Availability of adaptive measures does not necessarily reduce vulnerability because it requires people's capacity to implement those measures (Füssel and Klein, 2006), which is often a question of political and economic power rather than simply adaptive capacity (Ribot, 2011). System level action is important because it emphasises the interplay between social and ecological schemes but it neglects inequalities within societies. Societies are often severely stratified, in terms of opportunities, power, influence and access to resources (Lenski, 1966). For our study, we focus on vulnerability and adaptive capacity at both the community and household levels.

Adaptation programmes focused on agriculture and food security are designed to help vulnerable populations as well as the broader ecosystem cope with climate change. Populations are assessed to identify how best to assist them based on their socioeconomic and environmental characteristics, such as age, poverty, climatic risks and the ability to choose strategies that are important to them (Füssel and Klein, 2006, Ribot, 2010, Chaudhury et al., 2016a). The current models for adaptation, however, face several challenges. The first is that adaptation does not have a widely accepted definition (Smit et al., 2000, Füssel, 2007). Adaptation measures are usually constrained by complex links between social and ecological systems (Berkes and Folke, 1998) as well as human and biological activity (Thornton and Manasfi, 2010). Second, adaptation is seldom an exclusive response to climate change but also to wider development deficits. (Berrang-Ford et al., 2011). Efforts to separate adaptive from development measures are often futile (McGray et al., 2007). The development field is widely studied and has its fair share of critics who draw attention to problems of power, agency, political and cultural bias, and neoliberal capitalist-incentive approaches (Ferguson, 1990, Mosse, 2004). These critiques have generated various solutions for reducing vulnerability and improving capacity to adapt, with differing emphasis on

governments, markets, and communities to lead the process (Chambers, 1994, Mikkelsen, 2005). Evidence, however, suggests that no single model works in all circumstances (Ostrom, 2010a, Adger et al., 2005) but they all share a common focus that addresses local vulnerability, while drawing on different methods.

Despite the ambiguity in defining vulnerability and adaptive capacity, considerable progress has been made to develop indicators for measuring local adaptive capacity (Vincent, 2007, Thornton and Manasfi, 2010). Based on published research, we have identified several household adaptive capacity indicators for analysis (refer to Table 2 in Section 4 – Research Design and Methodology). These indicators enable households to respond effectively to unexpected challenges, adopt remedies and take advantage of new opportunities to improve their capacity to adapt (Jones et al., 2010). Although it is challenging to measure adaptive capacity, we will relate these indicators to the connectivity of the rural households to understand the link between the two.

Adaptive Capacity and Local Organisation Networks

Managers focus exclusively on causes common to all units when faced with models for adaptation that are based on factors of vulnerability occurring within and not between social units (such as individuals, households or communities). Efforts are then directed to alter these attributes in order to improve capacity to adapt to threats. However, most vulnerability driven models tend to overlook that individuals do not exist in isolation but function within an interactive society, characterised by unequal power relations (Cameron, 2012). These interactions often include many other external actors who may provide knowledge and resources that help those coping with climatic challenges. The literature identifies several determinants of adaptive capacity, including, improved access to resources and technology, better knowledge and

information, good infrastructure, respect for local knowledge and a well-functioning social system (Ribot et al., 1996, Smit and Pilifosova, 2001, Yohe and Tol, 2002, Vincent, 2007). Availability of many of these largely depends on an individual or household within the community who connects with local actor networks to overcome the disadvantage of size and location (McKitterick et al., 2016). Each time a farmer sells produce in the market or learns about novel practices there is the potential to adapt. We argue, therefore, that the adaptive capacity of individuals or households is not only affected by these traditional measures but is also closely related to connectivity and networks (Janssen et al., 2006, Cassidy and Barnes, 2012).

Network analysis has the potential to capture the multiplicity of relationships among actors, the structure and quality of networks and their contribution to adaptation rather than examining individuals and their attributes in isolation, (Hanneman and Riddle, 2005, Borgatti et al., 2013). Variation among actors is linked to the constraints and opportunities that arise from the way these actors are embedded in networks. The resulting network structure and behaviour are shaped by these local interactions (Powell and DiMaggio, 1991) and differences are extremely important in understanding vulnerability and adaptive capacity of rural communities.

Network analysis can be approached from several perspectives, such as the internal relations within a community or on particular types of relationship. Newman and Dale (2005) suggest that members of a community are bound together by a dynamic mix of bridging or external and bonding or internal relations. The bridging relations extend beyond the communities and provide access to various resources and opportunities, strengthening members' ability to adapt (Granovetter, 1973). Bonding relations, such as with family, friends and other community members are necessary to absorb the benefits offered through bridging ties (Newman and Dale, 2005, Bodin et al., 2006, Tompkins and Adger, 2004). Complementary bridging and bonding relations

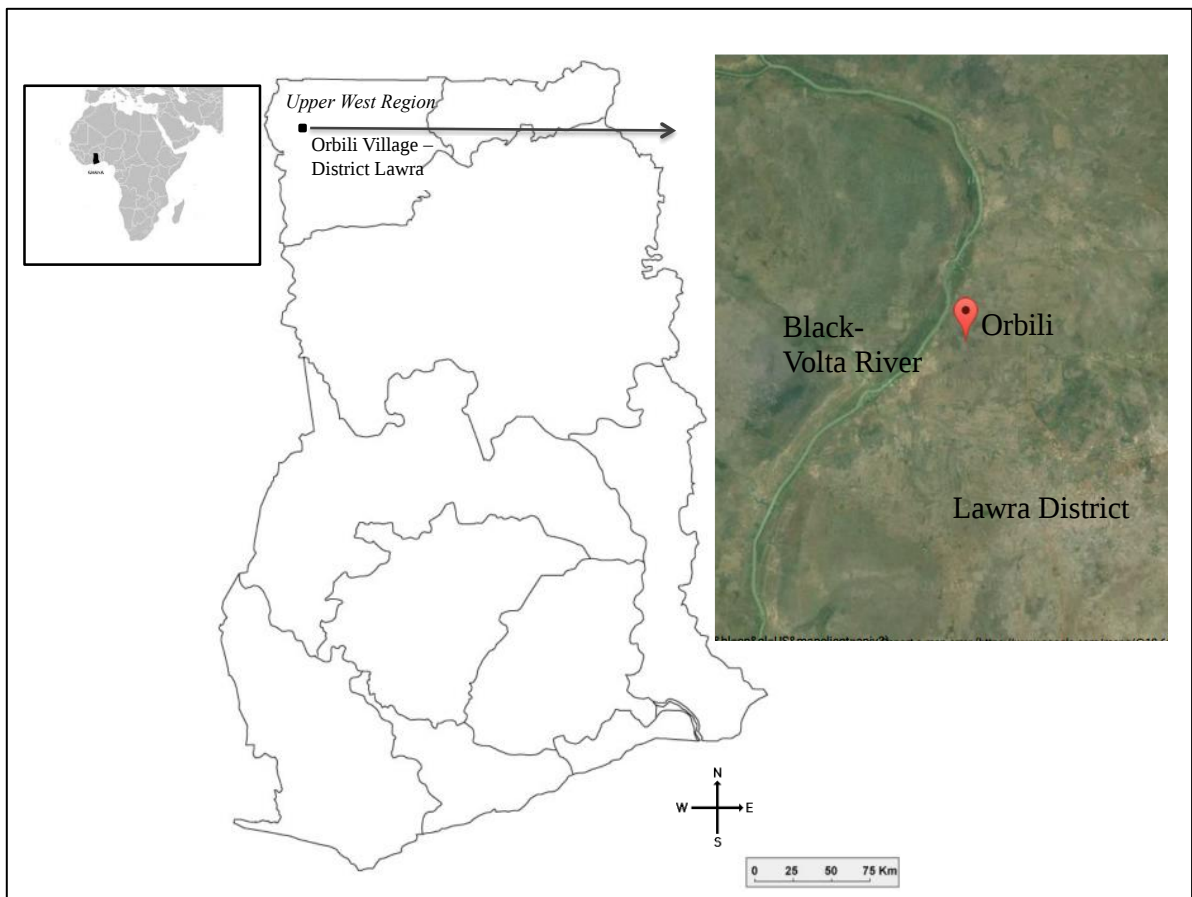
provide for greater capacity (Newman and Dale, 2005). Thornton and Manasfi (2010) further emphasise that not all adaptation is local, particularly when influenced by wider socio-ecological issues. Bridging relations determine and deliver adaptive capacity through numerous external actors. For example resources may flow from local governments or markets to communities, while knowledge on improved farming often comes through civil society actors. The reality is that many agents interact with communities to influence their members' network positions and, in turn, their capacity to adapt. The importance of external actors for building community capacity is increasingly recognised (Yaro et al., 2015, Agrawal, 2010). The question is not simply one of finding the right balance between bridging and bonding relations, but recognising contingency, the fact that one relation can impact another, thus altering the social fabric of a community for good or ill. In this research, we focus on bridging relations of rural communities with local actors to understand the bonding structures and their capacity to adapt.

Research Setting

The setting for this study was a village, Orbili, in Ghana's Upper West Region. Ghana is ranked as highly vulnerable to climate change, and is confronted by increasingly variable rains, floods, and droughts, threatening livelihoods and food security of their local populations (McSweeney et al., 2010a). This region of Ghana (Figure 1) is considered to have the lowest adaptive capacity in the country because of low socioeconomic development and reliance on rain-fed farming (Antwi-Agyei et al., 2012). Several environmental and climatic conditions make the region particularly challenging for farming. Firstly, the north has one rainy season with a short growing

season, while the south has two or three. Secondly, most rural farmers use manual labour that severely limits production, yield, income and food security. We selected Lawra District because it is home to several baseline study sites (Naab JB et al., 2011). Eight possible villages were shortlisted from within these sites. We visited each village to evaluate 1) community desire to have researchers present, 2) transportation/logistics, 3) size and social dynamics (a representative population), and 4) livelihoods and production patterns reflective of the region.

Figure 1: Map of Ghana showing our research site in Upper West Region



Source: Original Ghana map from: www.mapsoftheworld.com

According to the official district records¹, Lawra district has 120 villages with an average size of 54 households and a median of 43 households. Orbili Village, with its population of 156 adults in 58 rural households, offered a representative setting for the SNA study. The community is ethnically and linguistically homogeneous and all residents are smallholder farmers, with few having formal employment. No farms are sufficiently productive to avoid coping strategies to last the long lean dry season when grain stores run empty. Orbili is located by the Black Volta River that divides Ghana from Burkina Faso (Figure 1), which allows farmers to engage in labour intensive dry season vegetable farming. The produce is then sold in weekly markets over three to four months of the dry season. Surveys and workshops identified several climate stressors such as variable rainfall and soil degradation. The proximity of Orbili to the district capital of Lawra city offers ample opportunities for villagers to forge relations with formal and informal actors to improve agriculture. Existing baseline information on the area supplemented the analysis (Naab JB et al., 2011).

Research Design and Methodology

We applied a mixed methods approach of network and qualitative analysis supported by direct field observations (King et al., 1994), to capture the community and local actor networks. We collected relational and qualitative data over several months of field research through workshops, surveys, network mapping and detailed semi-structured interviews. These data were supplemented with original work on network and content analysis of the adaptation framework and policy documents from Ghana (Chaudhury et al., 2016b, Sova et al., 2014). Figure 2 illustrates the scheme of our approach.

¹ Data on village households in Lawra District were provided by the District officials at Lawra

Multi-Relational Two-Mode Network Design

The social network approach allows us to present the complex interactions between Orbili households and local actors within one structure. The literature on SNA is broad and well established. Scott and Carrington (2011) and Wasserman (1994) provide a detailed review of the theory and methods behind SNA. For this study, we amplify SNA methodology as a set of nodes that are tied by one or more types of relationships (Wasserman, 1994). The nodes or network members represent households and external local actors, while the relationship between nodes refers to specific types of interactions to exchange resources and knowledge (Haythornthwaite, 1996, Borgatti et al., 2009, Marin and Wellman, 2011). Under graph theory, these social relationships are represented on graphs as points and the relations between the nodes as lines (Scott and Carrington, 2011).

We are interested in studying the association between households' network positions, shaped by their bridging relations with local actors, and their capacity to adapt. This raises a methodological challenge. It is difficult to observe the effect of bridging relations directly on the internal community structure by using conventional network techniques that capture internal bonding relations. To overcome this methodological dilemma, we employ a two-mode network approach (Borgatti and Halgin, 2011, Hanneman and Riddle, 2005) that maps relations between two different sets of nodes rather than the more frequent one-mode analysis that focuses on relations within a single set of nodes. The Orbili households comprise one set of actors. The other set of actors are the external actors identified by households. According to Hanneman and Riddle (2005), one-mode analysis measures relations at a micro level to infer structures at the macro level while the two-mode analysis enables greater understanding of 'macro-micro' relationship. Relations are assigned between

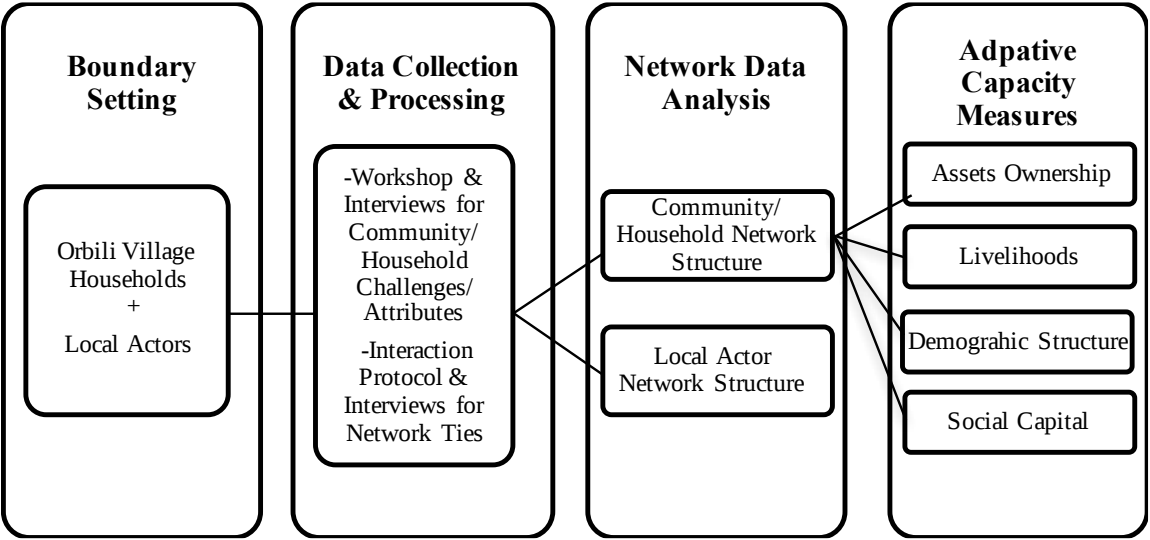
households if they share a common relation with a local actor. For example, if households A and B are connected to local actor Z, then A and B share a relation. From this two-mode network data we extract the one-mode community network shaped by bridging rather than bonding relations. Most social networks are concerned with a one-mode network, which offers conventional information on the actual bonding relations of households in a closed network. Instead the two-mode approach constructs an inferred or predicted one-mode closed network of possible bonding relations from their common bridging relations with local actors. This allows us to apply conventional network techniques to this extracted data to visualise and analyse households and their community (Borgatti and Halgin, 2011). The network and relations mapped from these two approaches are different as the data inferred from the two-mode data are not the same as obtained directly from households. Hence caution is needed in interpreting the results of the two-mode analysis (Hanneman and Riddle, 2005, Borgatti et al., 2013).

Despite differences in the two network approaches, the inferred structure from the two-mode network is suitable for our analysis because we focus on the relative position of households within the community, and not simply on the absolute network metrics. In this way the inferred network allows us to peer into community structures and relations that are not apparent from the one-mode network analysis, thereby offering a novel insight into the role of local actors on community structure, household positions, and adaptive capacity. We supplement the network analysis with qualitative data on the households.

We further take a multi-relational approach considered as a rich area of SNA (Wellman and Wortley, 1990). The literature identifies several determinants of adaptive capacity, such as access to financial, technological and knowledge resources, infrastructure, and the institutional environment within which adaptations occur (Ribot et al., 1996, Smit and Pilifosova, 2001, Yohe and Tol, 2002, Vincent, 2007). We focus

on two determinants that are driven by external relations and important for households in rural settings: flow of resources and knowledge transfer. Flow of resources, such as funds for labour or agriculture inputs, lead to improved farm productivity and diversity that creates a virtuous cycle of income and investment leading to improved adaptive capacity (Kelly and Adger, 2000, Howden et al., 2007). Resources are located at one node, so for the relation to form, these need to flow from the local actor to the community members. Knowledge transfer enables exchange of traditional and expert ideas between households and local actors that address the climate risks and encourage suitable adaptive practices (Folke et al., 2002, Chaudhury et al., 2016a).

Figure 2: Schematic of research methodology



Source: Author compilation

Boundary Setting

The starting point is defining the boundary of the analysis to determine which actors to include or exclude in the network mapping. A position-based approach (Laumann et al., 1989) is used that includes members belonging to an existing unit in the network. In our case, this boundary is naturally drawn around the 58 households in Orbili. A household is taken as the unit of analysis to capture the external relations of

the whole household, rather than just capturing those of the individual interviewed. Individuals within the households are considered as one household unit if they farm together, live together or share common income. Typically, the head of household was interviewed (mostly male), but where the head was not available, another knowledgeable member of the household was interviewed. In total 56 households were interviewed to collect demographic data, livelihood, and relations with local actors (two household members were not available at the time of interviews). With 97% of the households covered, the social analysis assumes fair representation of the Orbili community.

Local actors are those that are independent, operate beyond the community yet have direct interactions with community members. Local actors that do not have any direct interactions with the community are excluded from the analysis even if active locally. The Orbili households identified a total of 13 local actors. Our analysis is also limited to the ‘first order’ zone of the network meaning further relations of the local actors with other locals although captured from interview data, are not presented in this analysis to maintain focus on the community structure. Community groups, such as self-help groups, agriculture groups and volunteers are categorised as local actors because they are distinct and formal units active within Orbili. These community groups offer dedicated resource and knowledge support to its members and hence maintain relative autonomy from the general community.

Data Collection and Processing

Community and household attributes

We conducted a three-day community diagnostic workshop in Orbili and used follow-up interviews to understand the environmental and development challenges, and

coping strategies adopted by the community. Recognising these challenges identified local priorities and gained buy-in by the community. A total of 60 participants (26 men and 36 women) representing each of the 58 households, ranked challenges faced in farming, such as actions to overcome the challenges; mapped asset and institutions, and identified environmental and climatic challenges faced, amongst others. The four main challenges identified by the households were low income, low crop yield, low access to agriculture inputs and implements and variable rainfall.

Relation mapping

We developed the network analysis from the perspective of the community and therefore used a ‘directional’ approach to map the relations originating from a household to local actors. Primary relational data was collected from the 56 households through a detailed interaction protocol [refer to Supplementary Data for interaction protocol form]. The protocol captures four main aspects of the relations: length of relations, frequency of interactions, types of relation, and usefulness. While the first three aspects are specific, usefulness is open-ended to encourage discussion.

The framing question “who do you regularly interact with outside of your community for knowledge and resources?” was a ‘name generator’ (Burt, 1984) to solicit unbiased bridging relations with local actors rather than presenting a list of actors. We focused on relations with local entities rather than with individuals within them as entities offer general and stable units for analysis. This free choice approach placed no limit on the number of actors each person could identify, which captured the network breadth and reduced measurement errors (Holland and Leinhardt, 1973). The households identified a total of 13 local actors. We focused on supportive relations rather than negative. To differentiate between perceived and actual relations, we asked about their length, frequency and usefulness, supported by recent examples. These

attributes are not represented in the network structure as these were subjective and hence difficult to compare, but the information helped qualify interactions. We assigned weights to local actor relations based on their multiplicity and type using the equation.

$$W = \sum R R \quad \text{(Equation 1)}$$

Where W=weight of relation, R=type relations–knowledge and resources, (1=relation 0=no relation)

The interaction protocol was followed by an hour-long semi-structured interview with the household head to explore the relations more deeply. The analysis was supplemented by 20 follow-up interviews with the local actors and other prominent people to understand local challenges and interactions of local community.

Network Data Analysis

Gephi version 0.82 (<https://gephi.org>), an open-source SNA software, was used to visualise and analyse the data. The software creates network maps to represent relationships graphically and generates statistical data. Graphs and measures were generated for the weighted local actor network. From the two-mode network we extracted the one-mode community network using the ‘multimode’ feature in Gephi. This extracted one-mode community network offers a picture of community bonding based on the bridging relations with local actors. This is different from bonding observed directly and based on friendship and family relations that clouds the influence of local actors on the community structure. We used measures of network size, density, and centrality to analyse the local actor, overall community and household structures (Table 1). Degree and betweenness centralities identified the individual households within the community structure and the centrality association with adaptive capacity indicators. In the extracted network this represents households strongly connected to

local actors as opposed to households with strong internal bonding relations. We further used non-parametric Kendall's tau (Kendall, 1938) to assess the correlation between network measures and indicators of adaptive capacity, as the data were based on index values and not drawn from a probability distribution.

Table 1: Network measures for local organisation, community and household analysis

Network Characteristic	Measure	Link to Adaptive Capacity
Local Actor Network Structure		
Network Size	Network size shows the total number of local actors and their weighted relations with households	The network size gives the overall number of actors, relations and types of relations (resources & knowledge) (Hanneman and Riddle, 2011b) offered by local actors to households to improve adaptive capacity
Indegree Centrality	Indegree centrality ranks local actors based on their multiple relations with households	The indegree centrality identifies and ranks most prominent local actors that offer knowledge and resource support to the community and households to improve adaptive capacity
Overall Community Network Structure (derived from local actor relations)		
Density	Density is the proportion of all possible relations between households that are actually present in the network	The density of a network gives insight on the speed that information diffuses between households within the community network.(Hanneman and Riddle, 2011b) High density is beneficial as it makes the loss of a single household less disruptive to the overall network.
Household Structure (derived from local actor relations)		
Degree Centrality	Degree centrality ranks households based on their relations with other households	The degree centrality is a measure that identifies and ranks the most prominent households in the network and is a proxy for power, influence, trust, social learning and prestige (Ibarra and Andrews, 1993, Sparrowe et al., 2001). Centrality is important in times of change and rapid response as it improves coordination between households (Bodin et al., 2006).
Betweenness Centrality	Betweenness centrality ranks households on the number of	Betweenness centrality links different subgroups that allows

	times they act as bridge along the shortest path between two households	diversity in knowledge and facilitates learning (Hanneman and Riddle, 2011a). However, a high degree of separation between households may undermine trust (Bodin et al., 2006).
--	---	---

Adaptive Capacity Indicators

We used detailed household surveys to collect data on adaptive capacity indicators, based on Vincent's (2007) Household Adaptive Capacity Index that offers a comprehensive view of household structures. Table 2 presents the adaptive capacity indicators used in this analysis comprising asset ownership, livelihood, demographic structure and climate change awareness. While the literature identifies several indicators for adaptive capacity (Yohe and Tol, 2002, Smit and Pilifosova, 2003, Adger, 2006), we believe that the selected indicators offer a good base for our analysis in view of the local realities. This analysis is a novel step relating adaptive capacity indicators and network metrics that offers further opportunity for research to identify additional indicators and metrics in a variety of contexts. For example, reliance on natural capital was not included as an indicator since all households engage in agriculture and its effects could not be differentiated. Similarly, we did not include social capital indicators of community group membership and meetings attendance, as these were captured in the network mapping. Livestock was included under livelihood indicator because most was simply traded rather than owned as a long-term asset.

Table 2: Selected adaptive capacity indicators for households based on Vincent's Household Adaptive Capacity Index (2007)

Adaptive Capacity Indicator	Unit of Indicator
-----------------------------	-------------------

Asset Ownership - Land holding	Ownership in acres
Livelihood - Diversity (other than dry season farming) - Dry season farming - Planned improvements in farming	Number of different sources of income Engaging in dry season farming Increase in area of cultivation / improved techniques
Demographic Structure - Age of household head - Education level of household head	Years Education level (primary)
Social Capital - Climate Change Awareness	Understanding of local impacts of climate change on agriculture

Assessment and Management of Uncertainty

Network and social data is difficult to generate and is time-consuming especially at the local level since archival data does not exist. Even if it is collected, the approach raises issues of validity and reliability as well as ethical issues (Marsden, 1990). Having a well-designed methodology is important for generating credible and useful data, hence special attention was given to developing thoughtful and robust methods. Most of the empirical network data was collected through surveys and interviews and so we identified risks and setup mitigation strategies to minimise the risk of errors, omissions and mistakes. The risks involved characteristics of the interviewee, design of questionnaire and interaction protocol, interview process, language and translation. Mitigation strategies included triangulation of data through physical observation, pilot interviews to test and refine the questionnaire, use of skilled translators, audio recording of interviews (with consent) and use of independent translators to transcribe interviews. Use of software helped keep the data processing objective and transparent.

Results and Analysis

Local Adaptation Structures

Official development initiatives in Orbili are coordinated by the district assembly in Lawra, the lowest unit of formal governance in Ghana, supported by the traditional system guaranteed under the Constitution of Ghana. The chief of the village serves as the head of the community and spiritual leader under this traditional system and the community members view him as the ‘big man’ (Johnson and Earle, 2000), who leads by example and provides knowledge, skill, social support and protection for the community. A district chief executive (DCE), appointed by the president of the country and approved by the assembly, is responsible for administering development funding and priorities identified by the assembly. Local governance is therefore a form of partnership between government actors, the chiefs and their people. There are, however, significant political, administrative and coordination challenges in Orbili (and surrounding communities). The DCE is a central appointment, whereas the chief is non-political that results in a lack of engagement between the two. Isolation of the upper west districts deters central monitoring, which reduces Ghana’s efforts at fiscal and administrative decentralisation. This has produced significant delays in allocating funds to those working in the region, and also increased politicisation of the allocation. Despite the challenges, the official and traditional actors are key relations for the local communities to access development and adaptation resources. NGOs and market actors also play an active role in local development initiatives, however viewed as outsiders their efforts remain largely unnoticed in formal structures.

The Attributes of Orbili Community and Households

Households ranked low income, low yields, irregular rainfall, lack of inputs and education as the major challenges facing them. Coping strategies included alternative income streams from livestock trading, employment and dry season farming, improved farming techniques and agriculture support from the government amongst others. Many of these strategies required community members reaching out to local actors for support. The district agriculture department, mandated with providing extension service to the community, was identified as the main local actor for such support. Other actors included market dealers and community groups. The households also seek support from family and friends.

Asset ownership

Nearly all households (99%) own land with an average holding of 7 acres (range 2 to 30 acres). 25% of households own more than 10 acres. Most households also rear some livestock for their personal use, with few households owning large numbers.

Livelihood

Lack of education inhibits most villagers from gaining employment, with less than 10% formally employed. Households engaged in limited small-scale businesses during the year including charcoal production, brewing, and other services. The main household livelihood is rain-fed farming, dry season gardening, and livestock trading. Two-thirds of the households engage in 3 or more of these activities. Most, however, are trapped in a vicious cash flow cycle of using farming income to fund dry season farming and vice versa. The urgency to raise funds for inputs for the next harvest forces many households to flood the local market with low priced produce.

Demography

The average age of the household head is 43, (range 22 to 80 years). 33% of household heads are aged over 45. Shortage of mechanised implements (only 2 tractors were available in the entire district) and poor soils, forces households into intensive manual labour farming. This inhibits many older farmers from engaging in dry season farming, a vital income source in the dry season. We observed a strong negative correlation between the age of the household head and dry season farming (Kendall's tau = -0.4, $p < 0.001$). Over 90% of the household heads have no formal education. The school Orbili children attend is underperforming, resulting in low literacy.

Social capital

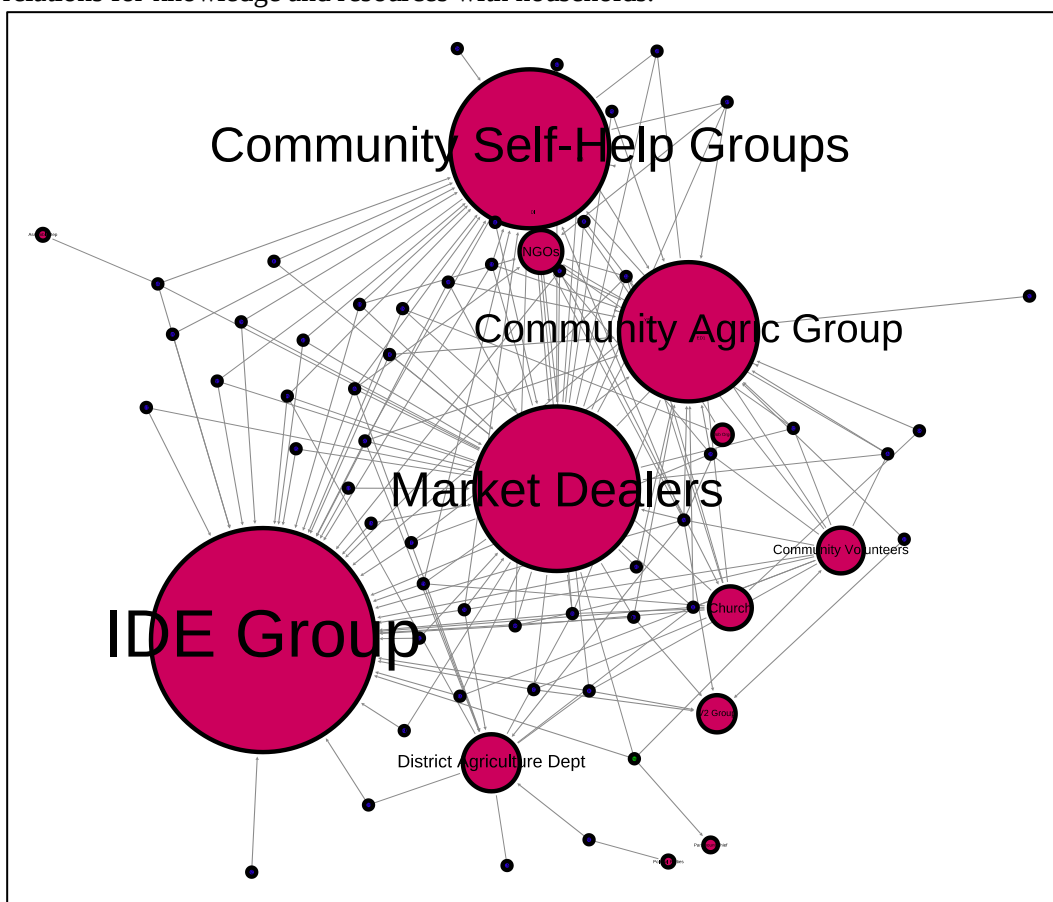
The community is ethnically and linguistically homogeneous. All members are ethnic 'Dagao, Degaari' speakers, except for a few women who have married into the village from the south of the country. All men in the village were born and raised there, signifying a high degree of kinship. The members actively participate in community self-help groups to support agriculture, women and youth issues, and offer small loans. All members also regularly attend meetings organised by the chief to solve community challenges and exchange information. The majority practice traditional religion and about one-third also attend church, identified as a source of knowledge and wellbeing. Over 85% of households showed some awareness about impacts of climate change on farming.

Overall the community is socially connected, although we observed significant variations in the different types of assets, attributes and capital possessed by each household.

The Structure of Local Organisation Network

Figure 3 and Table 3 illustrate the network map and ranking of local actors for the multiple knowledge and resource relations with the Orbili households. In total, the 56 households mapped interact with 13 local actors generating 192 direct bridging relations that translate to 302 weighted relations. The mean sum of weighted relations per local actor is 23 (median 12: range 1 to 76).

Figure 3: Indegree Centrality – Network map of weighted local organisations bridging relations for knowledge and resources with households.



Source: Author compilation

Notes: Nodes on the map represent the 56 households and 13 local organisations- red for local organisations, and black for community members. The node size of local organisations is proportional to the number of weighted relations connected to the node. The node size of household is set at minimum level since no relations connect into them

IDE group emerges as the central local actor in the combined knowledge and resource network connecting it to 38 households. These 38 households grow vegetables

in the dry season employing manual labour and are supported by IDE, an international NGO active in Orbili. IDE facilitates funding, knowledge, and expertise on farming techniques to dry season farmers by connecting them to local banks, identifying new markets, and aggregating produce. IDE's central role demonstrates how highly households value this resource that helps them decouple the funding trap of using farm income for dry season growing in the face of uncertain rains.

The next rank is market dealers that offer important access to agricultural inputs through commercial transactions and knowledge support. Self-help groups for agriculture, women, and welfare rank third, as many community members take part. The community groups provide much needed buffering through saving and pooling schemes in times of financial stress along with exchanges on farming techniques and financial management.

The district agriculture department ranks only fifth in the network linking it to 12 households, despite its official role as the knowledge hub for agriculture and policy. A frequent explanation offered by the agriculture department for this lack of engagement is shortage of extension officers due to a lack of funds and a national employment freeze. There is provision for 20 posts but only 10 officers service the district. Chronic delays, by the centre, in releasing district funds further reduces the effectiveness of an already understaffed department. The first quarter budget for 2012, for example, was released in last quarter of 2012. The V2 group and NGOs only offer targeted support rather than reaching out to the wider community. Interestingly, the two formal governance actors responsible for community administration and development, the traditional authority of the paramount chief and the district government represented by its elected assembly representative are ranked bottom at 11th and 13th connected with only 1 household. This lack of interaction is despite Orbili's proximity to the district centre, implying that the district government fails to capture the needs of the

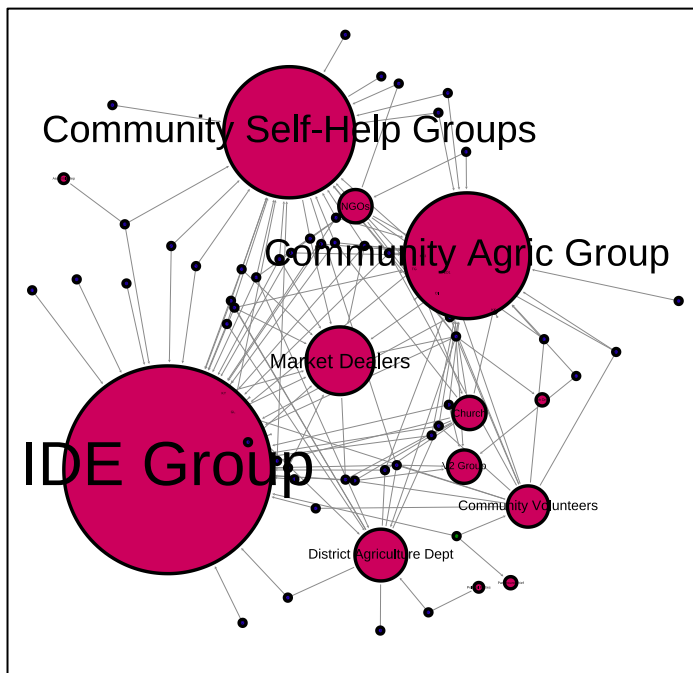
local community. The traditional paramount chief is only connected to the village chief highlighting the hierarchical structure of the traditional system.

Table 3: Ranking of local organisations based on total weighted indegree and for each type of bridging relation with the households. The top ranked organisation in each category is in bold

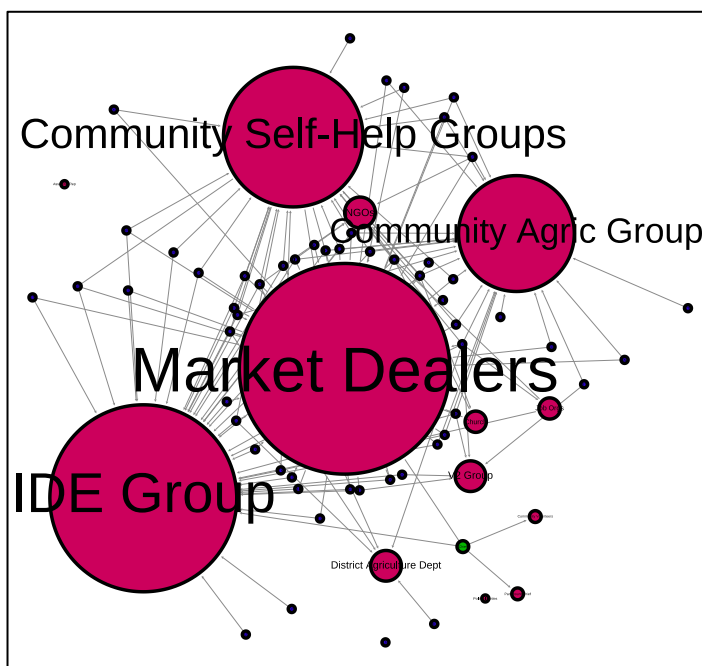
Local Organisation Particulars	Local Organisation Group	Households with Relations	Weighted Indegree (Fig 3)	Rank	Knowledge Network (Fig 4a)	Rank	Resource Network (Fig 4b)	Rank
Total Relations		192	302		147		155	
Mean		15	23		11		12	
IDE Group	Civil-society org	38	76	1	38	1	38	2
Market Dealers	Private sector	44	55	2	12	4	43	1
Comm Self-Help Groups	Cooperative	31	53	3	25	2	28	3
Comm Agric Group	Cooperative	24	46	4	23	3	23	4
District Agric Dept	Local govt	12	17	5	12	5	5	5
Comm Volunteers	Cooperative	12	13	6	12	6	1	10
Church	Civil-society org	11	12	7	9	7	3	8
NGOs	Civil-society org	9	12	8	7	8	5	6
V2 Group	Civil-society org	5	10	9	5	9	5	7
Job Orgs	Private sector	3	4	10	1	10	3	9
Paramount Chief	Traditional actor	1	2	11	1	11	1	11
Political Parties	Political parties	1	1	12	1	12	0	12
Assembly Rep	Local govt	1	1	13	1	13	0	13

Focusing exclusively on the overall weighted network may obscure the importance of some low ranked actors who are critical for specific help. Table 3 and network maps reflect that knowledge (Figure 4a) is more broadly acquired from local actors, whereas resources (Figure 4b) are concentrated on four actors with the rest offering very limited or targeted assistance. IDE is the most central actor in the overall network, but in the resource networks, market dealers take on the more central role, signifying their importance as providers of key inputs, especially in the face of uncertain rains and shortages of inputs.

Figure 4: Network map of local organisations bridging relations for knowledge and resources with households.



Knowledge Network (4a)



Resource Network (4b)

Source: Author compilation

Note: The node size of local organisations is proportional to the number of relations connected to the node. The node size of household is set at minimum level since no relations connect into them

We observe that offering resources and knowledge together by local actors is strongly correlated (Kendall Tau $-K=0.652$, $p<.01$). Thirty-eight equal resources and

knowledge and resources relations with IDE group, 28 resource and 25 knowledge relations with community self-help groups and 5 equal resources and knowledge relations with V2 group. Even market dealers that primarily offer resources, sometimes offer knowledge. This highlights that resource actors normally offer complimentary knowledge on using the resources, questioning the effectiveness of one without the other. The successful uptake of IDE dry season farming by the community is attributed to the right combination of knowledge and resources, making it practical for farmers to adopt and implement recommendations.

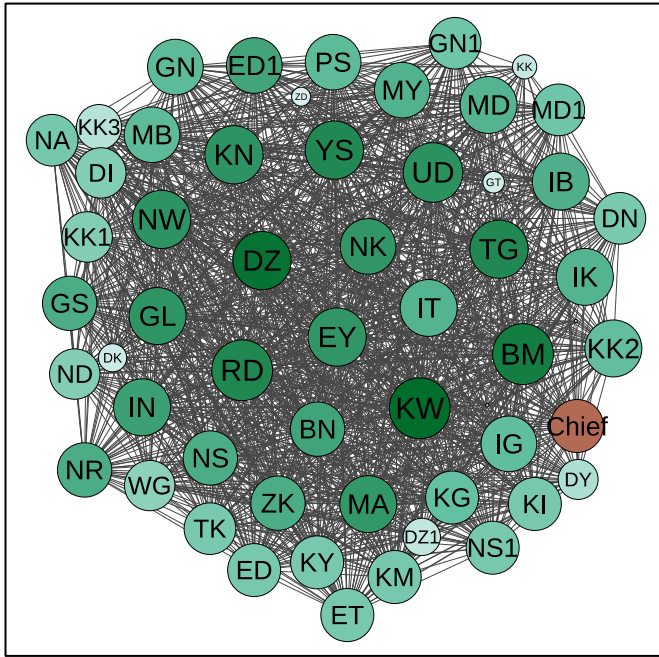
The structure of Household Network

The network maps 5a and 5b illustrate household centrality based on the degree and betweenness centralities in the network. The Orbili households appear strongly connected through their common relations with local actors. The one-mode community network extracted from the two-mode weighted network maps bonding relations of households, even when these are not observable directly (Borgatti and Halgin, 2011), and hence typically yields a higher density than one-mode networks based on relations that people claimed. Although the community as a whole appears densely connected, we observe a wide variation. The top-ten central households are on an average connected to 25% more households than the bottom-ten. Many of the bottom ranked households also have limited bridging relations with local actors thereby reducing bonding relations with other households. [Refer to Supplementary Data for details of households and relations.]

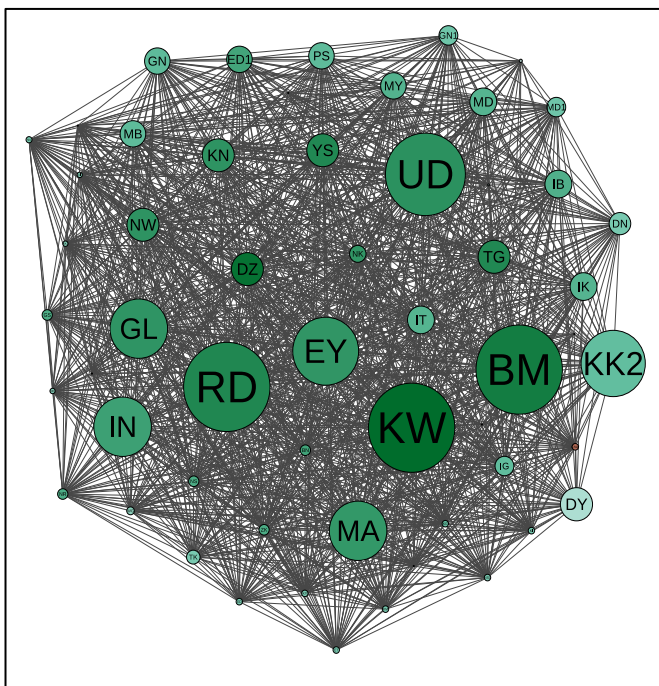
Analysing the degree centrality (Table 1 and Figure 5a), KW (Box 1) emerges as the most central figure and household in the community connected to all 55 households through 9 local actors. At the lower end, BD and LN (Box 2) are connected to only 11

households through 1 local actor. The betweenness centrality (Table 1 and Figure 5b) shows a more skewed picture of the community network with prominence of fewer households than in degree centrality, because of the wide variation in local actor connections. KW again emerges as a central figure, due to his relations with many varied local actors, however other central households become less prominent. The central households can offer others links to actors that they are not connected to, such as the V2 group and the district agriculture department. Although the chief (Box 3) enjoys a strong presence in the community because of his position as head of the community, in reality, the network graphs show that he is not well connected externally. Paradoxically, as a household, the chief ranks 40th out of the 56 households in the betweenness centrality ranking, as he is connected to only 4 local actors similar to most other households. Our interview data confirms that local actors and households view the chief as a fellow community member in need of similar resources rather than an expert with the ability to support the community in agriculture. Nevertheless, the chief offers potential links between the community and the paramount chief, as he is the only conduit to the paramount chief. When household nodes are examined for their external relations, a much clearer picture emerges of the prominence of some within the network and their bridging potential.

Figure 5: Network map of centrality of households extracted from bridging relations with 13 local organisations.



Degree Centrality (5a)



Betweenness Centrality (5b)

Source: Author compilation

Note: Nodes on the map represent the 56 households, connected through 2,626 inferred relations with density of 0.853. Initials of the household head are used for ease of presentation. The relations between the households are weighted to represent multiple relations. The node size and darker colour are proportional to centrality of the household.

Box 1: Profile of most central household – KW

Profile of KW Household

KW is the head of the most central household in Orbili, connected to 9 out of the 13 local organisations active in the community. Through these local organisations, he has common connection with all other 55 households in Orbili. KW is a male farmer, aged 31 with some formal education. He owns only 3 acres of land, but productively engages in modern rain-fed ridge and dry season farming. To supplement his income, he engages in 5 livelihood schemes of farming, dry season farming, livestock, employment and trading, against the average of 3 in Orbili. He is the secretary of the community volunteers, one of the only 5 model farmers for V2 livestock project, part of the IDE group, employed full time and a frequent visitor to the district agriculture department amongst other connections. Most households identified KW as a key source for external knowledge and connections. Faced with common community challenges of unpredictable rains and lack of inputs, KW has negotiated these through land improvements and crop management strategies. He acts as a model farmer for the district's new initiatives. He attributes his success to his seriousness in acquiring knowledge from local organisations and experimenting with the learnt strategies.

Box 2: Profile of least central household – LN

Profile of LN Household

LN is the head of the least connected household in Orbili, who only shares common connection to local organisations with 11 households. LN is a male farmer, aged 45 with no formal education. His main livelihood activity is managing livestock owned by his brother who resides outside Orbili. In return he is offered limited food and financial support. Livestock activity takes most of his time and attention, as he has to ensure that the animals do not encroach on other farms. As a result, LN has practically no relations with the local organisations, except limited interactions with the district agriculture department for gaining knowledge on improved agriculture practices. His farming activities are for household consumption. He is not part of any community groups and offered no coping strategies for overcoming unforeseen financial and environmental challenges.

Box 3: Profile of Orbili Chief

Profile of Chief Household

The chief is a male farmer, aged 60 with no formal education. He is the head of the community and a spiritual leader under the traditional governance system. He is the focal point for all external activities planned in the community. All community members regularly attend his monthly meetings organised for sharing information. However, when viewed as a household, the Chief ranks much lower in the community network at 31st and 40th out of the 56 households in degree and betweenness centralities, He is connected to only 4 local organisations but is the only organisation within the community connected to the paramount chief thus is the community's bridge to the traditional governance system. He owns 10 acres of land and engages in rain-fed and dry season farming and livestock rearing. He also earns income from performing administrative duty as the chief. He is part of the IDE dry season farming group, but not the community agriculture group. He is aware of climate change and has experienced it first hand through changes in rain patterns and increased wind speeds.

Household Connectivity and Adaptive Capacity

To examine the link between household connectivity and their capacity to adapt, we tested the association between centrality of households and the selected adaptive capacity indicators (Table 2). Table 4 shows the correlation between degree and betweenness centrality and indicators.

Table 4: Relationship of adaptive capacity indicators and networks measures of households.

Adaptive Capacity Indicator	Degree Centrality	Betweenness Centrality
<i>Asset ownership</i>		
-Landholding in acres	K=0.053	K=0.048
	p=0.600	p=0.627
<i>Livelihoods</i>		
-Diversity of livelihood (excluding dry season farming)	K=0.291	K=0.217
	p=0.007	p=0.041
-Dry season farming	K=0.356	K=0.339
	p=0.002	p=0.003
-Improvements planned in farm	K=0.029	K=0.089
	p=0.806	p=0.439
<i>Demographic structure</i>		
-Age of household head	K=-0.305	K=-0.28
	p=0.074	p= 0.004
- Education level	K=0.125	K=0.084
	p=0.087	p=0.471
<i>Social capital</i>		
Climate change awareness	K=0.074	K=0.042
	p=0.524	p=0.721

Note: Relationships significant below 0.01 level are in bold - K = Kentall's tau

Landholding is generally an important indicator for adaptive capacity as it enables farmers to produce more. We did not observe a significant correlation between land holding and centrality of the households. KW, the central household, for instance, owns 3 acres of land against the household average of 7 acres. A possible explanation for this lack of relationship is that for poor households' farming activity requires the right combination of relations in the right order (Füssel and Klein, 2006). The district agriculture department offers knowledge about improved farming methods with 12 relations but uptake is low in the community because the department offers few complementary resources, (only 5 relations). Farmers seek knowledge and resources together and hence many larger landholders do not seek external relations when the offer is limited. In fact over 90% of households were self-funding farming activities, and over one-third planned to reduce the land cultivated in the next season for lack of external support.

We observed a significant correlation between centrality of households and diverse livelihood and dry season farming. However, planned farming improvements, such as modern cropping techniques and expanding cultivation area did not correlate with centrality, which may indicate that farmers plans are independent of external influence. Having direct connections with multiple local actors offers households new knowledge, opportunities and accompanying support, thus creating a virtuous cycle of social learning, growth and rich relationships. Our local actor network analysis shows that IDE supports over two-thirds of households with dry season farming. Connected farmers acquire similar knowledge and resources from IDE to grow the same crops, share best practices and ultimately command higher pricing through pooled production.

The result is improved adaptive capacity for IDE group members. However, this high dependence on IDE can also increase vulnerability if diversity is lost. Granovetter (1973) argued that multiple bridging relations, as opposed to few strong ones, are a potential source of new information and innovation because they help actors connect with others currently unconnected. Strong relations offer similar information with many short paths between the actors through their common relation. The community experienced serious pest infestation in their vegetable gardens. All farmers were cropping the same vegetables and employing similar practices, encouraged by IDE, so pests spread quickly leading to significant crop destruction. Only one farmer, KW, coped with this infestation. From follow-up interviews, it transpired that KW, a central actor, had planted some different vegetables that survived the infestation. KW had several bridging ties, especially for knowledge, such as with the V2 livestock group and district agriculture department that the others did not. This allowed KW access to novel information through his various sources and enabled him to take risks, diversify, innovate and be more successful (Perry-Smith and Shalley, 2003, Borgatti and Lopez-Kidwell, 2011).

We observed a significant negative correlation between the age of the household head and centrality. In human systems, especially in subsistence agriculture, the age of farmers is a barrier to growing their network. Household heads aged over 45 average 15% and 50% fewer relations with other households and local actors respectively than their younger counterparts. This difference arises from the physical effort required for farming, especially in the dry season that inhibits them from doing anything else. Only 60% the household heads aged over 45 engaged in dry season farming compared to 100% under 45. The older farmers, therefore, miss the important IDE support facilitating funding and improved techniques to improve profitably. This then implies that if households fail to forge relations for resources it also stops them gaining knowledge about improved techniques and so become marginalised and vulnerable.

We did not observe any significant correlation between the centrality of households and their education level or their knowledge of climate change. Education in the community is low and so we were unable to observe its impact on the centrality of the household. However, the five better educated households in Orbili averaged 5 more relations than the others. Over 85% of the households claimed some understanding of the impacts of climate change upon farming especially that of variable rains. However, this awareness did not link to their centrality, partly because the district department of agriculture offered so little resource support that few households reached out to it.

In summary, network centrality informs some variation of adaptive capacity among households, while others such as asset ownership appear to be independent. Measuring both degree and betweenness centrality highlights the significance of some of the households through their diverse relationships but also as important conduits in the network for other that are less well connected.

Discussion

We demonstrate the utility of SNA for examining the bridging relations between Orbili households and external local actors. The results and analysis offer unique perspectives into the community structure, relative capacity of households to adapt, the role of local actors and the potential entry points for effective adaptation planning. The process is highly informative, although how effective these relations are in improving adaptive capacity requires careful longitudinal study beyond the scope of this project. Some of the pertinent factors are discussed below.

Bonding and Bridging Relations, and Household Stratification

Our analysis shows that Orbili households are bound by a dynamic mix of bonding and bridging relations. The community is ethnically and linguistically homogeneous highlighting strong bonds and yet we see significant variation in the bridging relations with local actors. As discussed earlier bonding relations are important for improved social capital, but it is through bridging that communities gain access to resources and opportunities not available locally. More bridging relations open up potential pathways to adaptation for households and improve their ability to link adaptation modes (mobility or diversification, for example) in synergistic ways. This helps connected households diversify their livelihoods, and break free from the resource constraints. For example, KW, the central household, has diversified income through acquiring knowledge from multiple local actors and experimenting with the learned strategies.

However, bridging relations can have an even greater impact on the community by influencing its very structure. Growth and preferential attachment mechanisms are common to a number of complex networks. Barabasi and Albert (1999, p510) conclude that as the network grows the older and connected nodes “increase their connectivity at

the expense of the younger ones, leading over time to some [nodes] that are highly connected, a ‘rich-get-richer’ phenomenon that can be easily detected in real networks”. This has important implications for adaptive capacity because relations with households are also often created by decisions of local actors, “based on information that is biased towards the more visible (richer) irrespective of the nature and the origin of this visibility” (Barabási and Albert, 1999, p512). These central nodes are also perceived to have a much higher status (Lincoln and Miller, 1979). We witnessed this phenomenon in Orbili, as local actors often nominate the more connected households preferentially for new initiatives. KW, for example, the central household, is identified by the district agriculture department as a reference farmer for most initiatives in the village, hence is connected to 9 local actors and is part of the most groups and activities in Orbili. Preferential attachment causes significant variations in household positions in the community structure, as many of those lower ranked don’t enjoy as good access to resources and knowledge, leading to variable adaptive capacity within the community. Several households expressed frustration at not being selected in the IDE group or not having links with the agriculture department, due in part to their lack of visibility. It is by viewing the community structures through the effect of bridging relations that we can begin to observe these variations, which in turn helps improve designs for effective and equitable adaptive strategies. However, more research and long-term observation is needed to understand better the effect of local actors on community structures.

Linking Household Connectivity and Adaptive Capacity

The social network data shows that households that are better connected to local actors have diverse livelihoods. These central households are exposed to more information and knowledge and are thus in a stronger position to grasp opportunities.

Taking an individual approach, one may attribute central households' higher adaptive capacity to their personal attributes such as age and education, but it can also be argued, based on the relational analysis, that it is their central position with bridging relations that connects households to vital and diverse sources of information that produces their higher adaptive capacity. Multiple bridging relations appear more important in improving adaptive capacity by offering numerous opportunities for diversification. By contrast, possessing only a few relations, even if strong, can increase vulnerability, as we observed in Orbili. However, bridging relations are biased towards younger farmers, as centrality drops with the age in Orbili. Support provided by some local actors, such as IDE's inputs for dry season farming, is not targeted towards the physical or mental needs of older farmers and so restricts their participation. This exacerbates stratification within the community and may lead to differential adaptive capacities between the younger and older household heads. A traditional approach might consider age as a particular vulnerability and hence prioritise help to the old. But the network analysis demonstrates that one possible reason for vulnerability amongst the elderly is a lack of connections to relevant local actors, which can be addressed specifically.

Our network analysis also highlights that connectivity of Orbili households through the local actor relations is not linked to some traditional adaptive capacity indicators, such as asset ownership, education and climate change awareness. Owning more land offers little advantage in improving the household's capacity to adapt in the absence of support from local actors. In fact cultivating more land increases the financial risk of crop failure. Awareness of climate change without tangible external support again offers little incentive to resource poor farmers to adopt adaptive measures.

Research also indicates that actors entrenched in the network, may not necessarily benefit from bridging relations, beyond that already acquired (Perry-Smith and Shalley, 2003). If centrality of an actor is too high, stress and conflict can become

overwhelming and constraining (Perry-Smith and Shalley, 2003). The network graphs in Figures 5a and 5b show that KW is the most central household due to his wide relations with local actors. Most households identified KW as a key resource. Some went so far as to say that without KW they are in ‘complete darkness’. While KW’s relations reflect a greater adaptive capacity, increasing them could overwhelm him and reduce his effectiveness. For example, KW’s offer to act as a teacher for a new school was short lived and he stopped teaching after a few months, citing illness. His role as a model farmer for the V2 project, demonstrating to others and liaising with the V2 team, was time-consuming and so reduced his own productive farming. Increasing the burden on well-connected actors may not increase their productivity to the same extent as those less connected and with more time. Strategies that rely on lead farmers as key knowledge disseminators need care to avoid overburdening these essential actors. For a network to deliver better adaptive capacity as a whole, it is important that bridging relations are more evenly distributed amongst the members, rather than concentrated within a few.

Identifying Entry Points for Adaptation Pathways

As adaptation moves to implementation, it is important to identify effective entry points for policy action into the local community through local actors. A traditional social capital analysis may well identify the chief as the main actor because of his traditional position and authority. While this may be true for some communities (Stein et al., 2011), our study shows otherwise. The chief’s household, is ranked low in the Orbili community network based on centrality yet assumes a vital bridging role (Granovetter, 1973, Burt, 2002), connecting others with traditional governance of the paramount chief. The paramount chief, as the traditional head of the region, is

influential in lobbying government for resources and development for his region. The strict traditional hierarchy, however, prevents ordinary villagers from accessing the paramount chief directly. Our results show that the chief is a poorly connected entry point or bridge into the community because his weak centrality lacks sufficient exposure in the community network so weakens his role in shaping adaptive capacity. The chief has no contact with the district agriculture department or the district assembly, identified by over 60% of households as important local actors for accessing official resources and knowledge. There are many other higher ranked households than the chief that have more relations with local actors and hence a potentially better grasp of the benefits and challenges of the community but lack direct access to the paramount chief to share this information directly. Our data suggests that enhancing the chief's connections would improve his and his community's adaptive capacity substantially. The network approach helps identify local entry points through observation rather than assumption. It also identifies particular weaknesses that can be remedied and delinks that can be enhanced. This structured network approach can be scaled up and replicated in wider settings.

A frequent criticism of adaptation programmes is that efforts are fragmented and operate through isolated, uncoordinated projects. They perform well initially but collapse once the stream of resources ends. Our study clearly demonstrates the essential adaptation role of a few key households and local actors, such as KW and IDE and therefore a serious potential weakness to delivering adaptation. The end of the IDE project, or the loss of KW through injury or illness would degrade Orbili's adaptive capacity. Therefore, identifying vulnerable points allows resilience and linkages among actors to be fortified.

Limitations and Ways Forward

However comprehensively relational data is collected, no network analysis is without limitations. The SNA in this study offers a complex, systemic view but at a single point in time that potentially overlooks the dynamic nature of relationships and networks (Tantipathananandh et al., 2007, Tang et al., 2009). However, attempts at dynamic studies raise the difficulty of defining when relationships start, change, and end (Doreian and Fararo, 1998). The creeping pace of development in the region slows changes in relationships and so does not invalidate our analysis. The network structure studied is also specific to Orbili and may be different elsewhere and even close by. While our conclusions are based on the specifics of Orbili, they have general applicability to providing adaptive capacity. Furthermore, we do not capture direct family and friendship bonding relations in the community. Such bonding networks offer interesting research opportunities for studying social capital and social learning but are beyond the scope of this paper. The true novelty of our research lies in studying implied and masked community structures shaped by bridging relations with local actors. Although, such community structures are inferred and different from those based on actual bonding relations within communities, our two-mode approach offers interesting opportunities for studying and comparing the two structures to improve adaptation planning.

Conclusion: Enhancing Networks to Improve Adaptive Capacity

This study offers a deeper understanding of rural community structures and adaptive capacity beyond individual vulnerability. Our data shows that a household's

capacity to adapt and its network position is linked, but it is difficult to be certain that connectivity leads to improved adaptive capacity or whether greater capacity allows households to be more connected. They suggest, however, that close relations with local actors improves responses to environmental change and associated problems (Walker et al., 1993), which can enhance household capability (Sen, 1984) and, in turn, influence adaptive capacity. These local networks also provide important links to distant planners and other resources necessary for effective adaptation implementation. This research provides a step towards establishing a link between networks and adaptive capacity and recognising their importance in rural community settings. By drawing community networks based on the external relations, we gain a clearer picture of the community structure, centrality and stratification of households, the role and changing position of local actors, and redundancy of networks in the social-ecological system. SNA complements institutional analyses of frameworks by showing the nature of evolving adaptive (or maladaptive) relations within the system. When combined, such a multi-pronged analysis could help optimise precious resources and time by ensuring that planning and implementing adaptation policies remains flexible, broad and resilient, rather than overly dependent on specific relations, institutions or actors.

Acknowledgement

This paper would not have been possible without the project and financial support of CGIAR Research Program on Climate Change Agriculture and Food Security (CCAFS). We would like to thank the wonderful community of Orbili for giving us unlimited access and Michael Kettlewell and Dr. Durre Ahmad for their editorial assistance.

8. EMPIRICAL PAPER 3

Climate Change Adaptation ‘on the Ground’: A network analysis of organisation and policy in Ghana agriculture sector

Abrar Chaudhury^{*1,2}, Marc Ventresca³, Timothy Hannigan⁴, Thomas Thornton¹, Ariella Helfgott^{1,2}, and Chase Sova^{1,2}

¹ Environmental Change Institute, University of Oxford, UK

² CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

³ Said Business School, University of Oxford, Wolfson College, UK

⁴ Alberta School of Business, University of Alberta, Canada

^{*}Corresponding Author

Academy of Management Proceedings 2016: Published
DOI 10.5465/AMBPP.2016.15026

^{*}Abrar Chaudhury

Environmental Change Institute, University of Oxford, UK

abrar.chaudhury@ouce.ox.ac.uk , abrarchaudhury@gmail.com

+(44)7861478411

Abstract

Governments in many developing countries use formal state structures to plan and implement adaptation. These agencies are bureaucratic, hierarchical, and assume symmetry of information and seamless cooperation. However, they overlook the many organisations that operate at the periphery but are crucial for successful adaptation. This paper uses network analysis to identify four ‘organisational-communities’ within the Ghana climate change adaptation regime and to examine their role in facilitating or constraining adaptation responses. These organisation-communities are diverse, yet exhibit common properties and perform specific roles within adaptation. We identify and classify these four communities as: ‘Agriculture Policy Incumbents’, ‘Climate Change Specialists’, ‘Arbiters and ‘Locals. Our results clearly demonstrate that state structures alone are ill suited to implementing adaptation. Understanding how these organisation-communities operate, what roles they play, how they are composed, and how they interact with others offers a better understanding of how adaptation regimes can progress in Ghana as well as other developing countries.

Keywords: Climate Change Adaptation; Organisations, Network Analysis, Ghana

Introduction

Management and organisation theorists have long been interested in how large-scale policy spaces are governed and how forms of social organisation condition institutional and local policy outcomes (Selznick, 1949, Laumann and Knoke, 1987, Sabatier and Weible, 2014). Skocpol and others energised these debates by challenging the relative autonomy of the modern state with the reminder: ‘States are complex Weberian organisations, the analysis of which benefits from direct and detailed organisational analysis’ (Skocpol et al., 1999).

In this paper we study organisation of large-scale policy, through the lens of climate change. With the urgency of climate change, states are now mobilising resources, expertise, and capacity to respond to the challenge, often referred to as ‘climate change adaptation’. Adapting to climate change presents a classic problem of public policy organisation because of its level of uncertainty, complexity, and ambiguity. Legitimate responsibility for governing adaptation invariably resides with the state, since adaptation constitutes public goods and generally offers low incentives to attract external attention (Huiteima et al., 2016). Adaptation responses are promulgated through regulatory guidance that presumes orderly formal structures that buttress a modern state. However, formal state structures offer only a slice of what is required and often understate the interconnected and interdependent nature of the challenge and the role of many other non-state actors needed to address the challenge (Ostrom, 2010b, Scott, 1998). Simplification by the state may make the vision of the planner more legible but human societies are far too complicated to be represented by a monolithic system. According to Scott (1998. Pg.6), the formal “designed or planned social order is necessarily schematic; it always ignores essential features of any real, functioning social order.”

Governance covers a whole range of institutions and relationships beyond the state that are involved in the process of governing where both state and non-state actors participate with the aim of solving large societal problems (Pierre and Peters, 2000). For example, states may set up policy regulations for adaptation, while the private sector may offer necessary capital and services directly to vulnerable populations. However, as most planned responses take place within the jurisdiction of national structures, they are constrained by institutional processes, such as regulatory design, common laws and social norms associated with rules in use (Adger et al., 2005). Standard organisational templates cannot be seamlessly applied to adaptation without misrepresenting its complexity. Strategies and actions require careful adjustments to embrace this inherently complex, uncertain and difficult issue, which involves many disparate institutions, organisations, policies, sectors and networks, (Etzion et al., 2015). There has been an hiatus in contemporary research focusing on large-scale policy spaces, at a time when debates addressing modern wicked problems, grand challenges, and more are resurgent. This gap presents an opportunity for organisation theorists and researchers to re-engage with policy analysis and action. This paper makes a step to bridge this divide. We investigate the dynamics of initial climate adaptation strategies, amalgamating insights from the extensive literature on adaptation with the standard critique on state policy and a fine-grained analysis using original network data.

Research Approach and Contribution

We do not aim to investigate whether states are the most appropriate unit of analysis (Pugh 1973, Weber 1978) for adaptation policy. Instead, we start with Scott's (1998) claims in *Seeing Like A State: how certain schemes to improve the human condition have failed*, that formal state structures for adaptation emanate from a 'high

modernist approach' that promotes rational, scientific, technical and production focus to simplify public policy administration, make society legible, organise populations and deliver welfare. The high modernist approach captures the 'business as usual' approach of many states and international agencies since it is simpler to spread decision-making across existing pathways, but often ignores "other competing sources of judgment" (Scott, 1998, p.93). This sets up a remarkable challenge: State actors approach the administration of complex issues through formal structures of government that start from high modernist rules and processes to drive and coordinate action among its different decentralised components. This stance is generally at odds with the emerging, flexible, interdependent and uncertain nature of adaptation, leading to poor interventions and misaligned outcomes. The formal structures are often poor guides to understanding the practices and effects of actors that are shaped by the relationships and interests of the organisations (Mosse, 2004).

Despite steady proliferation of new organisational forms backed by progression of organisational theory, from closed systems driven by rules and incentives to open and natural systems focused on human relations, external factors, collective action, and interdependencies within and without organisations (Scott and Davis, 2007, Tsoukas and Knudsen, 2005, Selznick, 1949, Katz and Kahn, 1978), states continue to use rational and hierarchical structures to implement action (Pugh, 1973, Scott, 1998). There remains the possibility of bureaucratic structures being insufficiently embedded within local social structures. This would reflect an *institutional irrelevance*, whereby global policy fields fail to link social structures and discourse to activity and outcomes (Ventresca, 2002).

This mismatch in structure and purpose has long been controversial in development practice (Riddell, 1999, Mosse, 2004), where marshalling resources to social actors and institutions with weak operational capacity by states leads to issues of

scale and effectiveness. Successful organisation strategies require careful matching of the scale of action and management (Cash and Moser, 2000, Termeer et al., 2010). These presume effective coordination of many actors operating across scale, but understanding this multi-jointed action is a serious gap in management and organisational theory.

Recognising the growing but scattered literature on governance and organisation of climate change adaptation (Huitema et al., 2016, Massey and Huitema, 2016, Ford et al., 2011), this paper adopts an empirical approach to explore how implementation structures for adaptation emerge and function at the local ‘coal face’ well beyond those formally designed by the state. We use Ghana’s (a lower middle-income country) planned climate change adaptation efforts in agriculture to study the organisation of complex policy fields.

Specifically the research asks

- (1) What are current patterns of organisational linkages across the adaptation regime?
- (2) How do these differ from the planned state structures?
- (3) How does this reinforce or undermine the traditional view of planned state structures?

This paper sheds new light on the organisation of complex policy by constructing an alternate view of organisational structures based on relations and roles of all actors, rather than accepting the conventional formal state structures. Adaptation efforts are more prudently characterised as a web of inter-organisational relations motivated by complexity, fragmentation and interdependence, rather than through linear hierarchical structures. This takes the form of recognising organisational networks both

as managing and implementing conduits and channels (Podolny and Page, 1998, Powell, 2003). The paper tests how these alternate relations and role-based levels relate to the planned structures, to identify overlaps and gaps in the implementation. Ultimately, this iterative approach unveils broader structural characteristics for organising adaptation nationally and its effectiveness. These questions are difficult to address, as the adaptation landscape is evolving, complex and developing on different scales and levels that are often uncoordinated. They are however, essential for ensuring effective adaptation.

Addressing this gap in the literature, the paper develops the theoretical foundations of the research based relational model followed by introduction of the methodology and methods for collecting, processing and analysing relational data of organisations across multiple levels. Detailed network maps or sociograms are presented for organisations and their interactions. Finally, we discuss the implications of our results and highlight some potentially promising research directions.

Theoretical Foundations

The research is founded on concepts of scales, relations and networks in adaptation. These concepts are important to develop our methods on the premise that actors (mostly organisations²) do not always follow the state hierarchies, and often operate beyond them. For this we need to study the wider network for adaptation,

² We treat organisations as the observable network nodes. Organisations represent stable entities that could be identified at various levels and hence fulfilled our objectives for mapping and analysing the cross level network. For the remainder of this paper we use the term organisation to broadly refer to the many actors who play roles in all phases of adaptation.

identify constellations of organisations, define roles of these subgroups and analyse their impact on adaptive action.

The difficult problem of adapting to climate change is that it is simultaneously a global and a very local issue. Adaption and management are not simply matters of institutions and organisations working within well-defined jurisdictions. In reality, they take on a network form of organisation that operates horizontally as well as vertically and achieves coordination through mutual adjustment rather than through direct command (Ansell, 2000). According to (Burt, 2005: 12) this entails a social focus, which includes “anything that brings people together in an activity with the result (intended or unintended) of facilitating relations among the people”. There is a plethora of research on network and collective governance models (Ansell and Torfing, 2015, Folke et al., 2005, Sandström and Rova, 2009, Vignola et al., 2013). However most research is focused at particular levels within the scale, such as policy or local community and often not across levels (Ansell and Torfing, 2015). Identifying broad adaptation determinants and metrics that works across levels is challenging (Vincent, 2007). Even where planned structures are in place, their effectiveness is unknown because they are new (Huntjens et al., 2012). Failing to take a network approach may lead to incorrect diagnosis of the challenge and selection of inappropriate responses.

Redefining Organisational Levels – Relational Network Approach

Successful strategies for adaptation require matching carefully the scale of action and management (Cash and Moser, 2000, Termeer et al., 2010) along with effective coordination of many organisations across all levels. In this paper we adopt Gibson et al’s (2000, p218) definition of scale as the “spatial, temporal, quantitative, or analytical dimensions used to measure and study any phenomenon”, and levels within

the scale “as the units of analysis that are located at different positions on a scale”. This definition is appropriate for our analysis, as it is broad and encompasses the scales relevant to adaptation. In practice different scales and levels have emerged based on the interest of action (Smit et al., 2000, Cash et al., 2006). The spatial scale, for instance, focuses on the geographic area such as regions or landscapes where climatic impacts are prevalent (Cash et al., 2006). Administration integrates adaptation within the existing planning structures in a country (Cash et al., 2006). Time-scale follows the process over time to assess its response to changing climate (Cash and Moser, 2000, Smit et al., 2000). The socio-ecological scale emphasis the intersection between humans and the biophysical world (Folke, 2006). Increasingly, many developing countries focus on the administration scale to integrate adaptation plans into their national development cycles, exemplified by Ghana and Nepal (Chaudhury et al., 2016b). This scale is preferred by officials because it acknowledges that adaptation is seldom the exclusive response to climate change but also to wider social and development challenges (Berrang-Ford et al., 2011). Efforts to distinguish clearly adaptive responses from development measures are often futile (Munasinghe, 2003, McGray et al., 2007, Huq and Reid, 2004) and hence better addressed within existing structures.

The conventional approach in formal planning by states is to view administration as hierarchical, which is burdened by rigid top-down implications (Berkes and Ross, 2016). This also assumes that there is a clear separation between functions of each level along administrative layers, such as local, regional and national levels. This is central to hierarchy theory, which offers a framework for considering inter-level relationships (whether spatial, temporal or both) and their ordering (Ahl and Allen, 1996). Hierarchy stresses the importance of specialisation as a means of improved efficiency. Coordination is achieved through centralisation with vertical commands and directions.

However, organisations often bypass these rigid structures to achieve their aims. Information does not always pass from global, through national to local levels but can take a reverse path back to national or global bodies (Eakin et al., 2009, Rudel, 2011). Administrative structures are often poorly matched to the scale of the challenge. Networks offer one possible solution to this scale mismatch (Ansell and Torfing, 2015), but often the segregation of organisations is blurred (Berkes and Ross, 2016, Allen et al., 2014). The concept of a ‘nested’ network offers some support to complex systems (Berkes and Ross, 2016, Allen et al., 2014). Nested networks emphasise cross-scale linkages whereby processes at one level affect those at other levels to influence the system’s overall dynamics (Allen et al., 2014). These wider interactions between organisations may produce important but unforeseen responses and effects (Termeer et al., 2010). These emergent patterns of behaviour are complex. Emergent in this sense means that they cannot be predicted simply by studying individual parts of the system (Cilliers and Spurrett, 1999). Furthermore, these patterns can arise without intent or overview. Accordingly, we adopt a flexible view of levels that emerge through repeated interactions between organisations across network rather than constructed to serve a defined administrative purpose.

The administrative scale, coupled with a growing trend towards decentralised governance within developing countries, typically maps onto national, provincial, and local geographic planning levels. Planning and implementing adaptation is spread across these levels with different roles for government, markets, organisations and communities (Mikkelsen, 2005). The national level (higher) generally assumes the role of formulating policies and implementation strategies based on national priorities and global guidelines. Whereas the local levels (lower) are entrusted with implementing the policies and strategies, because it is there that climate impacts are felt most and an effective response is required (Ostrom, 2010b).

Each level within the administration consists of many organisations that interact with others within and across levels to implement adaptation. In theory, the decentralized administration assumes active cooperation and clear separation of roles and actions between the higher and lower levels organisations. However in reality, these structures are rigid, bureaucratic and hierarchical (Pugh, 1973, Weber, 2009) and often plagued by turf wars, capacity challenges, political influence and financial constraints, undermining effective implementation (Chaudhury et al., 2016b, Ferguson, 1990). It is difficult to prescribe an ideal scale for implementation due to the emergent and localised nature of adaptation. Nonetheless, we build our analysis from the widely adopted administrative scales, but also explore the appropriateness of the rigid levels within these scales.

Networks and Organisation-Communities

Climate change adaptation scholarship and development theory, suggests adopting collaborative and participatory arrangements through which organisations combine their individual talents into a coherent solution (Adner, 2006, Chaudhury et al., 2016a, Mikkelsen, 2005, Law, 1992). Networks are gaining attention as an effective means of capturing different forms of participation under one umbrella (Janssen et al., 2006, Stein et al., 2011, Scott and Carrington, 2011, Scott, 2012, Wasserman, 1994). Networks can identify key organisations, gatekeepers and bridges in the structure that, with the right support, can facilitate access to essential resources, knowledge and information that otherwise are not available (Granovetter, 1973, Newman and Dale, 2005, Janssen et al., 2006, Bodin et al., 2006). This helps gain influence and spreads effective practices to produce effective adaptation action. Network analysis can also help recognise the essential skills and resources hidden within the network. Detailed

network sociograms are created from the interactions of organisations, which are then measured by applying network metrics (Wasserman, 1994, Borgatti et al., 2009, Scott, 2012). These mapping and measurement are important to visualise and understand the overall structure and the different roles of each within the regime.

However, analysing the entire network as a single entity may not offer a meaningful view of how adaptation is organised because it overlooks the subtle variations of the relationships within the network. Scale and level help identify patterns of relations and action but they do not necessarily dissect these patterns (Gibson et al., 2000). The patterns may appear ordered at one level, but random at another.

Organisations can have stronger relations with some in the network, than others. This differing frequency of interactions creates natural sub-groups or communities of strongly connected organisations (Newman and Girvan, 2004, Blondel et al., 2008, Fortunato, 2010) that may not always match the planned administrative levels, thus creating gaps and overlaps. There are numerous examples of networks in nature, society and technology that consist of intermediate level organisations, with groups of them forming tightly connected communities that are only weakly linked to others (Andrea et al., 2009). We refer to this arrangement in adaptation regimes as ‘organisation-communities’.³

Organisations within these communities are close and in a strong position to exchange information, resources and opinions, and so share common properties and interests (McPherson et al., 2001). For example, NGOs with shared expertise form collaborative arrangements to promote adaptation services, yet compete for these

³ We use the term organisation-communities in this paper to refer to communities of organisations detected through network measures, in which organisations are joined together in groups through frequency of interactions. This is different from the traditional use of community in social science to mean social, territorial and geographical communities such as villages, neighbourhoods, town, city or communities focused on the quality of character of human relationship such as professional or spiritual (Mcmillan and Chavis, 1986),

services, thereby forming what Lave and Wenger (1991) describe as a ‘community of practice’. These communities of practice have common concerns and pursue knowledge through regular interactions (Berkes, 2009, Fox, 2000).

A fundamental component of a multi-level and multi-organisation adaptation approach is the creation of innovative governance and organisation (Armitage et al., 2008). This entails new niches, or roles for organisations within the system in response to changing conditions. Partitioning the links into smaller organisation-communities offers a more detailed view of the network structure and the precise roles of each organisation. By identifying these niche organisation-communities and their evolving roles we can understand the adaptation landscape better and its link with the national structures, to develop effective implementation strategies.

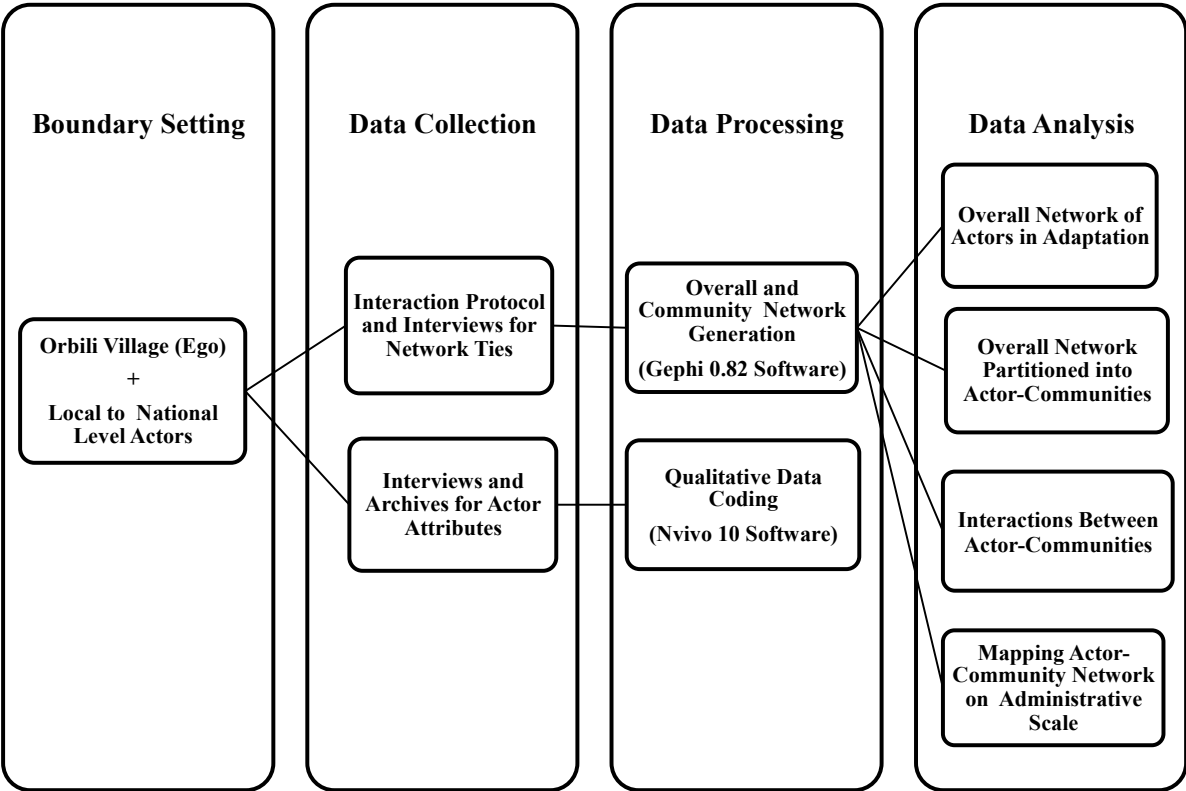
Research Design, Methods and Data Collection

We study the organisation of complex policies in the context of planned adaptation to climate change in Ghana’s agricultural sector (a lower middle-income country). Ghana is highly vulnerable to climate change with increasingly variable rains, floods and droughts, threatening livelihoods and food security (McSweeney et al., 2010a). Agriculture continues to be the largest sector in Ghana, key to its development ambitions and an important component of the climate change discussion (Government of Ghana, 2010). Agriculture offers a good example for analysing multi-organisation interactions on decentralised structures when climatic stresses often impact many levels of governance, for example local food shortages can rapidly become a national challenge.

Methodology

Through systematic, detailed analysis of organisation-communities in the case of Ghana we aim to establish general insights that have wider application (Yin, 2009, Eisenhardt, 1989). We used a mixed methods approach of network and qualitative analysis supported by direct field observations (King et al., 1994), to capture the wider adaptation network and characterise the role of organisation-communities. We collected relational and qualitative data over several months of field research from 2013 to 2014 through workshops, surveys, network mapping and detailed semi-structured interviews. Over 150 interviews were conducted of key national, sub-national, local and community organisations engaged in adaptation. Figure 1 illustrates the scheme of our approach.

Figure 1: Scheme of research methodology



Source: Author compilation

Multi-Relational Ego Network Approach

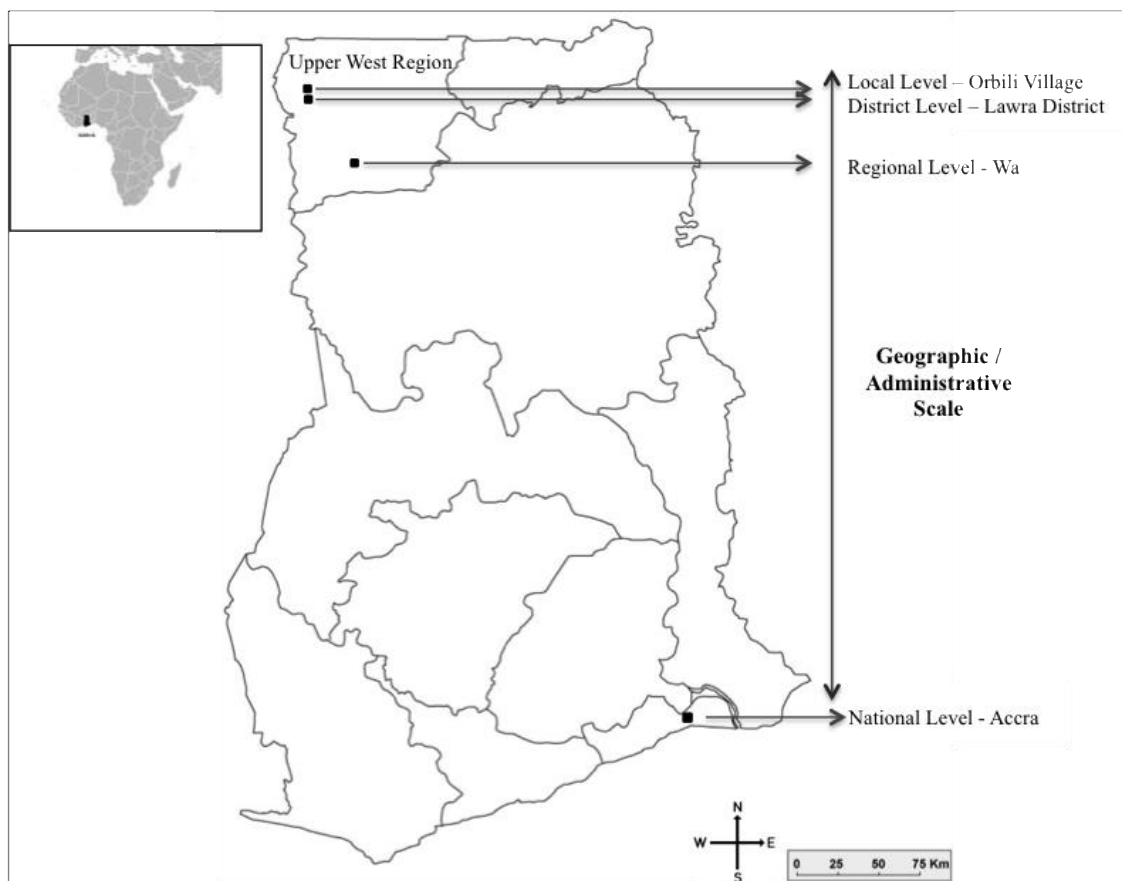
We adopted an egocentric network approach (Hanneman and Riddle, 2011a) to map the organisations and their interactions in Ghana's agriculture adaptation regime. The network is mapped around a particular node, known as an ego, and includes all organisations that are connected to the ego (referred to as 'alters') and all the connections among those organisations (Hanneman and Riddle, 2011a, Marin and Wellman, 2011). Because most organisations are connected indirectly to other organisations, it is important to go beyond simply examining the immediate connections to capture and understand the wider network. The ego network offers a useful way of understanding complex networks, and visualizing how the ego is embedded. We also adopted a bottom-up or 'backward mapping' approach to map the network starting at the lowest level of implementation (Elmore, 1979). This is opposed to taking a policy driven 'forward mapping' approach that starts with policy and assumes "that policymakers control the organisational, political and technological processes that affect implementation" (Elmore, 1979, p603). Bottom up approaches show that central programmes offer more opportunities to local implementation organisations but central policy is just one of the considerations in the process (Klijn, 2008).

Boundary Setting

The first step in the network mapping is setting the boundary for the analysis as it determines which organisations are to be included. We selected Orbili village, a community of 58 smallholders households located in Lawra District, Upper West region as the ego for the network mapping. Although population size and density vary across

Ghana, Orbili is representative of an average village in the district⁴. The Upper West region of Ghana is highly vulnerable because of low socioeconomic development and adverse environmental and climatic conditions making farming particularly challenging (Antwi-Agyei et al., 2012). The network mapping builds on our extensive research on the links between the connectivity of Orbili households and their capacity to adapt (Chaudhury et al., 2017). Accordingly, Orbili offered an appropriate ego to map the wider network.

Figure 2: Map of Ghana showing the administrative/geographic scale with reference to location of ego (Orbili) in Upper West



Source: www.mapsoftheworld.com and author compilation

⁴ According to the official district records, Lawra district has 120 villages with an average size of 54 households and a median of 43 households. Orbili village is, therefore, an average village in Lawra considered representative of the area.

Starting with Orbili's 58 households, we mapped the network from proximate to distant organisations across the whole administrative scale; from community to district, regional and national levels (Figure 2). Instead of constructing the network based solely on data from the ego, we build it through collecting data across all levels. We created a list of all organisations connected to the ego, interviewed them and collected further relational data to expand the list of organisations moving through the administrative scale of district, region and nation. Through this iterative process based on real data, a wide network sociogram emerged, of local to national organisations, all involved in agricultural adaptation to climate change that maintained direct pathways to Orbili. Limitations on the numbers of strong relationships between organisations and the tendency for relationships to be reciprocated often make it fairly easy to find boundaries for the network (Hanneman and Riddle, 2005, Granovetter, 1976). In this study, we sampled organisations ranging from government bodies, the private sector, research organisations, NGOs, international institutions and community groups. Although a few important individuals were included in the mapping, such as the Paramount Chief in his formal traditional role, we focused mostly on organisations.

Although the ego network is an effective way of capturing the whole network it is possible to overlook relevant unconnected organisations and certain local organisations specific to our ego of Orbili may differ in other communities. However, as the relations moved outward from Orbili the relevant nodes became common to most lower level organisations; for instance, the district government interacts with many communities, including Orbili, the regional organisations interact with several districts while the national organisations interact with many regions. This mapping approach provides an opportunity to capture local realities that are in tension with distant organisations. Local organisations are best informed about the local issues (e.g., state of the local agriculture; livelihood needs of villagers) and comprise one critical nexus

where implementation aspirations meet practical exigencies (Klijn, 2008). Whereas national organisations have a regional and national vantage point and a repertoire of tools and techniques (e.g., scientific databases; remote sensing) not normally available to villagers (Berkes, 2009).

Data Collection

We developed a detailed interaction protocol to capture these relationships focusing on the organisations and not the specific individuals interviewed within those organisations. In general, the interviewees were key organisation personnel responsible for adaptation. The interaction protocol was divided into four sections. The first was a name generator to solicit unbiased relations (Burt, 1984) with other organisations based on tangible interactions to deliver a qualified list of organisations (Campbell and Lee, 1991). The second captured the nature of relationship (i.e. collaboration, services, funding, reporting and membership.) The third focused on the type of relationship between the organisations (i.e. resource, services, knowledge and connections.) The final section determined the strength of interactions with interviewees with weights assigned on the effectiveness of the relationships. The interaction protocol was followed by detailed semi-structured interviews to provide context to organisation-communities and their extended roles in network. The interaction protocol identified 66 organisations in the network and we were able to interview 44 of these. Generating the names of qualified organisations is a novel contribution.

Network Data Processing

We build an empirical action framework for processing and analysing the data. This framework integrates aspects of key studies on networks, inter-organisational

relations, social structures, and attributes of climate change adaptation. The framework is also an important contribution for collecting, processing and analysing multi-organisation and multi-level relational data that informs adaptation action and complex fields more generally.

We used Gephi version 0.82 (<https://gephi.org>), an open-source SNA software, to process the data. We adopted an undirected network approach that assumes reciprocity of relations (Wasserman, 1994) since the direction of relations was not as important as the existence of a link between organisations. We also took a multi-relational approach considered to be a rich area for SNA (Wellman and Wortley, 1990). The analysis elicited different types of interactions among the various organisations. The informants identified four kinds of interactional relations: (1) flow of resources, (2) knowledge transfer, (3) service exchange, and (4) social connections. These four types of relations describe a fuller framework in which to assess capacity for adaptation. For instance, flow of resources lead to improved agricultural productivity and diversity that creates a virtuous cycle of income and investment. Knowledge transfer enables exchange of traditional and expert ideas between organisations that address the climate risks and encourage suitable adaptive practices (Folke et al., 2002). Social connections may not directly influence adaptation, but it links organisations with others who are important resources. We assigned weights to the relations based on their multiplicity between organisations and the effectiveness of each, using the equation

$$W = \sum R \times E \quad (\text{Equation 1})$$

Where W = weight of the relation, R = type relations—knowledge, resources, services exchange and connections (1=relation 0= no relation) and E = effectiveness of relation (scale of 1 to 3, where 1 is least effective and 3 is most effective).

Next, we ran a modularity algorithm in Gephi (Blondel et al., 2008), to detect distinct organisation-communities within the overall network. This algorithm partitions the ego network into communities of densely connected nodes, with nodes belonging to different communities being only sparsely connected (Blondel et al., 2008). The algorithm allowed us to set different resolutions for detecting different numbers of communities. We settled for four distinct organisation-communities as these reflected separate structures for meaningful analysis. Finally, to supplement the network analysis, we transcribed and coded the qualitative interview data for objectives, activities and characteristics of organisations in climate related activities.

Data Analysis

We generated the overall network sociogram for Ghana's agriculture adaptation regime covering many organisations from local to national levels and measured the properties of the network structure. The name generator helped us identify the organisations in adaptation. We further identified eight categories of organisations ranging from governments, to local communities. We mapped their interactions for the four types of relations (see equation 1). We then constructed community profiles and roles for the four organisation-communities detected, using the network properties and the qualitative characteristics of each organisation within each community. We followed this by analysing the nature of relations within and between the organisation-communities, to understand how adaptation responses evolve and the impact relations have in facilitating or constraining action. The relations cover five categories - collaborations between organisations, exchanges for services, funding, formal reporting and membership on committees and taskforces. Finally, we compared the partitioned

community network with the administrative scale to identify overlaps and gaps between the community and administration.

We applied network measures of size (number of weighted relations), density (proportion of all possible relations in the network) and degree and betweenness centrality (ranking of organisations based on their relations and bridging roles with other organisations) to study adaptation action in network terms. The network size provides numbers and types of relation that facilitates adaptation, such as knowledge, services and resources. The density of a network gives insights on the speed at which information diffuses within a network (Janssen et al., 2006, Bodin et al., 2006). High density makes the loss of single organisation less disruptive. Centrality is important in times of change and rapid response as it improves coordination between organisations (Bodin et al., 2006). The degree of centrality is typically used as a proxy for power, influence, trust, social learning and prestige (Ibarra and Andrews, 1993, Marsden and Friedkin, 1993, Sparrowe et al., 2001), whereas, betweenness centrality links different sub groups that allows diversity in knowledge and facilitates social learning (Hanneman and Riddle, 2011a).

In summary, we started with the 58 households of Orbili village. Through their interaction with local organisations, we identified other organisations and mapped their distant relations with district, region and national organisations. This original model enabled us to construct the first empirical network sociogram of organisations in agricultural adaptation in Ghana. We identified eight categories of organisations, four types of relations, five categories of interaction and four sets of organisation-communities. Collectively this allowed us to identify, observe, process and analyse in depth Ghana's adaptation efforts that would have been difficult using conventional methods.

Results and Analysis

First, we present the Ghana's planned administrative structure derived from policy documents, archives and decentralised structures in place (Figure 3). This represents the 'baseline' structure for adaptation. Second, we present the first empirical network sociogram of the organisations involved comprising eight categories of organisations and four types of relations across the baseline structure to identify central organisations and their distribution (Figures 4 and 5). Third, we illustrate the network sociogram comprised of four organisation-communities that perform specific roles for adaptation in the agriculture regime (Figures 6 and 7). Fourth, we overlay the network sociogram with organisation-communities on the administrative scale to illustrate the gaps and overlaps within the network (Figure 8). The standard administrative view assumes that structures have uniform interactions in place. In reality there is asymmetry of information, gaps in roles and mismatched density of relations.

1) Planned Administrative Structure of Ghana's Agriculture Adaptation Regime

This baseline administration in Figure 3 follows the high modernist state structure. The Ministry of Environment, Science, Technology and Innovation (MESTI) and the National Climate Change Committee (NCCC) jointly manage the National Climate Change Policy (NCCP) centrally, with the NCCC charged with day-to-day operation. However, it has not met since 2012, creating a vacuum in coordination and implementation.

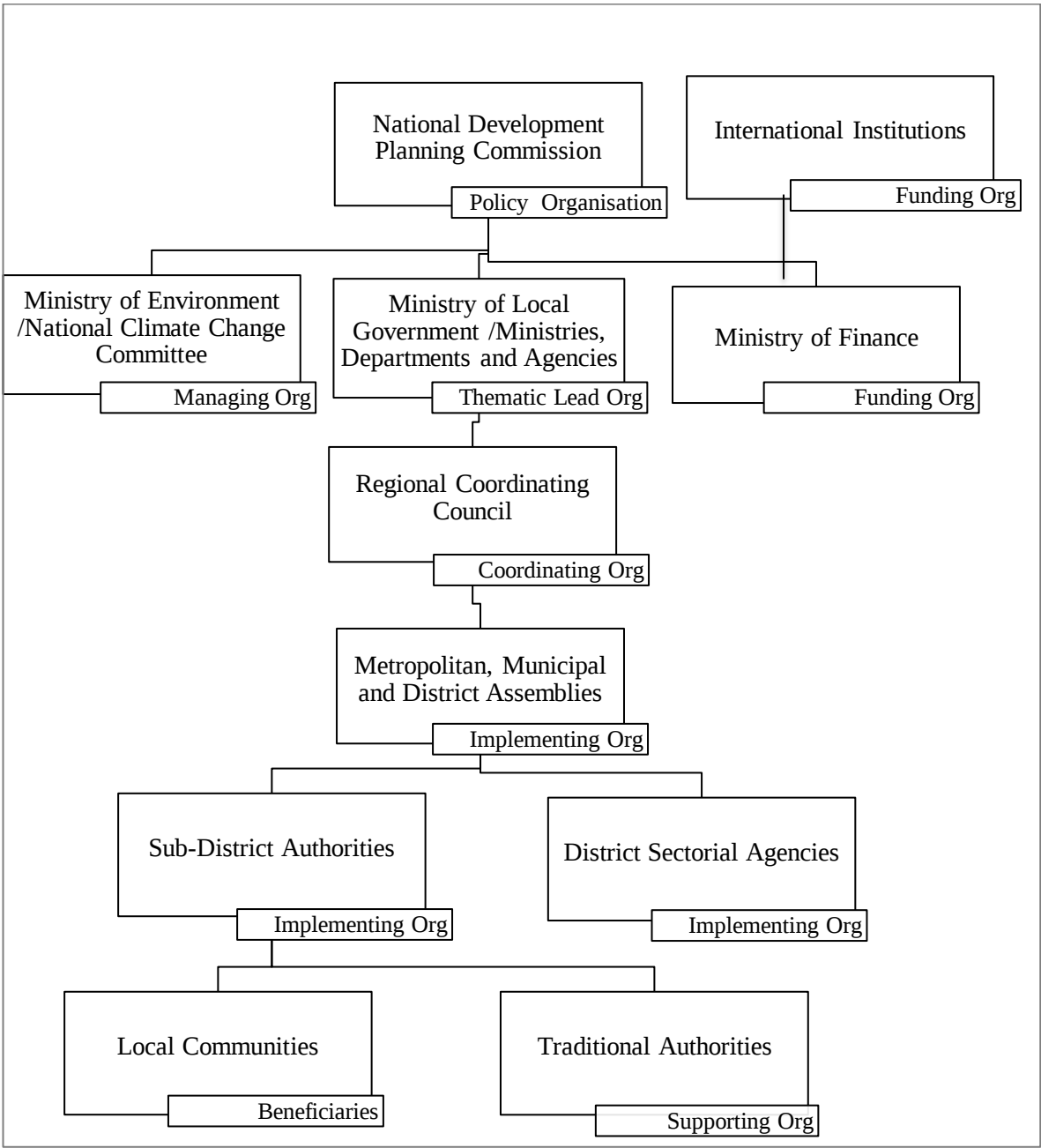
Ghana has focused on decentralization since early 1988. The autonomous Metropolitan, Municipal and District Assemblies (MMDAs), the lowest unit of decentralised administrative governance, assisted by decentralized agencies, assume

local responsibility for developing and implementing NCCP, based on priorities that emerge from the sub-district authorities. The Ministry of Local Government and Rural Development (MLGRD) supports the decentralised administration with coordination from the Regional Coordinating Council (RCC). The National Development Planning Commission (NDPC) and the Ministry of Finance (MoF) provide detailed planning and budget guidelines to the relevant national ministries, departments and agencies and MMDAs for promoting adaptation into Ghana's national development structures. International institutions, with coordination of MoF and relevant departments, offer funding for the various initiatives.

Official development initiatives are coordinated locally by the MMDA's supported by the traditional governance. The chief of the village is the traditional head of the community and spiritual leader. A district chief executive (DCE), appointed by the office of the president and approved by the district assembly, is responsible for administering development funding and priorities identified by the assembly. As such the local government system is a form of partnership between formal government, the chiefs and their people.

Given the diversity of Ghana's environment and weather, effective local planning is required to protect rural livelihoods in the face of climate change. This, however, depends on effective decentralisation and particularly fiscal decentralisation. There are, however, significant political, administrative and coordination challenges that have reduced confidence in the whole system, such as interference from central government, overlaps in administrative and traditional structures, delays in release of central funding and limited capacity to generate funds locally (lack of income and development). Despite the challenges and gaps, government organisations are perceived as central units in the official planning and organisation of adaptation.

Figure 3: Ghana’s Planned administrative structure for developing, supporting and implementing adaptation



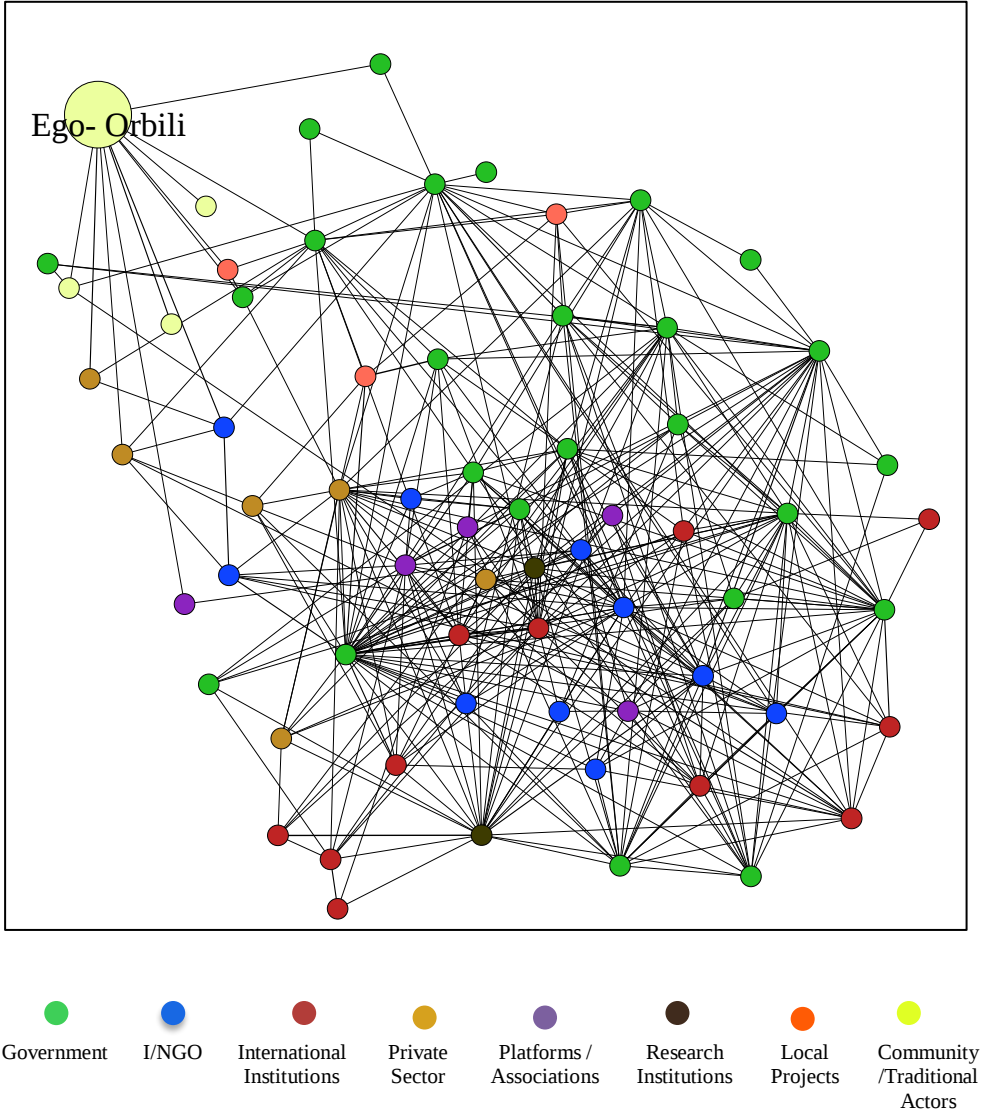
Source: Ghana NCCP, 2013 and author compilation

2) The Network Structure of Ghana’s Agriculture Adaptation Regime

The overall network mapped from the Orbili ego consists of 66 organisations (nodes) linked through 3,054 weighted relations (edges). The network is sparsely connected with density of 0.16 (16% of all possible relations), indicating that many

potential relations are missing in the network and so important information and resources may not diffuse easily through this network. Figure 4 shows the first empirical network sociogram of the organisations active in adaptation across all levels of administration. This egocentric network sociogram illustrates eight categories of organisations but overall the network is loosely connected through casual collaborative relations (over 50%) with uncertain continuity.

Figure 4: Network sociogram of organisations in Ghana’s agriculture adaptation regime, built from the ego node of Orbili



Source: Author compilation

Note: The node size of organisations is proportional to the number of weighted edges connected to the node. The colours of the nodes represent the category of the organisations

Central and local government organisations represent over a third of the organisations in the network. This is to be expected as implementation of planned activities is the government's remit in Ghana and is promoted through official administrative levels. We also see strong presence of NGOs, making up a fifth of the organisations, because they play an active role in climate projects and ancillary services. International institutions, private sector, climate platforms and community organisations are also prominent.

Partitioning the network into national and local administrative levels (Orbili) overlaid on the map of Ghana reveals a high concentration of national organisations. 48 organisations are connected through 2,378 weighted relations and represent roughly 78 % of the network (Figure 5 and Table 1). Their network density is 0.24, which is about 50% higher than the combined network. National level organisations have broader interests across country and different distribution patterns. On the other hand, the local levels of community, district and region consist of 18 organisations connected through 324 relations, representing some 11% of the network. However, the density of their relations is 30% higher at 0.21 than the overall network. These higher national and local densities can be attributed partly to geographic proximity and overlapping interests that allows for easier and more frequent interactions (Liben-Nowell et al., 2005, Adamic and Adar, 2005).

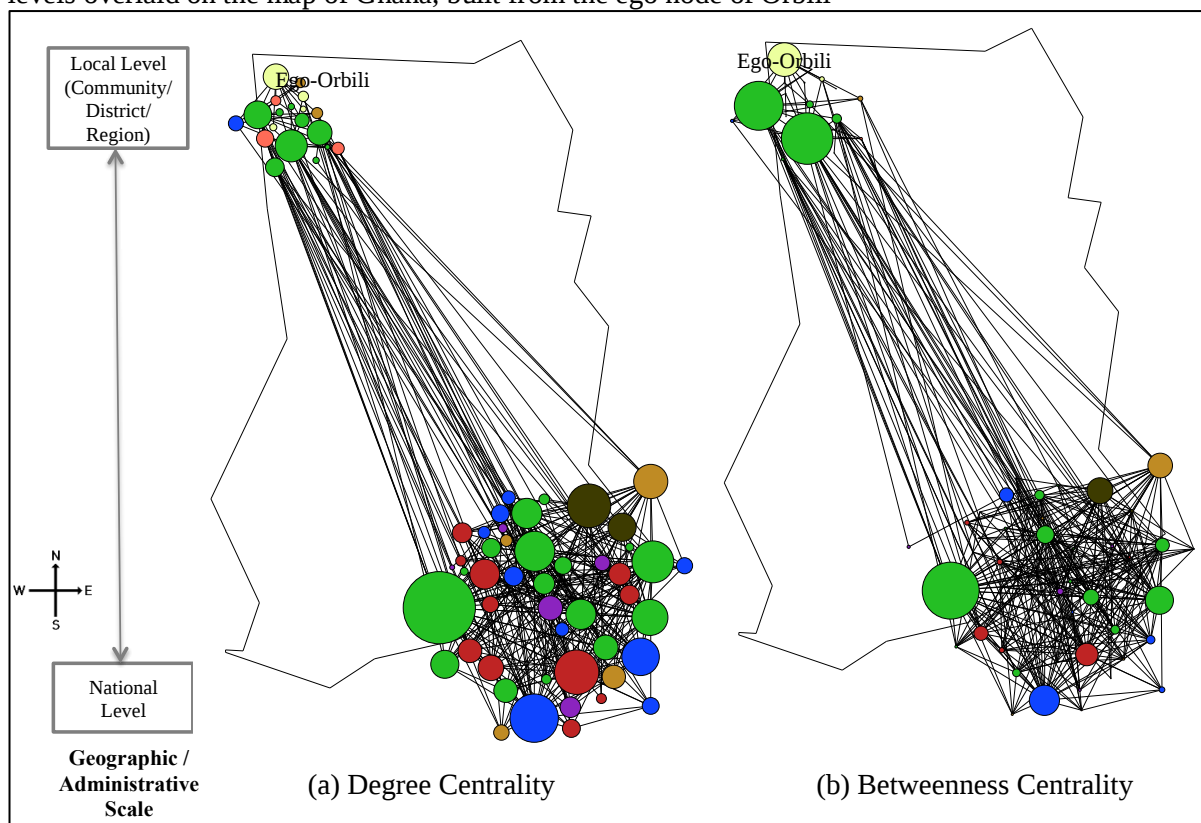
Each category of organisation, with its distinct characteristics, influences the way adaptation is framed, actions are prioritised, and relations established. This diversity also becomes important in how and whether implementation proceeds. While a broad mix of organisations in the network is useful for generating diverse knowledge, and offers greater access to resources, coordinating their actions increases complexity. Government organisations, for instance, are bureaucratic (Pugh, 1973) and hence emphasise formal reporting structures. NGOs on the other hand are objective-driven and

fill gaps through informal collaboration and services. Finding common space for different types of organisation to interact and operate is difficult in the structures surrounding adaptation.

Although the network is one interconnected entity because of the egocentric approach, the diameter of the network or the shortest path between two distant organisations is 5, highlighting the separation between local and national organisations. The distance between organisations (or, conversely how close they are to one another) is an important measure. Some organisations are able to reach most others in the network with little effort, while others have difficulty connecting or being heard (Hanneman and Riddle, 2005).

Combining the local and national levels significantly reduces the density of the network, highlighting that the two levels are weakly connected. While we observe many well connected organisations indicated by their larger node size (Figure 5a), the betweenness centrality (Figure 5b) reveals only a few hubs linking the network, with government organisations having the highest betweenness at both national and local levels. Nationally, the agriculture ministry is the apex organisation for agriculture policy and development and assumes the central role linking organisations that are otherwise weakly connected. Similarly, locally the district government and the agriculture department connect Orbili and other local organisations to the wider network.

Figure 5: Network sociogram of organisations on the administrative scale of local to national levels overlaid on the map of Ghana, built from the ego node of Orbili



Source: Author compilation

Note: The node size of organisations is proportional to the number of weighted edges connected to the node. The colours of the nodes represent the category of the organisations.

Table 1: Category of organisations in egocentric network

	Local Level	National Level	Combined Network
Size (Nodes)	18	48	66
Edges	32	268	350
Weighted Degree	324	2,372	3,054
Weighted Degree %	11%	78%	100%
Average Weighted Degree	18	49	46
Density	0.21	0.24	0.16

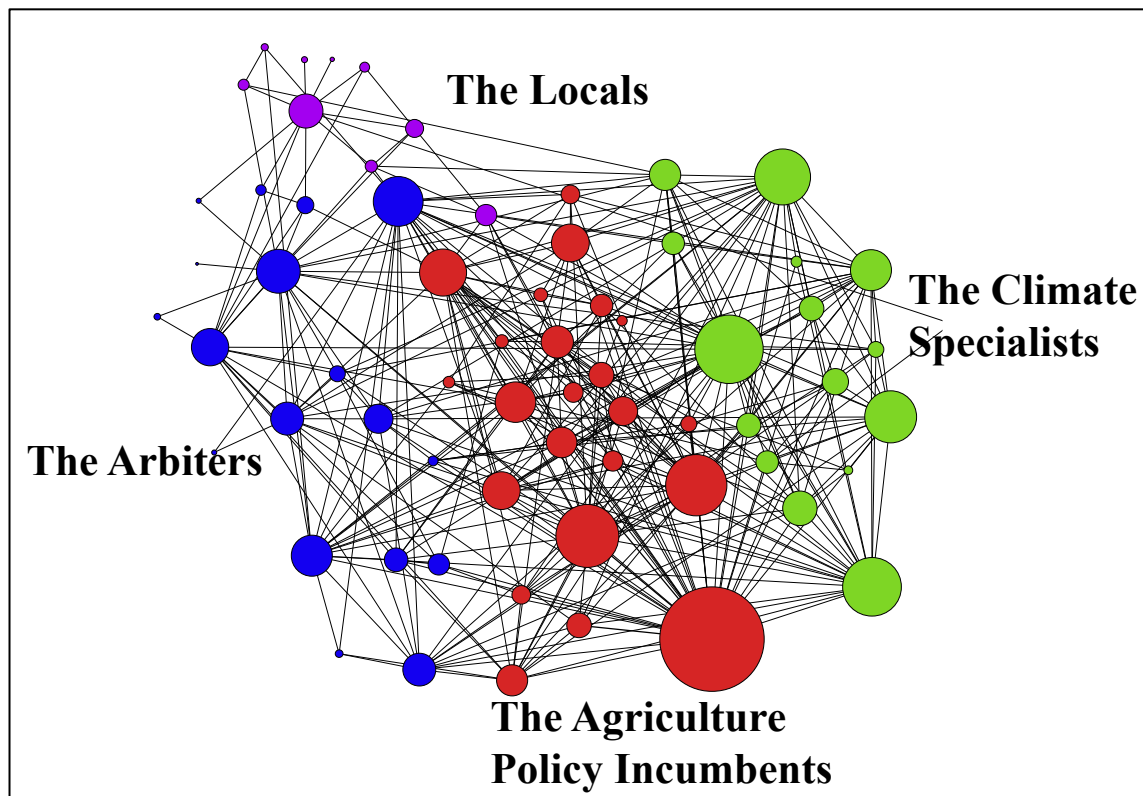
Note: Figures and percentage show the total of number of organisations in each category and the percentage of the total organisations.

3) Community Structures in the Network

Analysing the whole network for size and density provides a measure of the range of possible relations and organisations, but what matters is the pattern of the relations (Hanneman and Riddle, 2011a). Viewing the network as tightly connected sub-groups offers a deeper understanding of its attributes and context. We, therefore ran a community detection algorithm in Gephi (Blondel et al., 2008) to partition the network into sub-groups and identified four distinct ‘organisation-communities’ within the network (Figure 6 and Table 2). We labelled these communities: ‘Agriculture Policy Incumbents’ (red nodes), ‘Climate Specialists’ (green nodes), ‘Arbiters’ (blue nodes), and ‘Locals’ (purple nodes). The names of the organisation-community imply the focus of each within the network.

The organisation-communities exhibit distinct properties and characteristics, which define their roles. Moreover, each consists of multiple types of organisations spread across the administrative scale, bonded through common interests, goals or objectives. The Agriculture Policy Incumbents control resources and agricultural expertise; the Climate Specialists offer knowledge, policy support and services for climate change adaptation; the Arbiters plan, control and implement development and adaptation agenda; while the Locals implement. The organisations in each community interact with each other and with those of other communities, forging multiple relations. Analysing the organisation-communities thus sheds light on how adaptation action develops within the network.

Figure 6: Undirected network sociogram of adaptation organisations



Source: Author compilation

Note: Figure 6 is an undirected network sociogram of adaptation organisations. Nodes on the sociogram represent the 66 organisations in the network across local to national levels. The nodes are colour coded to distinguish between the four distinct organisation-communities - red for the Agriculture Policy Incumbents, green for the Climate Specialists, blue for the Arbiters and purple for the Locals. The edges between the organisations are weighted to represent multiple relations and strength of interactions between the organisations within and across organisation-communities. The node size of organisations is proportional to the number of weighted edges connected to the organisation. [Refer to Appendix A in Supplementary Data for details of organisations in each organisation-community]

Table 2: Network metrics for total network and the four identified organisation-community

	Total	The Agriculture Policy Incumbents	The Arbiters	The Climate Specialists	The Locals
Nodes	66	23	18	16	9
Edges	350	84	42	51	11
Weighted Degree	3054	854	386	502	142
Weighted Degree %	100%	28%	13%	16%	5%
Avg. Weighted Degree	46	37	21	31	16
Network Diameter	5	3	4	4	4
Density	0.16	0.33	0.28	0.43	0.31

Note: The total includes metrics between and across the four organisation-communities.

4) The Four Kinds of Organisation-Communities and Their Roles

The Agriculture Policy Incumbents

The Agriculture Policy Incumbents (hereafter, ‘policy incumbents’) are the largest and the most diverse community in the network, consisting of 23 organisations linked through 854 relations. They cover 28% of the total network, have over a third of the possible relations and comprise organisations from central government, international institutions, private sector, academic and research institutions and prominent NGOs. They offer vital funding and functional support for agricultural development and specific projects, and so occupy a prominent position. This control of resources also gives the Policy Incumbents considerable autonomy over their actions, agendas and programmes, and in turn major influence over agricultural activities.

Although adaptation in agriculture is of interest to the Policy Incumbents, it is not the main driver for relations within the community. For example, a large international fund with over US\$100 million committed to agricultural development in northern Ghana, has only recently incorporated a small component for climate adaptation into its planning. Many prominent international institutions also create informal alliances to coordinate their activities and support for the formal government agencies. The funding offered raises their centrality and that of the relevant government agencies within the Policy Incumbents. As a result, the Policy Incumbents have twice as many funding relations than any other organisation-community. Collaborative relations on projects and programmes dominate and represent over half of all relations. Roughly 20% of the relations are for service exchanges, where organisations, such as the meteorological agency, provide information to both private and government organisations. There are, however, no relations for formal reporting, which reinforces the Policy Incumbents’ independence in forging links based on their own agenda, rather

than on formal obligations. With their strong control over resources, the Policy Incumbents are ideally positioned to push agriculture adaptation to the forefront in Ghana's national planning. Yet progress is slow as other short-term traditional development needs in agriculture, such as food or input shortages, take precedence over long-term adaptation.

The Climate Specialists

The Climate Specialists are the second largest but the most strongly connected community in the network with density of 0.43. The Climate Specialists consist of 16 organisations linked with 502 weighted relations and cover 16% of the total network. They bring expertise on climate change and offer support on adaptation strategies. Like Policy Incumbents, the Climate Specialists are also diverse with organisations from government, NGOs, and climate focused international institutions. The government agencies of the environment ministry, which is the country's apex body for climate change policy, and its implementing arm, emerge as central among the Climate Specialists, accounting for more than 20% of relations. However, these organisations are policy setters only with little local presence and rely on others for implementation. The NGOs fill some of this void by closely collaborating with these policy organisations. In one example, we interviewed an NGO at the sub-office of the environment ministry, highlighting the strong relations between the NGO and the official environment organisations. As a result, NGOs are the most central and frequent Climate Specialist organisations with over half of all relations.

While most international institutions are part of the Policy Incumbents, we observe some in the Climate Specialists. The relations and attributes of these institutions highlight their focus on climatic issues and so have stronger relations with other Climate Specialists. Many of the NGOs in the Climate Specialists are also linked

to these international institutions as service providers. Climate platforms are a category of relations unique to the Climate Specialists, which are dominated by NGOs. The NGOs actively interact under these platforms raising awareness about the long-term effects climate change, but also individually compete with each other for the scarce funding as service providers, prone to adopting short-termism. Collaboration is dominant among Climate Specialists accounting for three-fourth of the relations because of their collective climate interest. NGOs are also prominent members of climate platforms, committees and service exchanges. However, there are limited formal reporting and funding relations because of the absence of officials among the Climate Specialists. Overall the Climate Specialists play an important role in formulating policy for agriculture adaptation and generating knowledge. However, the specialised knowledge has to be transferred to other organisation-communities for effective action, especially in engaging the Policy Incumbents for financial support.

The Arbiters

The Arbiters are the next largest community, consisting of 18 organisations linked with 386 weighted relations. The Arbiters cover 13% of the network with a density of 0.28. National and local government agencies make up three-quarters of the Arbiters. The remaining organisations include specific programmes for rural and social development with strong official involvement. The Arbiters main objectives are agenda setting, planning, coordinating, monitoring and implementing national development priorities across the country, which includes agricultural strategies. Ghana's transition from central to a decentralized fiscal and administrative system has resulted in separation of roles between the national and local organisations.

The national government organisations focus on policy and planning; the regional government organisations coordinate and monitor regional activities, and the

district government organisations implement the policies, but can also independently plan activities. A Functional and Organisational Assessment Tool (FOAT) is used to drive action at the local level. FOAT is a performance-based tool for securing district development funds from the national level. However, action is trivial since only 5% weighting is assigned to climate change activities within their planning. As a result, almost half the relations in the Arbiters are formal reporting linkages between government organisations.

Ghana's transition to a decentralised system is still incomplete therefore the national government organisations continue to exert control over local departments, such as agriculture despite the separation of roles. The result is multiple lines of authority between districts and the centre. This duplication, labelled by a district coordinator as 'having two bosses', results in competing relations, which are not obvious within the formal structures. Accordingly, the Arbiters also tend to collaborate informally, between and across levels for planning and implementing activities, bypassing the formal structures and bureaucracy. The Arbiters have relations for service provisions and limited relations for funding (less than 5%), highlighting the focused and formal nature of their relations. The Arbiters thus take on the important role of official agents for setting the climate agenda and delivering adaptation action across levels. However, the rigid, bureaucratic nature of relations impedes the flexibility required for effective implementation.

The Locals

The Locals are the smallest community in the network, consisting of 9 organisations linked with 142 weighted relations. The Locals only cover 5% of the total network, but are fairly well connected with network density of 0.31. The Locals are predominately concerned with supporting practical agricultural activities on ground, in our case in

Orbili. Although the Locals have an inward focus, it comprises a wide range of organisations including local communities, community groups, traditional authorities, NGOs, private sector and national government agencies. The relatively small size of the Locals is partly due the egocentric network approach of this research that limits the community to organisations directly connected to the Orbili ego. Adding more local communities would increase the size of the Locals. However, it is unlikely to affect the overall structure of the network or the composition of others since the next level of organisations are common, for example market dealers or rural banks that connect to many communities.

The Locals have an even spread of relations that includes collaboration between NGOs and rural banks, reporting between the traditional authorities, service exchange between private sector suppliers and local community, funding by rural banks for agriculture and membership of Orbili community groups. The Locals play an instrumental role in translating complex policies and knowledge into action. However, Locals, with their inherently narrow focus, constitute fewer organisations and hence lack the breath and diversity of relations needed for action to be effective.

Partitioning the network into the four organisation-communities yields unique insights about the composition, roles and characteristics of each organisation-community, which cannot be identified easily by conventional stakeholder and social science analysis techniques. Table 3 provides a summary of the organisation-communities and their roles. The composition, attributes and relations of the community help us delve deeply into their distinct roles and the likely actions expected from each.

Table 3: Summary of intra-community relations and roles of the four organisation-communities

Organisation-Community	Organisation-Community Composition	Intra-Community Relation Driver	Description of Organisation-Community Roles
The Policy Incumbents	Broad mix of organisations comprising government, international institutions, private sector, research institutions, NGOS	Resources and Collaboration	Funding of projects and activities in agriculture sector, with some support for adaptation actions. Collaboration between organisations for improving functional expertise in agriculture sector
The Climate Specialists	Dominated by NGOS, but other organisations from government and international institutions are also present	Collaboration and Services	Collaboration for generating climate expertise and promoting adaptation policies in the country. NGOs act as service providers for adaptation activities
The Arbiters	Government agencies and development projects	Reporting	Official responsibility for agenda setting, planning, coordinating and implementing national development priorities, including adaptation actions for agriculture. Formal budget guidelines are used to drive action and to coordinate activities of various government organisations across planned administrative levels
The Locals	Local communities, community groups, traditional authorities, local government agencies, private sector, NGOs	Collaboration and Services	Collaboration and services relations for implementing practical agriculture activities and raising awareness of adaptation practices for agriculture on ground

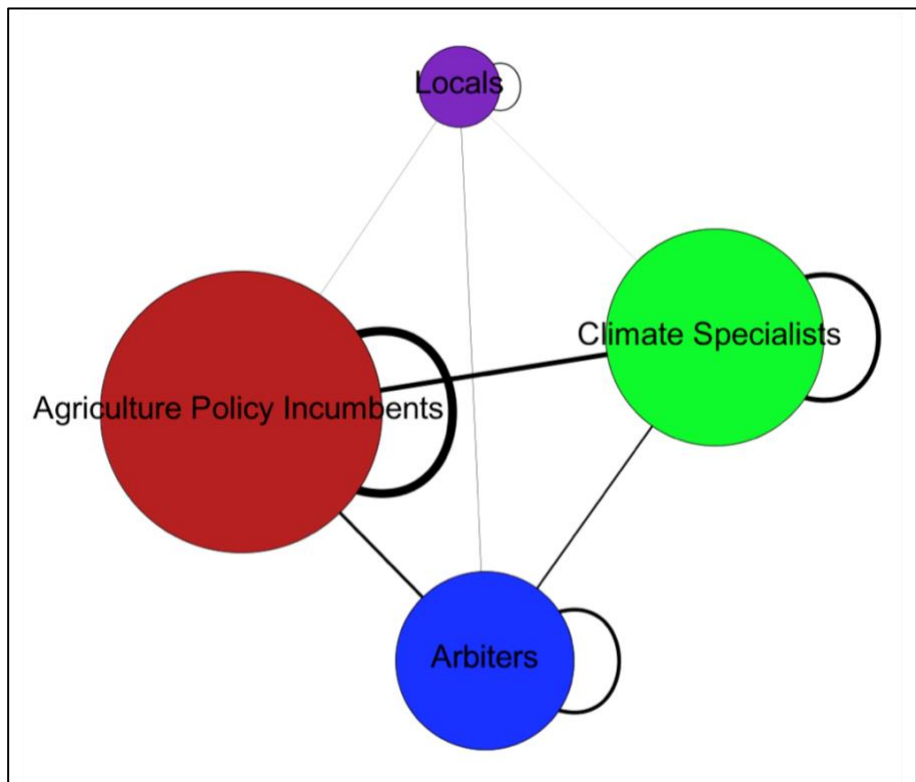
5) Relations Between the Four Organisation-Communities

Analysing the relations between the organisation-communities reveals those that facilitate or constrain adaptation and highlights the actions that are likely to result.

Figure 7 shows a version of the network partitioned into the four organisation-communities. A total of ten relations exist between and across communities – the four within the communities (intra-community) already detailed and six between the communities (inter-community) that cover 38% of the network. Here we are interested

in the latter to understand how these organisation-communities interact to facilitate or constraint adaptation. The nature of these inter-community interactions is summarised in Table 4.

Figure 7: Simplified network structure showing four organisation-communities



Source: Author compilation

Note: The nodes size is proportional to the total number of weighted relations between and across communities. The weight of the edges (thickness of line) is proportional to the number of relations between the organisation-communities.

The Policy Incumbents and the Climate Specialists are most active with 500 relations, covering 16% of the network. Roughly half the relations are collaborative to support agriculture adaptation initiatives. Many NGOs in the Climate Specialists also act as service providers for projects and activities funded by the Policy Incumbents that cover over one-fourth of the relations between the two. The NGOs use climate platforms set-up collectively to demonstrate expertise and raise awareness on climate change, yet compete for services to the Policy Incumbent. Membership of steering

committees is another way the Policy Incumbents and Climate Specialists interact. For example, the agriculture ministry (Policy Incumbents) served as the agricultural theme lead on the climate change task force, led by the environment ministry (Climate Specialists) to develop the national climate change policy. Such membership relations open up further avenues for the two organisation-communities to establish strong interactions, however these relations often evaporate once the planned task is achieved.

The Policy Incumbents also actively interact with Mangers with 316 relations and 10% of the network. Again, collaborative relations dominate with over half of the total. Ghana's move to decentralisation limits direct relations between the national government organisations (Policy Incumbents) and local government organisations (Arbiters). However, as the structure evolves, the national government continues to exert influence on local government. Accordingly, Policy Incumbents informally collaborate with Arbiters, outside official structures, to facilitate action. There are also frequent service exchanges between the two organisation-communities. For example, the meteorological agency (Policy Incumbents) provides weather data services to many of the local government departments (Arbiters).

The Arbiters and the Climate Specialists interact moderately with 222 relations, covering 7% of the network. Entry points for NGOs into official governance structures are limited, and so the Climate Specialists mainly collaborate with the Arbiters to offer expertise, which represents nearly two-thirds of relations. The environment ministry (Climate Specialists) is the apex policy-setting organisation for climate change but has limited presence on ground and has to rely on the Arbiters for implementation. This is not easy, as most of the Arbiters are bureaucratic government organisations who are expected to implement an agenda for which they are not directly accountable. This creates major gaps in the implementation process. The Arbiters also interact with the Climate Specialists through common memberships of committees, such as one set up by

government to oversee the formulation and implementation of the national climate change policy.

The Locals are the least connected in the network reflected by the smallest node in Figure 7, with 118 relations with other organisation-communities and covering less than 5% of the network. The Locals are, however, most connected to the Arbiters amongst all other communities, as many of them must report to the Arbiters under the official governance structure, such as traditional bodies reporting to the national planning agencies. The Policy Incumbents and the Climate Specialists are predominately connected to the Locals through one NGO active in Orbili that is the interlocutor between the Locals and the other organisation-communities. The NGO offers vital agricultural knowledge and funding to Orbili farmers and collaborates with international institutions (Policy Incumbents and Climate Specialists). However, detailed interviews with the NGO revealed that climate change adaptation is not their priority but is subordinate to its main objectives of agriculture value chains. This highlights the fragility of the Locals' relations with the Policy Incumbents and the Climate Specialists, which can become highly refracted through special purpose intermediaries like NGOs.

Table 4: Summary of inter-community relations

Inter-community relations	Key relation driver	Description of relations
The Policy Incumbents and The Climate Specialists	Service provision and collaboration in exchange for resources	Climate change expertise. Funded agriculture projects and programmes
The Policy Incumbents and The Arbiters	Collaboration	Agriculture policy and project diffusion in official structures
The Arbiters and The Climate Specialists	Collaboration and Membership	Integration of climate change adaptation in official planning structures for agriculture.
The Policy Incumbents and The Locals	Collaboration	Weak relations with international institutions through bridging NGO
The Arbiters and The Locals	Reporting	Formal reporting relations of local government organisations
The Climate Specialists and The Locals	Collaboration	Weak relations through bridging NGO

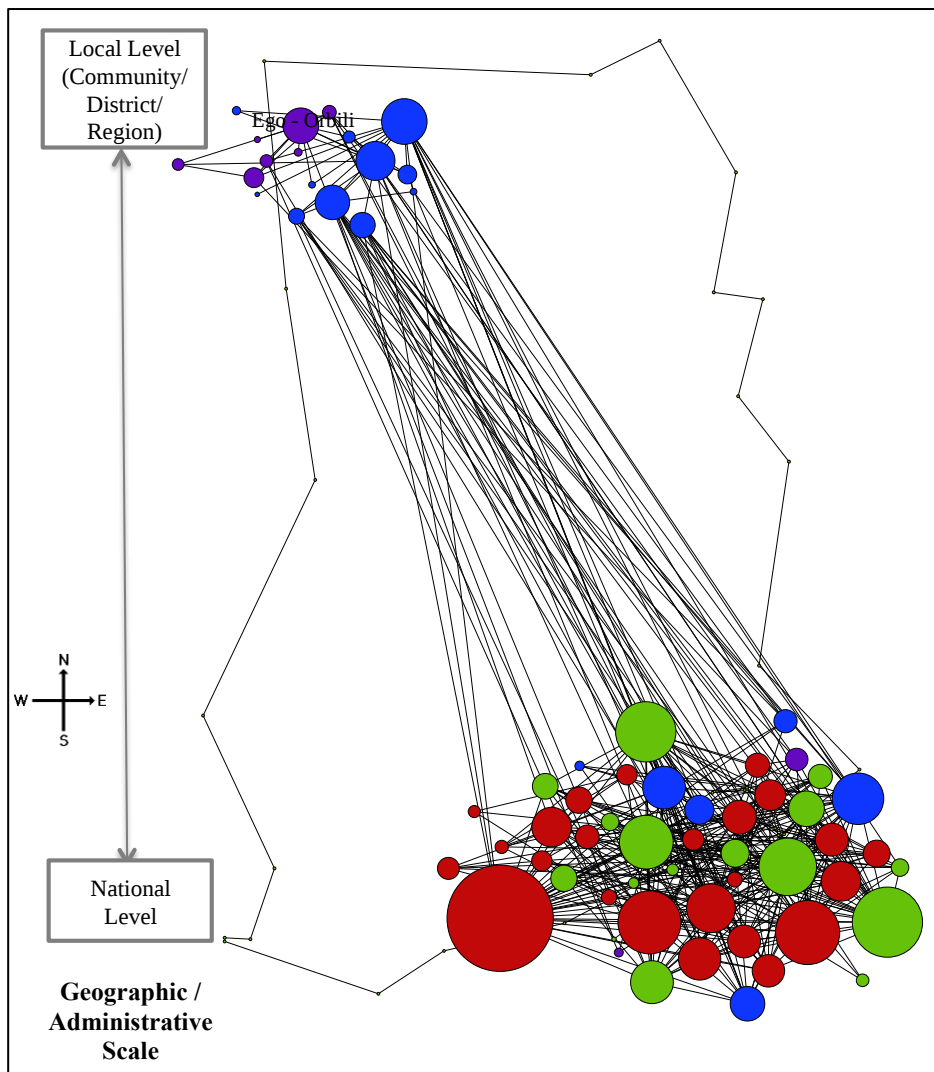
6) The Organisation-Communities and Planned Administrative Scale

In this final step, we mapped the four organisation-communities onto Ghana's planned administrative scale to understand how the organisation-communities and administration relate. Figure 8 shows the active presence of Policy Incumbents and Climate Specialists at the national level, with modest presence of Arbiters and only two organisations from the Locals. This is not unusual as the national level hosts a wide range of organisations focused on policy, planning, funding and functional activities. However, the weak presence of the Locals at the national level, illustrated by the small node made up of one NGO and a traditional government organisation, means that the Locals have little influence on drawing attention to Orbili. Climate planning in Ghana encourages using local knowledge to inform policy. However, the Locals are too poorly connected to the dominant players and are only represented indirectly through the Arbiters. This is a missed opportunity that ignores long established local traditional structures to promote adaptation action. The traditional local authorities complained about the lack of official resources and engagement to support the community. By

encouraging better bridging relations, traditional organisations can be included to promote climate action more effectively

Moving to the level of the region, district and community the Arbiters and Locals have a stronger presence. The Arbiters are responsible for local administration of planning, coordinating and implementing agricultural development and climate adaptation along with their national planning mandate. The Arbiters are therefore active locally. The Locals are strongly represented because of their focus on practical local activities. Surprisingly the Policy Incumbents and the Climate Specialists are completely absent at the local level. Considering the importance of the Policy Incumbents and the Climate Specialists role in funding, directing policy and generating knowledge on agricultural development and adaptation activities, their absence at the local level creates a serious void. As a consequence, the Arbiters and the Locals have to shoulder the delivery of adaptation, for which they are not best equipped. Although the districts have set-up formal local environmental units, these units are under-resourced and disconnected from other organisation-communities, especially the Climate Specialists, thus lack expertise and capacity to deliver climate adaptation. We observed that this lack of capacity often resulted in mislabelling by the local government of many environmental challenges, for example sanitation, as climate related in order to tick the appropriate boxes of the formal fiscal and budget reporting requirements.

Figure 8: Mapping of four detected communities on Ghana's planned administrative scale



Source: Author compilation

Note: Red for the Agriculture Policy Incumbents, green for the Climate Specialists, blue for the Arbiters and purple for the Locals.

Discussion

Ghana's agriculture adaptation regime appears fragmented to the outsider, with multiple organisations interacting and functioning in an uncoordinated manner.

However, closer inspection using network analysis reveals more structure to these interactions in the form of connected organisation-communities. Organisations having

more frequent interactions, common attributes and shared interests, fit strongly within a community and take on specific roles to promote certain actions. Detecting and identifying these subtle organisation-communities in the wider network allows for detailed analysis of the adaptation process, which is impossible with conventional adaptation and social science approaches. Our organisation-community approach offers an alternative perspective, highlighting the adequacy and significance of roles and relations of organisations in adapting to climate change. We discuss the finer points of these unfolding organisation-communities and their role in adaptation.

Adaptation as Organisational Roles

In this research, we move from the defined and stated functions and objectives of individual organisations, to how these organisations interact and behave in practice in the wider landscape. For the first time, we begin to observe and to some extent explain action in Ghana in terms of relations amongst different organisations, culminating into four distinct organisation-communities. Each organisation-community takes a specific role in facilitating or constraining adaptive action for agriculture. The Policy Incumbents offer functional expertise and resources for agricultural development. The Climate Specialists provide climate expertise through knowledge sharing, policy and services. The Arbiters set agendas and push adaptation planning, monitoring and implementation through the official decentralised structures. While the Locals adopt the prescribed action, and implement it. The four organisation-communities combined contribute to the national efforts in promoting adaptation within the country's agricultural system. However, to understand the wider role of these organisation-communities in adaptation, it is imperative to analyse their relations within and across the organisation-communities.

Our results show that these organisation-communities are bound together by various bonding (inter-community) and bridging (intra-community) relations (Granovetter, 1973, Newman and Dale, 2005, Bodin et al., 2006). Bonding is between organisations within identified organisation-communities that create dense network structures (see Table 3) and strong, but localised, trust. Whereas bridging extends outside the organisation-community and provides access to diverse resources, knowledge and support from other organisation-communities that are otherwise unavailable from within.

The bonding within the four identified organisation-communities in Ghana fosters group homophily i.e. it facilitates organisations with similar attributes, interests and expertise to interact more thus making communication and forming relations much easier. Under network theory this helps develop deeper specialization within the community (McPherson et al., 2001). The organisations within these four organisation-communities forge multiple bonds to strengthen the community structures through informal collaboration, funding, services and formal reporting. However, bonds that are too strong and inclusive can also confine expertise and action within a community, thereby reducing its effectiveness (Newman and Dale, 2005). We observed that knowledge about adaptation is confined to the Climate Specialists that have limited local presence where it is most required.

Along with bonding, bridging relations between the four organisation-communities are thus equally, if not more important to move expertise and action beyond a single community. Bridging encourages diversity within the network and enlarges the vision of the communities to combine their complimentary knowledge, resources and capabilities, make collective decisions and coordinate actions across different levels (Berkes, 2009). Our results show varying depths of bridging that raise issues of alignment. The Policy Incumbents and Climate Specialists interact most

actively as the NGOs in the Climate Specialists offer complimentary services and collaboration to projects and activities funded by the Policy Incumbents. However, the NGOs also compete for this scarce funding, and hence have less influence over the Policy Incumbents in promoting adaptation specifically against other agricultural development priorities.

Asymmetrical State Structures for Adaptation

Ghana, like many developing countries, manages, plans and implements adaptation programmes through its formal agencies. Our results reinforce Scott's (1998) arguments that state structures are incapable of capturing the full reality of climate change. They are bureaucratic and hierarchical and therefore not suited to react to the complexity of adaptation. Our results show that many state and non-state organisations contribute to adaptation efforts and ignoring the latter would result in significant gaps. State organisations undoubtedly have an important role to play at all levels of governance, but state organisations are not seamlessly connected to other relevant state organisations required for successful adaptation. Our results emphasise that state organisations are best understood through their roles within organisation-communities, and how these communities perform through bonding and bridging. For example, the Ministry of Food and Agriculture interacts strongly with international agencies about agricultural issues within its Policy Incumbents community rather than with its counterpart Ministry of Environment in the Climate Specialists community with the result that progress on climate adaptation is slow and fragmented.

Furthermore, the Policy Incumbents and Climate Specialists only interact at national level and have no presence at the local level. These communities have to rely on the Arbiters to take adaptation to the Locals. But the Arbiters, dominated by state

organisations, are bureaucratic and therefore not the best conduit for delivering adaptation. Adaptation, addressing risks and uncertainties has to have a high degree of flexibility across all levels to deliver success. The regional government agencies are part of the Arbiters and could be the bridge between national and local levels, but they lack the resources and often the official mandate to be effective.

Ghana's decentralised government means that state organisations are widely spread throughout the country (especially through Arbiters) but important agencies, crucial for successful adaptation (Policy Incumbents and Climate Specialists), are absent from the district and local levels where people are most vulnerable to climate change. The Policy incumbents and Climate Specialists are generally not required to visit communities such as Orbili and the distance of most vulnerable people from the capital and the poor transport system are major disincentives. Many of the national level state organisations that we interviewed had never visited the district containing Orbili. While much can be coordinated from the centre, most of the action has to happen locally for effective implementation and therefore requires a concerted effort from everyone to focus action where it is needed. New entrants are likely to attach themselves to the Climate Specialists and the Policy Incumbents at national level because of easier access and lower costs (Ansell and Torfing, 2015) exacerbating the gaps. A prudent means of strengthening adaptation action would be to encourage, incentivise and ensure more and better bridges between all existing organisation-communities, instead of only encouraging new initiatives.

The conventional administrative structure that relies on state organisations and regulatory roles to drive action is clearly insufficient for a complex environment spread across levels. All the levers of policy, incentives, regulations and collective action are needed for effective adaptation. Planners need to ask where best to establish relations, for what roles and through what types of organisations (state or non-state). By seeing

the delivery process as a network of organisation-communities with specific roles and not simply a hierarchy, we can identify capabilities and roles that are weak, saturated or altogether missing and therefore offer areas for targeted improvement.

Policy and Organisational Design Implications for Adaptation

The organisation-community approach to roles allows us to accumulate organisational elements to design multi-organisation and multi-level approaches. In turn this feeds back to the design of adaptation policy.

A frequent criticism of adaptation regimes is that beyond the formal organisations, efforts are too often fragmented and operate loosely through ad-hoc arrangements. Our results confirm that collaboration is the commonest relation in the network and, by definition, is informal and casual. For example, the central NGO operating in Orbili (Locals) collaborates loosely with the district agriculture office (Arbiters) to share information. While the NGO has contributed significantly to Orbili's adaptive capacity by providing considerable knowledge and resources, it has no obligation to continue in the absence of any formal requirements from officials. The benefits of these relations will dilute once the connections break, unless the permanent local organisations take over the NGO activities. Unless the activities of organisation-communities are linked through formal partnerships, much of their effort may be rejected by state organisations. The organisation-community analysis highlights critical points in the network and types of relation required to strengthen the whole and in turn the effectiveness of adaptation.

Organisation-community analysis also helps identify effective entry points for organisations and relations within the network. Traditional network analysis may suggest adding organisations into the regime to increase resources, knowledge,

administrative support or action on ground. While clearly this adds strength, it does not specify the location in the network where they will be most effective.

Introducing more organisations in the network, without understanding organisation-community structure and roles may lead to overcrowding that results in wasteful competition and duplication. Our results demonstrate that adding more organisations, for example to the Arbiters, may not be as effective in improving network connectivity as by filling missing relations between the Arbiters and Climate Specialists. The Arbiters are already formally connected to national and local levels under the decentralised governance and so adding more organisations would simply add bureaucracy. Instead linking them to the Climate Specialists at the local level would improve transfer of expertise to local planning units and thus strengthen the whole network.

Relations between the organisation-communities at the national level are dense and one reason for this is that there are multiple avenues for the different organisation-communities to interact through collaboration, reporting, and membership of steering committees or platforms. The national climate change committee, set up by the government, had members from all four organisation-communities, offering ample opportunities for interaction. District and region also setup planning committees to encourage interaction and interdepartmental coordination. These committees strengthen the bonding relations in the Arbiters, but they do little to encourage bridging between the Arbiters and the others. Several interviewees from local government were frustrated at not having an official space to reach out to organisations in other communities. Therefore, it is crucial to provide formal avenues for organisation-communities to interact and maintain a shared understanding at the local level and not just at the policy level, particularly where opportunities to interact are limited by geography.

The role approach moves away from a hierarchical control and command model where central organisations determine action. Instead the role approach is more distributed and resilient method of governance, with no dominant leader and with several centres of action and control. The complexity and uncertainty that characterises climate change makes it difficult to establish a strictly unified approach for implementation. Instead action and structures emerge through a network of relations among organisations interested and active in adaptation. In tackling these wicked challenges, organisations face conflicting demands from policy prescriptions and actions of others. This study shows how a distributed role model evolves to generate actions for adaptation, rather than through the formal planned structures. Breaking down the challenge into identifiable roles widens the perspective of the challenge to generate robust responses. It also allows organisations to maintain engagement across conflicting positions.

Limitations

Our approach for detecting organisation-communities uses standard partitions in which each organisation is assigned to a single community. In reality there is no single option and organisations often belong to more than one community, resulting in overlap (Fortunato and Castellano, 2009, Andrea et al., 2009, Cox, 2008). Identifying these overlaps poses methodological challenges of assigning organisations accurately to different communities, and lowers the quality of the organisation-communities. Here, the roles of bridging or trans-boundary organisation or organisation-communities (Cash et al., 2003, Berkes, 2009) that communicate, translate and mediate information (Cash et al., 2003) is valuable. There are several potential bridging organisations in Ghana such as the regional organisations that could reduce information asymmetry, build

confidence, and resolve issues, but remain under-used. Choosing a different ego could also produce a different network structure, however the network would still converge, as national climate organisations are essentially similar.

CONCLUSION

We started with the simple study of interactions of organisations in adaptation to observe progress. Using network tools, we delved deeper and observed that these interactions shaped these organisations into four distinct organisation-communities with specific roles. The role-based approach demonstrated how the organisation-communities can constrain or enhance effective action, which is hidden using conventional approaches. The network analysis shows in detail the likely fate of climate change adaptation efforts – not from lack of intent, lack of funding or lack of planning, but from a lack of appropriate connectivity. We provide an approach that augments and extends standard policy planning through engaging insights from a century of organisation and administrative theory that can identify the organisational weaknesses, which may lead to failure of adaptation.

Our study describes the problems of implementation that occur from the tendency of state planners to rely primarily on administrative structures to deliver adaptation. These structures assume information symmetry and seamless cooperation among the various agencies within the state. They overlook the many organisations that operate at the periphery but are crucial for adaptation. Our findings validate Scott's (1998) broad critique on how state managed policy initiatives may founder. To gain a better understanding of adaptation, it is important to recognise the need to go beyond descriptive network mapping and explore the roles and patterns of relations among strategic organisation-communities.

We observed that seemingly peripheral organisations form implicit communities of practice based on geography, sectors and common interests and interact through a combination of bonding and bridging relations. Maintaining a dynamic interplay of these relations allows proactive action, as organisation-communities become specialised, through bonding and bridging. Segmenting the network into organisation-communities, provides a clearer picture of organisations roles and effectiveness. This process allows us to identify gaps, biases, and weaknesses in the adaptation regimes that impede implementation. A network that functions well evolves so that we do not see the network or the organisation-communities, but a coherent solution for implementing adaptation (Law, 1992). The challenge is how to hold the system together without organisations breaking away? One approach is to build robust solutions that achieve short-term objectives while preserving long-term flexibility, and keeping future lines of action open (Padgett and Powell, 2012). Enhancing responsive and resilient networks of organisations with clear roles is important for improving the capacity of vulnerable populations to adapt.

Our study illustrates where the diverse efforts of providers can mitigate or impede the consequences of a changing climate on a village in North West Ghana, but our results are, however, not limited to this single locality and have wider application.

Acknowledgment:

This paper would not have been possible without the project and financial support of CGIAR Research Program on Climate Change Agriculture and Food Security (CCAFS). Support was also provided by the Environmental Change Institute (University of Oxford) and the Environment Institute (University of Adelaide). We would like to thank the wonderful community of Orbili and the many organisations in Ghana, and for Michael Kettlewell for his editorial assistance.

9. EMPIRICAL PAPER 4

Robust Adaptation Planning (RAP) Framework: Applications in Ghana's Agricultural Adaptation Regime

Abrar S. Chaudhury^{*1,2}, Ariella Helfgott¹, Thomas F. Thornton¹, and Chase Sova^{1,2}

¹ Environmental Change Institute, University of Oxford, UK

² CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

^{*}Corresponding Author

Sustainability Science (Special Feature): Sustainability Science for Meeting Africa's Challenges (2017) 12: 657: Published: <https://doi.org/10.1007/s11625-017-0462-0>

^{*}Abrar S. Chaudhury

Environmental Change Institute, University of Oxford, UK

abrar.chaudhury@ouce.ox.ac.uk , abrarchaudhury@gmail.com

+(44)7861478411

Abstract

This paper introduces a five-step framework, namely the Robust Adaptation Planning (RAP) framework, to plan and respond to the ‘grand challenge’ of climate change. RAP combines, under a unified framework, elements from robust action, participatory planning and network theory to capture the different motives, perception, and roles of actors that are important for climate change adaptation. RAP leverages existing structures and networks and involves diverse actors to plan, sequence and time strategies across multiple levels (i.e. from local to national). Actors identify adaptation interventions and important actor relations to develop wide networks, highlighting potential pathways for connecting action from central policy to local implementation (and vice versa). Comparing these proposed participatory structures with existing structures reveals actors deemed important for delivering adaptation, as well as gaps and overlaps in their relations. The end result is a robust plan covering many perspectives and local realities for both relieving immediate and adapting to longer-term consequences of climate change. We applied the RAP framework in Ghana’s agricultural climate change adaptation regime to demonstrate its usefulness as a means of planning adaptation interventions in a climate-vulnerable, multi-actor and multi-level setting. The application of the RAP framework in this paper highlights how it can: 1) visualise the adaptation space (and its different components), and reduce the complexity of implementing adaptation responses; 2) offer a shared space to actors from all administrative levels to think and create collective narratives for adaptation without demanding explicit consensus and; 3) identify key actors and actions through a collaborative planning process, and allocate responsibility for the smooth delivery of adaptation interventions.

Keywords: adaptation planning; agriculture; robust action; network analysis; climate change; Ghana

Introduction

Climate change has emerged as one of the greatest threats facing humanity in the 21st century. Such is the scale of the problem that it is labelled a ‘grand challenge’ or a ‘super wicked problem’ with no obvious solution and no single actor capable of offering comprehensive resources or knowledge to tackle it (Ferraro et al., 2015, Lazarus, 2008). Sub-Saharan Africa is already affected by climate change and future impacts are expected to be substantial (IPCC, 2014a). This is especially pertinent to agriculture that supports millions of rural households across the continent (FAO, 2012), and is the key economic driver of many African economies.

Changes in rainfall patterns and higher temperatures in the region can reduce crop yields and increase the risk of crop failure (Nelson et al., 2009). Furthermore the high reliance on natural resources, limited ability to adapt financially and institutionally, low per capita Gross Domestic Product (GDP), poverty, and a lack of safety nets mean that climate change poses a considerable challenge in Sub-Saharan Africa, especially for rural communities and the agricultural systems they depend upon (Schlenker and Lobell, 2010).

Unprecedented and coordinated responses are required of many disparate actors, from national governments, and international organisations to civil society and individual researchers/practitioners in order to help vulnerable populations adapt to the adverse impacts of climate change (Bryson, 2004, Ostrom, 2010a). Invariably, the objectives, motives and actions of these actors are incompatible or misaligned with the goal of effective adaptation to climate change, leading to ill-defined and weak responses (Mermet, 2011, Chaudhury et al., 2016c). Capturing the different motives, perception, and roles of these many actors under a unified framework is a major challenge (Etzion

et al., 2015), but necessary to develop effective climate change adaptation strategies and plans for agricultural systems.

Identifying strategies and responses that are practical, sound and meet the actors' varied interests requires careful and flexible planning. This is challenging because most adaptation measures are usually planned and implemented by public actors within national structures that are rigidly bureaucratic, incremental, and often underemphasise the role of many other actors (Scott, 1998, Adger et al., 2005). Added to this complexity is the lack of consensus on defining adaptation (Smit et al., 2000, Adger et al., 2003, Füssel, 2007) or characterising the scales and levels involved in tackling adaptation (e.g. temporal and spatial scales) (Gibson et al., 2000, Cash and Moser, 2000).

Effective responses to climate change require both the immediate relief from extreme events, as well as the development of longer-term plans that match the roles and capacities of actors with the appropriate scales and levels of the overall challenge (Gibson et al., 2000). For agriculture, this may entail short-term measures such as securing heat and drought tolerant inputs for local farmers that experience uncertain rains during the planting season (Tambo and Abdoulaye, 2012), as well as longer-term improvements in farming practices through crop diversification, among others (Lin, 2011).

The published literature recognises that good collaboration among affected stakeholders is crucial for effective adaptation action (Newman and Dale, 2005, Bodin and Crona, 2009, Cassidy and Barnes, 2012, Folke et al., 2005). However, there is little information about suitable methods and frameworks for coordinating the actions of different actors, and developing responses to climate change across multiple levels of time, space, and socio-political organisation. Much of the recent work on adaptation has focused either at broad policy and governance levels (Sandström and Rova, 2009, Stein

et al., 2011, Vignola et al., 2013), or at highly context-specific local levels through local case studies (Reid and Huq, 2007, Schipper et al., 2014). Actually adaptation studies have seldom focused across levels (Sova et al., 2016, Sova et al., 2015). Even when actors and adaptation actions are identified, it has been challenging to organise the necessary communication and implementation across levels and scales (Hajer and Wagenaar, 2003, Hill and Engle, 2013).

To meet this gap, we introduce a five-step framework, namely Robust Adaptation Planning (RAP). In particular the scope of RAP is to assist the planning of appropriate interventions to respond to the wicked and grand sustainability challenge of climate change adaptation. RAP builds on the ‘robust action’ approach that is defined as “noncommittal actions that keep future lines of action open in strategic contexts” (Padgett and Powell, 2012, p.24). Robust action offers a suitable base for the RAP framework as it encourages responses to immediate climate change impacts without losing sight of long-term trends and emerging needs (Padgett and Ansell, 1993, Ferraro et al., 2015, Nair and Howlett, 2016). RAP leverages existing institutional structures and stakeholder networks by using diverse actors to plan, sequence and time adequate strategies across many levels to reduce risks of failure and avoid duplication (Adner, 2006).

At the heart of RAP lies a participatory approach that promotes a collective response from actors, without requiring explicit consensus on the semantics of adaptation. Actors identify adaptation interventions and important relations to develop wide networks, highlighting potential pathways for connecting central policy to local implementation and vice versa. By comparing these proposed participatory structures with those actually existing on the ground, RAP can identify actors that are important for delivering effective climate change adaptation, as well as the gaps and overlaps in

actor relations/linkages. This can result in a robust adaptation plan that can cover many perspectives and local realities.

To demonstrate the utility of RAP for adaptation in climate-vulnerable, multi-actor and multi-level contexts, we piloted it in agricultural settings of Ghana dominated by subsistence agriculture smallholders¹. Ghana offers three appealing features for the RAP application: a high vulnerability to climate change, a developing country setting and a high reliance on agriculture (McSweeney et al., 2010a, Government of Ghana, 2010). As part of the RAP process selected actors from across Ghana developed plans collaboratively to implement priority adaptation interventions for a small vulnerable agricultural community.

The paper begins with a theoretical introduction to robust adaptation planning for climate change. We do not provide a comprehensive literature review of the disciplines underpinning RAP since these are mature, well researched and widely accepted (Ferraro et al., 2015, Mikkelsen, 2005, Scott and Carrington, 2011). Instead, we discuss aspects that are important for developing the RAP approach. We then outline the five-step RAP framework and the methodology adopted for the specific application in Ghana. We present the main findings from the application, assess the usefulness of the RAP framework in a multi-actor and multi-level setting, and outline future opportunities and recommendations for its application.

¹ Agriculture is the mainstay of Ghana's economy (a lower middle-income country), occupying over half of its population, mostly as smallholder farmers (Government of Ghana 2010).

Methodology

Theoretical Foundations of Robust Adaptation Planning

Robust action and participatory planning

The objective of RAP framework is to develop robust plans to balance the need for short-term responses and adapting to the long-term consequences of climate change. Unlike traditional organisational plans that emphasise clear objectives and steps to achieve specific goals (Daft et al., 2010, Bolman and Deal, 2013), RAP encompasses strategies that incorporate multiple interpretations of climate change and adaptation, without demanding a unified definition of adaptation (Lempert and Schlesinger, 2000). In particular, we propose Ferraro et al's (2015) robust action 'multi-vocal inscription' and the 'participatory architecture' strategies that promote structures and rules for interaction among many actors across levels, which creatively combine opposing views on the problems of defining adaptation and selecting responses. Multi-vocal inscription, where a single action can be inscribed and interpreted from many perspectives (Padgett and Ansell, 1993), offers an appropriate strategy to sustain engagement even when consensus is unlikely.

At the same time, participatory architecture provides a means of engendering and sustaining the involvement of diverse actors to foster long-term engagement. Participation helps overcome the bias of policy-driven or locally-focused approaches by providing space to express diverse opinions, which makes the overall approach more deliberative, effective, and efficient (Mikkelsen, 2005, Chaudhury et al., 2016a). This is important because adaptation action involves so many people, scales, and levels, where each may have different perspectives, biases, and interests related to the adaptation processes. Forcing a strict definition of adaptation actions is problematic and may disorientate or unnecessarily constrain people when application is unclear. Robust

action allows coordination between different actors by developing focused, yet broad, approaches that are applicable in various plausible scenarios (Vervoort et al., 2014), without requiring explicit consensus.

However, scaling the participatory framework to feed into policy, without losing the quality of participation is challenging. Other criticisms of participatory approaches include methodological weakness of the participatory tools, technical limitations of participation, elite capture of the process and limited impact of actions (Mosse, 2004, Cooke and Kothari, 2001). RAP overcomes some of these limitations by involving a wide variety of actors in the design, help to articulate collective needs, create meaning and value for collective actions, and minimise blind spots (Chaudhury et al., 2016a, Brown, 2009)

Network theory

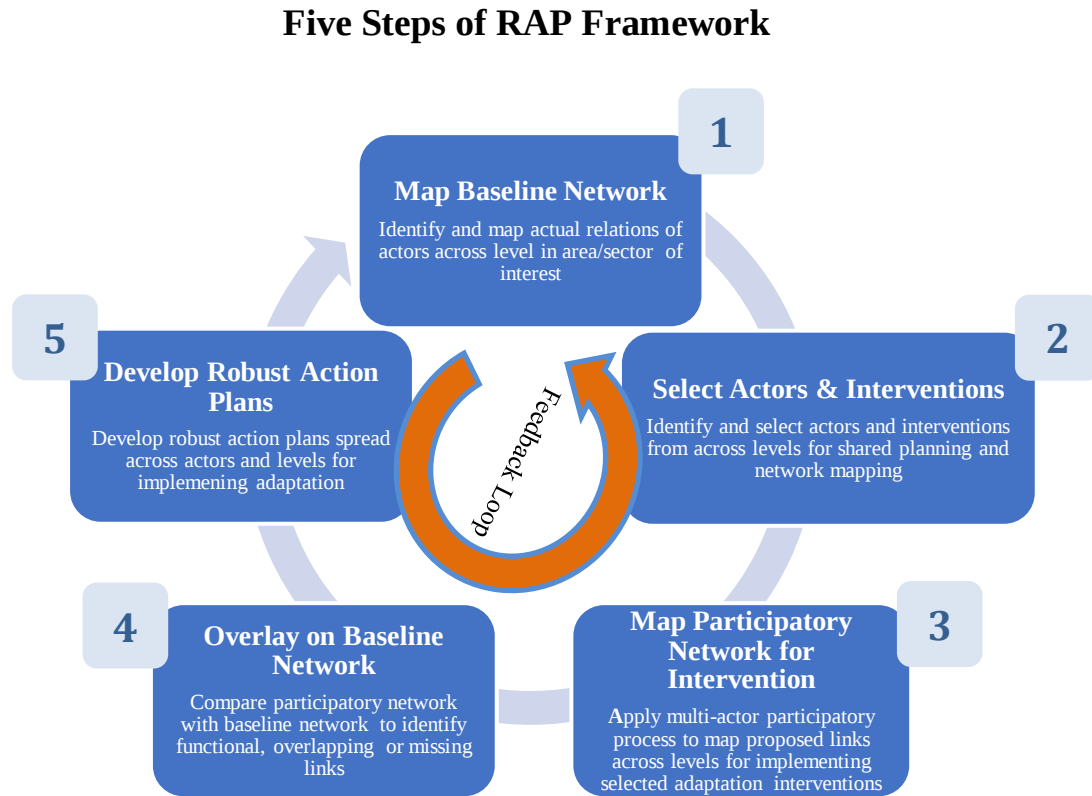
Networks are gaining attention as an effective means of capturing different forms of participation and relations under one umbrella (Ibarra and Andrews, 1993, Wasserman, 1994, Hanneman and Riddle, 2005, Borgatti et al., 2009, Scott and Carrington, 2011). Network analysis is an appropriate building block for RAP as it offers both a theoretical framework for understanding the causes and consequences of relationships and a methodological framework for visualizing and measuring these relationships (Marsden, 1990, McCarty and Bernard, 2003). Networks can provide essential resources, knowledge, and information that otherwise are not available within a single actor (Newman and Dale, 2005, Bodin et al., 2006). They can also influence and spread effective agricultural practices, thus enhancing widespread action for adaptation. Networks help identify key actors, gatekeepers and bridges (Granovetter, 1973, Burt, 2002) in the adaptation structure who, with the right support, can offer valuable contributions. Detailed network maps are created from the interactions of

actors for one or more types of relationships, which are then measured applying network metrics (Wasserman, 1994, Borgatti et al., 2009). The mapping and measurement of networks are important to understand and visualise the overall structure and the different pathways linking all levels within the adaptation regime.

Research Approach of the Robust Adaptation Planning (RAP) Framework

The RAP framework follows a five-step process (Figure 1) as discussed below. These five steps occur sequentially and inform one another through feedback loops. The RAP framework may require several iterations to find the appropriate balance between actors and relations and, in turn, robust implementation. The RAP analysis works with planned interventions, whose benefits are uncertain. This analysis is typically initiated and undertaken by the RAP project leader (either a researcher or a representative from the public or private sector) who acts as a process facilitator or knowledge broker (Wittmayer and Schöpke, 2014). The invited workshop participants support the RAP leader in developing the proposed participatory mapping and actions plans.

Figure 1: RAP Five-Step Framework



Source: Author compilation

Step 1 entails the mapping of the baseline actor network. The RAP project leader is responsible for mapping the actual relations of actors active or affected by adaptation. The network can be mapped through several approaches, such as backward mapping that builds the analysis from the lowest level of implementation or forward mapping that is driven by policy objectives (Elmore, 1979). The network may be a complete network (i.e. include all actors in a network) or an egocentric network (i.e. focus on relations of a single actor) (Hanneman and Riddle, 2011a). The relations may be single or weighted, and represent multiple interactions such as for knowledge, resources, or services facilitating adaptation. The objective of this step is to produce a baseline that depicts the wider network based on the actual relations of actors across

multiple levels, yet maintains a direct pathway to the focus of interest (e.g. a community, region or an economic sector such as agriculture or forestry). The national level generally assumes the role of formulating policies and implementation strategies based on national priorities, while the local level focuses on implementing the specific policies and strategies because it is there that climate change impacts are felt and most effectively countered (Ostrom, 2010b). The baseline network should, therefore, match the level and scope of analysis for effective action.

Step 2 entails the selection of the participating actors and adaptation interventions that frame the process. Actors identified during the baseline network (Step 1) are invited to develop the participatory network (Step 3) for selected interventions within an area of interest. The participants for RAP are typically chosen from actors most interested in (or affected by) the adaptation regime (Green, 2002), or where their participation is necessary to ensure successful implementation of the adaptation initiatives. These can be individuals, groups or organisations. Independent experts and decision makers can also be included to add breadth. Selecting participants is an imperfect and recursive process that will vary with location and scope of the analysis. It is important to have a broad and balanced representation of actors from all levels (i.e. from local community to national policy), categories (e.g. state, non-state, community, research) and network (i.e. central or peripheral actors) that can usefully contribute. An unbiased selection criterion that is communicated clearly to the participants makes the process more inclusive and transparent (Biernacki and Waldorf, 1981, Goodman, 1961). It also respects the right of actors not to participate, while participants can nominate representatives (e.g. senior personnel or knowledge expert) or nominate others that can contribute meaningfully. It is also important to communicate clearly to the participants (in person if practical) before the RAP workshop (Step 3), the objectives, goals and

steps of the framework. This helps gain necessary information, build consensus, and address some of the questions about legitimacy, motivation, representation, and credibility of the process and its participants.

While the RAP framework can be applied to any adaptation intervention, it is important to select those that are important to all actors, to secure strong buy-in. One approach is to focus on issues originating from the ground. Established participatory techniques and methods can be used to enable people to define the actions they require (McGee, 2002, Chambers, 1992, Chaudhury et al., 2016a). Alternatively, policy-based actions can be selected from broader national development goals or sectorial priorities. The RAP leader may prepare (with support from experts) and present to the participants a long list of existing adaptation interventions covering local challenges and policy goals. The participants can select (and if needed) modify, combine or develop from scratch adaptation interventions for RAP. While this paper demonstrates the applicability of the RAP framework for any selected intervention, Step 2 can also help refine standard interventions based on the collective input of the participants.

Step 3 involves the mapping of the participatory network. This step begins with a participatory workshop comprising those actors invited in Step 2. The workshop offers the participants a dedicated space to develop detailed, hypothetical network maps of actors and relations collectively for the interventions selected during Step 2. Together the participants propose the processes, actions, actors and links needed for implementing the selected adaptation actions.

First, the workshop recognises the different roles of each participant. This helps promote a deeper appreciation of each actor's roles within the network and helps overcome any culture of blame (e.g. farmers are lazy, officials are corrupt). The participants draw diagrams and rich pictures (Monk and Howard, 1998, Lewis, 1992) of

the adaptation space on a sheet of paper. These can include institutions, organisations, actors and other elements, as a way of gathering and representing information about complex situations. Drawings can both evoke and record insight into a situation and are useful to allow groups to explore their subconscious and conflicted understanding of the adaptation challenge (Bell and Morse, 2013). The workshop produces detailed layered maps that show the actors and activities with respect to the selected intervention and provides a visual basis for exploring connections and disconnections. Participants mark lines on the map representing proposed links between actors, such as how knowledge and resources should flow. This allows them to capture and acknowledge the complexity and perspectives within the adaptation system. The output of this step is thus produced by the participants, and is a multi-level network map of the links needed between actors to implement the selected interventions.

Step 4 overlays the participatory network map produced during Step 3 onto the baseline network produced during Step 1. This procedure shows the implementation pathways based on actual relations rather than those assumed to be optimal for implementation. For the successful implementation of the identified interventions this step identifies actors and their links that are functional, overlapping or missing. These are colour coded to identify the pathways (e.g. green for functional links and red for missing links). The comparison is intended to facilitate cross-level analysis and demonstrate flows of knowledge and resources, thereby identifying links to work with and build from. Identifying missing but important links offers opportunities to decide what is required to establish these links and ensure that information, knowledge, and resources get to where they are needed the most. This process helps create new insights by sharing ideas across all levels and instils hope and optimism about what can be achieved simply by improving communication.

Step 5 undertakes the development of the robust action plans. In this final step, the participants produce detailed action plans using relational data from the previous steps to implement the chosen intervention. The main objective of Step 5 is to translate the needs identified through the RAP process into a robust plan for implementation. Action plans are broken-down into detailed, concrete steps that define tasks and roles. Thus, they create a sense of ownership and responsibility within a complex process. The plans address strategies for establishing links between disconnected actors to improve cross-level collaboration while strengthening existing links. The primary outcome of this step is a range of response options that improves alignment and integration of adaptation initiatives, and provides ownership for actors at every level. Participants are helped through workshop facilitation to consider actions and links between levels. They also identify suitable conditions for these links to function effectively, thereby producing cross-level integrated response pathways. This helps to uncover gaps, overlaps, trade-offs and synergies between actions of actors operating at different levels. This process leaves participants with a clear vision of the implementation process by improving alignment and integration. The plans incorporate steps to distribute responsibility amongst the actors. Focal actors or champions are assigned by the workshop participants to lead the implementation. Timelines are agreed and roles of other actors are defined, setting responsibility for action.

The action plans for the selected interventions can be viewed against different social and economic scenarios (Vervoort et al., 2014). This can facilitate testing their robustness and covering uncertainties, along with a portfolio of actions that can be referred to as circumstances change. This ensures that decision-makers are aware that plans are sensitive to future uncertainties and keep future lines of action open.

Study Site

The RAP framework was developed as part of Systemic Integrated Adaptation' (SIA) project within the CGIAR Research Program on Climate Change, Agriculture, and Food Security (CCAFS) and is housed in Oxford's Environmental Change Institute (ECI).

We piloted the RAP framework in the agricultural adaptation regime of Ghana. Adapting to climate change in agriculture is a recognised goal for Ghana, as it is confronted by increasingly variable rains, floods and droughts, which threaten rural livelihoods and food security (McSweeney et al., 2010a, Government of Ghana, 2015b, Stanturf et al., 2011).

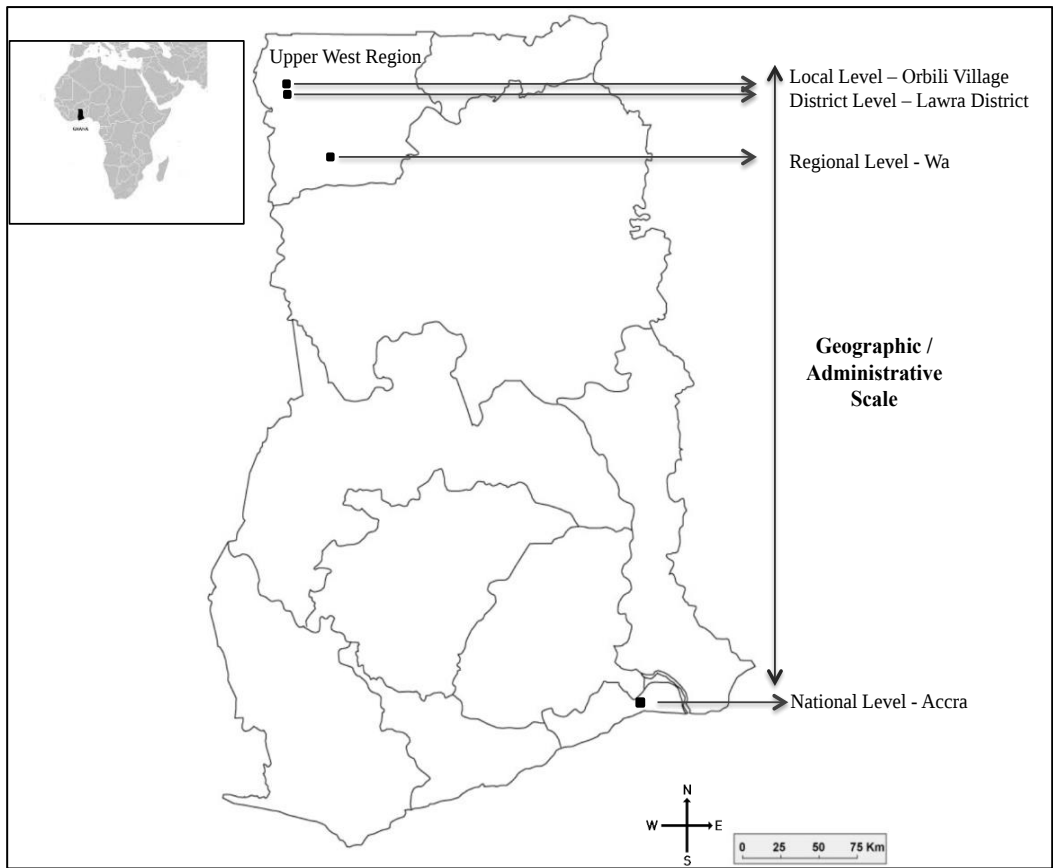
In particular, for the RAP application we selected the Lawra District in Upper West Ghana because it is home to our extensive study of the regions and several CCAFS baseline study sites (Chaudhury et al., 2017, Naab JB et al., 2011, Sova et al., 2016). Farming is particularly challenging in this part of Ghana due to the low socioeconomic development and adverse environmental and climatic conditions, (Antwi-Agyei et al., 2012, Etwire et al., 2013).

According to the official district records, Lawra district has 120 villages with an average size of 54 households and a median of 43 households. We shortlisted and visited eight villages within Lawra to evaluate the logistics, village size and social dynamics (a representative population), livelihoods and agricultural production patterns and community desire to be involved in research. Orbili Village, with its population of 156 adults in 58 rural households, offers a representative and appropriate focal point from which to build the multi-level RAP process.

We must note that as the analysis in this paper is based on a single case study, care must be taken in generalising the results. As this paper attempts to highlight the

RAP methodology and its functionality, rather than focus on the utility and desirability of the selected interventions, a single case village offers an appropriate context for the application of RAP. Figure 2 shows the administrative/geographic scale spread across the local, district, regional, and national levels, as mapped from Orbili.

Figure 2: Map of Ghana showing Upper West Region



Source: www.mapsoftheworld.com and author compilation

Data Collection and Analysis

We adopted a mixed-methods research approach (Silverman, 2013) that combined qualitative and network analysis supported by fieldwork. Table 1 summarises the data, methods and deliverables for each step of the RAP application process in Orbili. We collected baseline relational and qualitative data through workshops, surveys, network mapping and detailed semi-structured interviews over several months

of field research in 2013-2014. To develop the baseline over 150 interviews were conducted with key national, sub-national, local and community-level actors engaged in climate change adaptation (Step 1).

Table 1: Summary of the RAP pilot application

RAP Steps	Duration	Data Collected	Analytical Methods	Deliverables
Step 1 Map Baseline Network	3-6 weeks for network data collection. 2 weeks for network data analysis	Relational data of key actors from local to national levels, based on the egocentric Orbili	Interaction protocol to capture egocentric network, actor interviews, Gephi social network analysis software	Baseline network map of actors across Ghana based on their multiple relationships (Figure 3, and Supplementary Data)
Step 2 Select Actors and Interventions	2-3 weeks for producing the suite of interventions. 4-6 weeks for organising the participatory workshop and selecting/inviting participants.	On-the-ground challenges from local community. Expert input to develop interventions to meet the challenges	Community diagnostic workshop at Orbili, expert consultations, content analysis, personal visits to potential workshop participants	Suite of adaptation interventions. Selection of 40 participants for the Accra workshop (Supplementary Data)
Step 3 Map Participatory Network	Three-day participatory workshop in Accra	Proposed processes, actions and links between actors to implement the interventions	Participatory approaches, rich pictures and diagrams, network mapping of relations	Multi-level network map of the links between actors necessary for implementing the selected interventions of AIMS and SAI (Figure 4)
Step 4 Overlay on Baseline Network	Three-day participatory workshop	Participatory network map from Step 3 and baseline relational maps from Step 1	Network analysis (network metrics)	Colour-coded network map showing functional (red) and missing (green) links for selected adaptation interventions (Figure 5, Table 2)
Step 5 Develop Robust Action Plans	Three-day participatory workshop	Identification of action tasks and allocation of roles, using data from Steps 1-4	Participatory planning approach	Detailed action plans (divided in tasks and roles) to establish disconnected (and strengthen) existing links for implementing AIMS and SAI interventions (Supplementary Data)

We applied an egocentric approach (Hanneman and Riddle, 2011a, Marin and Wellman, 2011) to capture the baseline network (Step 1). The network is mapped around a particular node, known as an ego, which in our case is Orbili village (Figure 2). We developed a detailed interaction protocol to capture primary relational data of the actors. In particular the interaction protocol captured four main aspects of actor relations, namely length, frequency, type, and usefulness².

Instead of constructing the network based solely on data from the ego, we build it through collecting data across different levels. In particular we started with the 58 households in Orbili, and we progressively mapped the network for more distant actors across different administrative layers, spanning from the community, district, and region to the national level. Through this iterative process, we obtained a wide and representative network of actors (from local to national) who were involved in agricultural adaptation, yet maintained direct pathways to Orbili [refer to Appendix A–Paper 4 in the Supplementary Data for actors in baseline network]. This corresponds well with the multi-actor and multi-level approach of the RAP framework.

We used Gephi version 0.82 (<https://gephi.org>), an open-source Social Network Analysis (SNA) software, to process the data. We also adopted a multi-relational approach, which is a valuable analytical area for SNA (Wellman and Wortley, 1990). The analysis elicited four types of interactions among the actors that collectively help to assess capacity for adaptation: (1) flow of resources, (2) knowledge transfer, (3) service exchange, and (4) social connections. For instance, flow of resources can lead to improved agricultural productivity and diversity creating a virtuous cycle of income and investment (Deressa et al., 2009). Knowledge transfer can enable the exchange of

² Length represents how long actors have been interacting. Frequency captures how often actors interact (e.g. monthly, quarterly or yearly). Type highlights the different relationship between the actors (i.e. resource, knowledge, services, and connections.) Usefulness determines the strength of relationships between actors, as scored by the actors.

traditional and expert ideas between organisations that address climatic risks, and encourage suitable adaptive practices (Folke et al., 2002). Social connections may not directly influence adaptation, but it links actors with others who are important resources.

We assigned weights to the relations based on their multiplicity between actors and the effectiveness of each (as scored by actors) to identify central actors using E

$$W = \sum R \times E \quad (\text{Eq. 1})$$

Where W = weight of the relation, R = type of relations, i.e. knowledge, resources, services exchange and connections (where, 1 = relation 0 = no relation), and E = effectiveness of relation (scale of 1-3, where 1 = least effective and 3 = most effective).

We conducted a three-day community diagnostic meeting in Orbili comprising 26 men and 36 women that represented each of the 58 households (voluntary participation, followed with interviews). This diagnostic meeting helped us understand the local environment, development challenges and the responses to climatic and environmental change adopted in agriculture. With input from experts across many levels and content analysis, a suite of adaptation interventions was collated for subsequent RAP application, based on actual and prioritised challenges faced by locals (see next section).

We organised a three-day workshop in Accra for Steps 2-5 that brought together 40 participants from across the different administrative levels as identified through the baseline mapping. Workshop participants developed the participatory network, which culminated in robust adaptation plans. The participants included Orbili farmers, district officials, NGOs, regional coordinators, private sector, international institutions and government ministries, amongst others [refer to Appendix A – Paper 4 for a list of participants and a visual agenda for the workshop]. We included independent experts and decision makers to add breadth to the workshop participants.

Before the workshop, we visited potential participants to brief them about the RAP methodology and the expected outputs of the adaptation action plans. In Orbili, we encouraged households to self-select participants to gain ownership of the process. In particular, we focused on a balanced representation from each administration level and stakeholder category [refer to Appendix A – Paper 4 in the Supplementary Data for more details], while also encouraging gender balance. The workshop structure and specific tools applied are covered in more detail in Helfgott et al. (2014).

Adaptation Interventions

As mentioned above, Step 3 of the RAP procedure entails the selection of the adaptation interventions that frame the participatory process. In this paper, the workshop participants selected two adaptation interventions for RAP application (see Results for more information about the selection process). The selected interventions are Agriculture Information Management System (AIMS) and Sustainable Agriculture Inputs (SAI).

These interventions focus directly on the key challenges identified by the local community in the diagnostic workshop (see previous section), address issues of adaptation of agricultural systems to climate change, and require cross-level effort through many actors. Hence, they were considered suitable by the workshop participants for the RAP framework application.

The AIMS was developed by the RAP research team (with experts for the RAP testing) and its focus is to produce a comprehensive agricultural extension policy and accompanying legislative instrument to close the gap between the current extension support offered by the government, and the needs of local farmers. AIMS disseminates to local farmers (and for training extension staff) information on appropriate adaptation

strategies and technologies in the form of workshops, field demonstrations, trainings and literature. This would enable the exchange of traditional and expert ideas between local communities and external actors to address climate challenges and encourage suitable adaptive practices. The head of an NGO aptly pointed out that “*whenever a new (agricultural) technology is discovered, it needs to be communicated to the farmer. Capacity building for program officers, technical, agricultural extension officers, is key and that is where the bulk of the funding should be going*” (Personal communication 2013). Similarly, an extension officer attributed low extension support on the shortage of funds suggesting that “*as an extension worker, you get frustrated...because you do not have the resources for your plans. So, when you see the farmer you start avoiding him*” (Personal communication 2013).

The SAI was also developed by the RAP research team with experts for the RAP testing. Its aim is to promote the sustainable and informed use of agricultural inputs to improve productivity and crop diversity. This can create a virtuous cycle of income and investment for farmers. Within SAI, the main focus is on the sustainable use and fair allocation of fertilisers to farmers, because of the frequent shortages in the supply chain across regions and districts of Ghana. SAI envisions improving transparency, accountability, and coordination within the national distribution system (through district and regional directors) for the effective management and timely import/manufacture of fertiliser stock to meet local demand. The key challenge of SAI was aptly highlighted by a representative of a local civil society organisation who stated that farmers “*didn't get fertiliser last year because it was sitting in a warehouse somewhere. So all the farmers were waiting for their fertiliser and by the time it came the growing season was over*” (personal communication 2013).

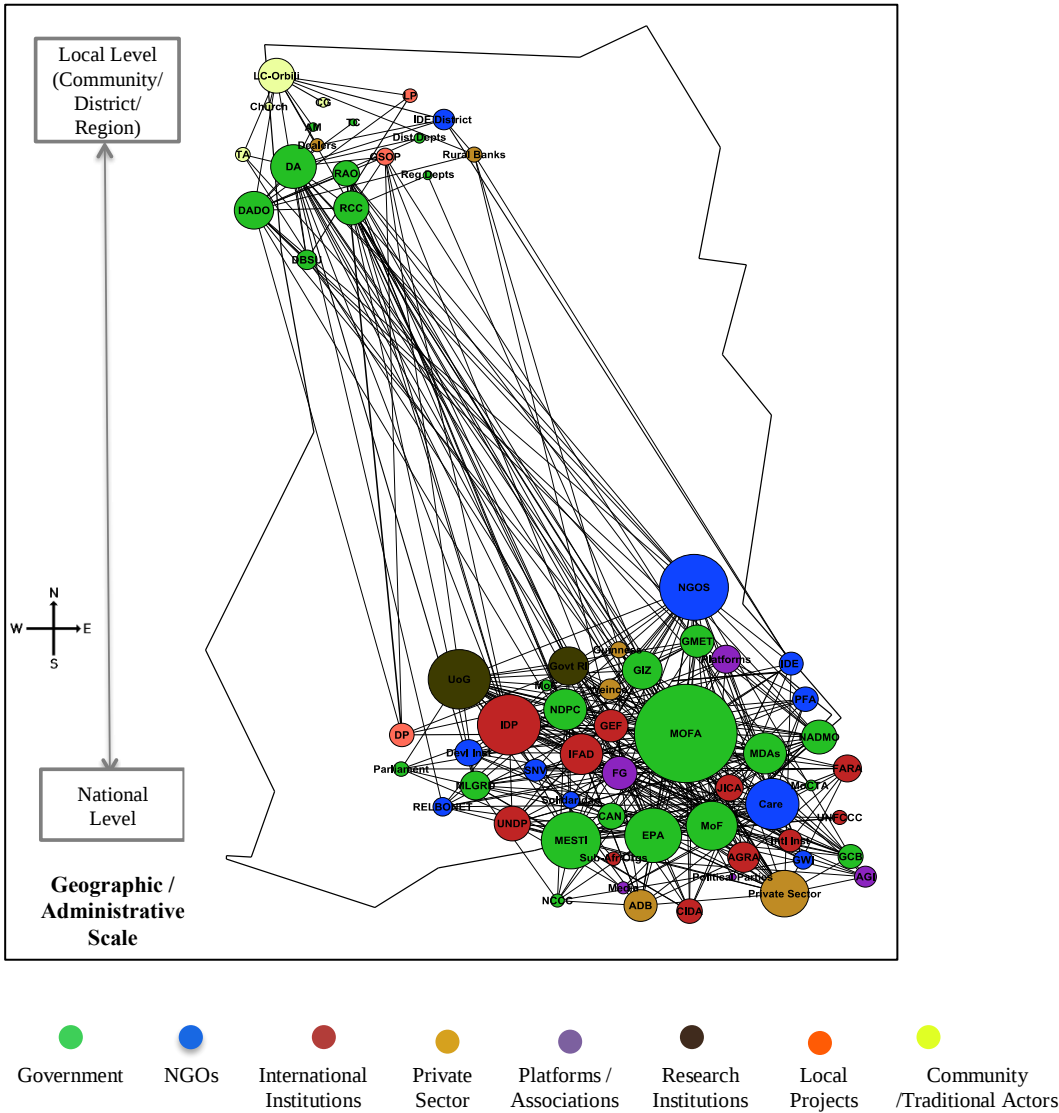
Results

Establishing Relations Between Actors

Figure 3 illustrates the baseline network map of actors (colour coded by actor category) active in agriculture adaptation spread across all administrative levels as drawn following an egocentric approach (with Orbili village being the ego) (Step 1). In total, we mapped 66 actors connected through 350 direct relations and 3,054 weighted relations. The network is sparsely connected with a density of 0.16 (i.e. the proportion of all possible relations that are actually present).

On the other hand, the overall network is diverse with multiple categories of actors being represented (Figure 3). However, government represents over a third of all actors in the network. This is to be expected as the implementation of formal agricultural activities in Ghana is the responsibility of government agencies, and is thus promoted through the official administration structures. We also observe a high concentration of national actors representing 72% of the network, as opposed to 28% of local level actors at the level of the community, district, and region. This is again not surprising as national actors have a broader interest in climate change adaptation across the country but nonetheless highlights the skewed structure of the network. Although the network is a single connected component because of the egocentric approach adopted, the diameter of the network (i.e. the shortest path between two distant actors) is 5. This highlights the significant separation between local and national actors, with all the ramification it can have for the effective implementation of plans and strategies.

Figure 3: Baseline network map: Undirected network map of adaptation organisations



Source: Author compilation

Note: Nodes on the map represent the 66 organisations in the network from local to national organisations. The edges between the organisations are weighted to represent multiple relations and strength of interactions between organisations. The node size of organisations is proportional to the number of weighted edges connected to the node.

Overall, the Ministry of Food and Agriculture (MOFA) is the apex organisation for developing agricultural policy in Ghana. It assumes the central role in the network linking many actors across levels that are otherwise weakly connected. Similarly at the local level, the District Assembly (DA) and the District Agriculture Department Office (DADO) connect Orbili and other local actors, to the wider network.

We also see a strong presence of NGOs (representing a fifth of actors) because they play an active role in climate projects and ancillary services. International institutions, climate platforms, community actors and the private sector are also visible in the network. Each category of actors has its distinct organisational characteristics and operational structures. This influences how climate change adaptation is framed, activities are prioritized and relations established across all levels [refer to Appendix A – Paper 4 for details of actors in baseline network].

Selecting Adaptation Interventions

The main challenges identified by households of Orbili village were low income, low crop yield, poor access to agriculture inputs and implements and variable rainfall. With input from experts across many levels and content analysis, the research team collated a suite of adaptation interventions for Orbili village. Based on this understanding of the local context the RAP facilitator team proposed adaptation interventions and the RAP participants deliberated and selected the actual interventions for piloting the RAP framework. The selected interventions are Agriculture Information Management System (AIMS) and Sustainable Agriculture Inputs (SAI) (see Methodology for more information).

It should be mentioned here that as the purpose of this paper is to highlight the methodological procedure of the RAP framework, the intent here is to use AIMS and SAI to highlight the procedure, utility and usefulness of the RAP framework in a climate adaptation setting by combining it with broader network analyses. It is not the focus of this paper to assess the effectiveness of the specific adaptation interventions chosen by the actors.

In total 40 participants attended the participatory workshop in Accra (Step 3), with representation from each administrative level: national (45%), region (20%),

district (15%) and community (20%) [refer to Appendix A – Paper 4 in the Supplementary Data for more details]. A team of experienced researchers and workshop facilitators (10), translators (3), note takers (4) and support staff (4), supported the workshop participants.

The workshop was structured to offer a safe space where actors from different administrative levels and backgrounds could comfortably express their opinions and open up to other perspectives. The participants developed rich pictures of the issues and opportunities at each administrative level within Ghana for AIMS and SAI (see Figure 4 for examples of the rich pictures created for SAI). Workshop participants collectively identified actors and relations, within and across administrative levels that were considered important for the interventions, and created potential pathways for effective linkage across levels.

Step 3 helped create a shared understanding of terms, definitions, actions and the need for a collaborative approach towards planning climate change adaptation interventions, without enforcing any one particular approach. From the 66 actors identified in the baseline mapping (Step 1), workshop participants identified active roles for 24 and 15 actors for AIMS and SAI interventions respectively (highlighted as red coloured nodes in Figure 5). Participants identified more actors and links for AIMS as technical and traditional knowledge is spread across many actors, whereas under SAI most of the actors/relations are concentrated to the fertiliser supply chain.

Figure 4: Examples of rich picture of organisations and relations collaboratively created by the participants for the selected interventions



Source: Author compilation from workshop

Figure 5 and Table 2 show the network maps of AIMS (Fig. 5a) and SAI (Fig. 5b) overlaid on the baseline networks and the related network metrics (Step 4). The participatory mapping identified 11 and 5 missing relations (red lines). These missing relations were in addition to existing functional relations of 35 and 24 (green lines),

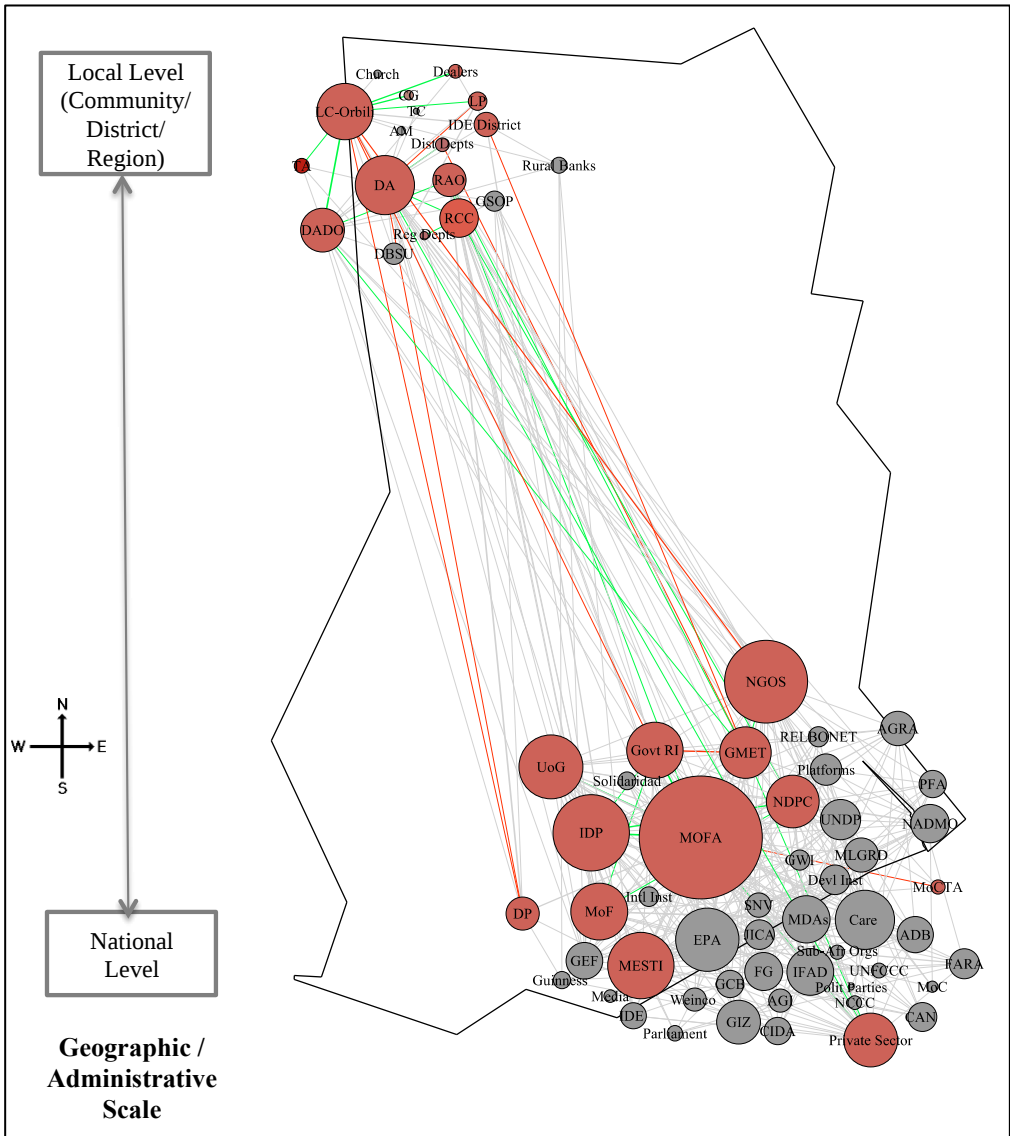
among the 24 and 15 identified actors under AIMS and SAI respectively. The participants did not identify any new actors for both interventions, highlighting that leveraging existing networks is more useful than unnecessarily introducing new actors. Creating only 5% additional relations for AIMS and 4% for SAI of the total weighted relations in the baseline network, a more strongly connected network emerged for the two interventions, also with clearer pathways.

We observed stronger density of relations (both for existing and new relations) for SAI at 0.22, compared to 0.14 for AIMS. One plausible explanation for the low density in AIMS is that action and knowledge generated requires the broad participation of many actors from national to local level. Yet not all actors need connections to others for the successful diffusion of knowledge. For example, connecting Ghana Meteorological Agency (GMET) to local NGOs can transfer knowledge to the wider community about local weather patterns and crop selection, rather than tediously communicating directly with each individual. SAI, on the other hand, entails the physical flow of resources (i.e. fertilisers) through the network. As resources are located at one node, these need to flow from one actor to another for the relation to form. This requires direct connections between actors rather than broad links. For example, participants identified missing links between market dealers, community members and official actors (e.g. regional and district departments of agriculture, extension officers) for monitoring fertiliser supplies. This lack of engagement frustrated local farmers that faced fertiliser shortages.

The above experience during Step 3-4 suggest that the RAP framework can point to missing links between actors that can be effectively filled to establish targeted action. While we cannot comment on the effectiveness of these proposed new links, it is reasonable to assume that they improve transparency and effectiveness.

Figure 5: Undirected network map of adaptation organisations.

Figure 5(a): Agriculture Information Management System (AIMS)



Note: Nodes on the map represent the 66 organisations in the network across levels. The coloured nodes (red) represent the organisations relevant for the AIMS (5a) and SAI (5b) interventions. The edges between the organisations are weighted to represent multiple relations and strength of interactions between the organisations. The green edges show the functional links between the organisations and the red edges represent the missing links that need to be established. The node size of organisations is proportional to the number of weighted edges connected to the node.

Figure 5(b): Sustainable Agriculture Inputs (SAI) – Fertilisers management

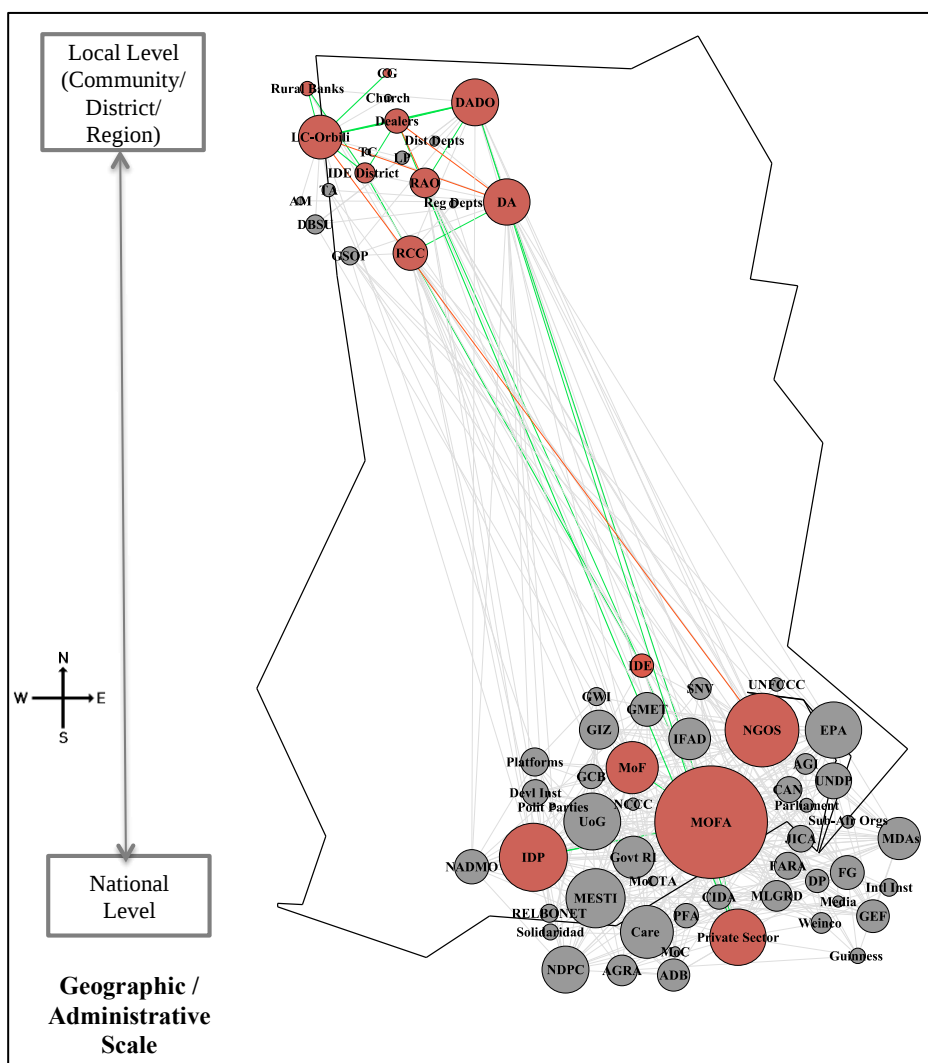


Table 2: Network metrics for AIMS and SAI interventions and baseline network.

	AIMS	SAI	Baseline Network
Size (Organisations in Use)	24	15	66
Existing Relations	35	23	350
New Relations Proposed	11	5	
Overall Relations (Existing + New)	46	28	
Existing Weighted Relations	205	159	3054
New Weighted Relations Proposed	158	134	
Overall Weighted Relations (Existing + New)	363	293	
Overall Density (Existing + New)	0.14	0.22	0.16

Developing Action Plans

In this final step (Step 5), the participants developed action plans for delivering AIMS and SAI. Each action plan identified detailed activities and steps to achieve them, assigned responsibility to actors and setup concrete timelines for undertaking each action, [refer to Appendix B – Paper 4 in the Supplementary Data for more details]. The participants suggested ‘champions’ for taking the plans forward, consulting and involving other crucial actors. The action plans included strengthening existing relations and establishing new ones where needed. For example, connecting local communities to procurement officials would improve transparency of action. Although it is difficult to quantify the effectiveness of these relations, they enable pathways within the wider actor network.

For AIMS, the participants debated the challenges within extension services, including knowledge gaps, lack of technology (e.g. localised weather forecasting, crop production and price data dissemination), funding shortages, resource availability and lack of coordination among the various actors. Some even went as far as to say that formal extension services were virtually dead and extension staff had to rely on the help of NGOs to offer such services. Plans for AIMS, therefore, envisioned an improved agricultural extension policy backed by funding to overcome farmers’ current knowledge and support gap. The proposed extension policy would require appropriate contributions from many actors including national ministries, district and regional governments and local communities. It would entail establishing new (and strengthening older) links among all the various actors, especially connecting local communities to central policy-makers in order to reflect local realities in policy design. A pluralistic model was planned to allow service provision by both government and the private sector. This included plans for non-traditional and e-extension services to meet immediate challenges, while maintaining long-term support by extension provision.

Regional government actors (e.g. Regional Coordinating Committee and Regional Agriculture Office) were identified as ideal bridges between national and local actors to improve collaboration, transfer knowledge and offer support to farmers across the country. Champions within the local community were identified to receive extension service, adopt new techniques that enhanced traditional practices (e.g. river water pumping systems for dry season farming), and transfer knowledge to other community members. More detailed information about the action plan can be found in Appendix B – Paper 4.

For SAI, the action plan envisioned setting up a national advocacy group, comprising the key ministries of agriculture and finance. The advocacy group would directly engage with development partners and input suppliers to ensure the timely supply and distribution of fertilisers. The action plan advocated formalising and strengthening existing links among these actors to tackle procurement and supply challenges. Regional and district actors (e.g. Regional Coordinating Committee and District Assembly respectively) were identified as champions for communicating local demand to national actors (e.g. the proposed national advocacy group) and monitoring its subsequent delivery. A key missing link in the fertiliser supply chain identified through RAP was the representation of local farmers on the district's committee for fertiliser procurement. Farmers blamed the administration for shortages whereas the administration labelled farmers as misusing their allocations by illegally selling subsidised fertiliser for higher margins. By directly involving farmers in the distribution process, the RAP participants envisioned overcoming the mistrust between actors and promoting transparent and fair allocations of inputs (Njoroge et al., 2015). Finally, the SAI action plan emphasised improving the communication between actors by promoting links between disconnected actors and strengthening existing links, rather

than just increasing the number of actors (or their relations). More detailed information about the action plan can be found in Appendix B – Paper 4.

Discussion

Visualising Actions Across Actors and Levels

Planning and implementing adaptation is complex because climate change is both a major sustainability challenge and a ‘wicked problem’ that involves many contingent environmental and human variables, playing out across various geographic scales, levels of governance, and sectors of the economy/society.

The low density of connections in Figure 1 suggests that many potential relations between actors are missing, and as a result important information and resources will not diffuse easily through this network (Bodin and Crona, 2009). Actors central to agricultural adaptation can be identified easily, while others that are equally important operating at the periphery of the agricultural sector (e.g. private sector actors) can be harder to identify. Some actors do not even label their activities as related to climate change (e.g. IDE, the central NGO working in Lawra) and could fall outside the regime. Yet many of these peripheral actors could provide valuable contributions through existing knowledge and resource connections.

Deciding which actors to include or exclude, what links to focus on in the design and at what point, is not simple. Visualising this complexity through the rich pictures and network mapping obtained during the RAP process can highlight strengths and contingencies, as well as minimise blind spots and biases. This approach is common to several problem-solving and creative thinking methods because our intuition communicates more easily through impressions and symbols than in words (Bell and

Morse, 2013). We found that encouraging each of the many actors participating in the RAP process to create pictures helped develop inclusive and robust action plans that are rooted in a manifest social-ecological system of agents, drivers, and processes with existing and potential relations between them. In this way, RAP utilises the collective wisdom of participants to develop feasible and widely acceptable action plans.

Visualising adaptation challenges, through rich pictures and logical pathways, helps to break down the climate change adaptation challenge into manageable steps, while offering a structure for developing long-term strategies. Similarly, visualisation helps to identify actors that are important for adaptation but have weak or no links with the adaptation regime. Targeted action plans can be developed to reach out to such actors outside the network in order to acquire new practices and technologies (Kenis and Oerlemans, 2008, Powell et al., 1996) that improve adaptation plans

During the implementation of RAP in Ghana, there were many ‘aha’ moments where participants discovered roles and actors that they were previously unaware of. For example, when illustrating lessons learned from the RAP process one climate NGO official pointed out that “*farmers are undertaking so many activities already in the area of adaptation, which they don't know is adaptation*” (personal communication 2014). Similarly, participants identified and debated the somewhat ambiguous and overlapping role of regional actors at the local level, which tends to lead to inaction and gaps in offering support. This realization can provide an effective means of supporting existing adaptation processes rather than overriding them with outside models.

Visualising draws attention on existing structures and actors that can be deployed, thus avoiding duplication of structures that is costly and time-consuming. For example, an official from the Environmental Protection Agency (EPA) reinforced the importance of visualisation by pointing out that “*often we underestimate the capacity of the communities. Because [members] know what is happening within their communities,*

they know how best to adapt. The difficulty is the lack of capacity to be able to see the bigger picture and put it in a more constant framework” (personal communication 2014). RAP, especially when it incorporates iteratively actors at multiple levels, has the potential to ensure that all key actors in the system do see the big picture, as well as the (potentially changing) positions of other actors’ within the networks over time.

Creating a Shared Narrative for Adaptation Action

Alongside creating the visual network mapping and the participatory planning, a key output of the RAP framework is developing a shared understanding of the challenge and actions required. To reach this understanding explicit consensus is not always needed. Invariably adaptation action takes a policy-driven, forward mapping, top-down approach that starts with policy and assumes “*that policymakers control the organisational, political and technological processes that affect implementation*” (Elmore, 1979, p603). At the other end, the bottom-up and backward mapping approaches acknowledge that while central programmes offer more opportunities to local actors, they are only one of the considerations in the implementation process (Klijn, 2008).

As a result, when designing/implementing adaptation actions it is not simply about deciding whether to take either a top-down or a bottom-up vision, but also to recognise that responses lie across levels, especially in strategic collaboration and coordination or roles and responsibilities. An official from the Ministry of Finance (MoF) reinforced this multilevel approach by saying that “*we don't do top-down planning. [Instead] it is top-down and bottom-up, because the policy comes from the top, but the activities come from the ground to satisfy those policies*” (personal communication 2014). However, this understanding is also simplistic as the

implementation of policy is often spread across actors and levels, rather than confined to just a few actors at a particular level.

However, most of the participants had little faith in the government's ability to implement adaptation interventions alone and stressed that a shared approach is needed. As the head of a farmer interest group put it: *“all the policies are actually good, it is the implementation that is problematic... We have realized that it's very difficult for a lot of policies to reach the grass roots farmer”* (personal communication 2014). The official from the office of the National Development Planning Commission reiterated that the *“main problem in Ghana is not the lack of ideas, but their implementation and coordination for effective, efficient and smooth implementation”* (personal communication 2014). Hence it is important to include others, *“if you are going in to work with a community, you need to involve them, otherwise it will not be sustainable”*, as an academic from the University of Ghana stated (personal communication 2014). Thus, through the RAP process a shared narrative of ongoing involvement of the community and other actors was recognised as a prerequisite for sustaining adaptation processes.

Having actors from all levels sitting across the same table breaks barriers, and helps frame better solutions in terms of actions and roles. This allows for an inclusive and multidimensional approach for the design of adaptation interventions based on shared knowledge. For AIM, the multidimensional approach entailed the improved collection of baseline data on agriculture extension support to inform and update the current policy. Creating such a ‘deliberative space’ (Hendriks, 2002) is important for actors to dissect successfully the issues at stake.

The RAP approach builds on the premise that participants are most knowledgeable about their own levels/actions, and it is by respecting and incorporating their diverse views that a shared approach evolves. Facilitating participants to take an

emphatic view of the worldviews of actors from different levels within the planning structures can help move the discussion away from the traditional hierarchy of power (i.e. from higher policy level to lower community level) to one of shared responsibility and mutual dependence. During the RAP process, the officials from the Regional Coordinating Committee that are empowered with oversight of districts acknowledged the challenges of enforcing direct authority on the districts, as well as their lack of response. A more prudent approach to engage districts would be for the region to act as facilitator of knowledge sharing across districts, rather as an enforcer of central policy.

It then becomes possible to capture the interests and understanding of different actors about the issue without enforcing a single definition (i.e. multi-vocality), where many meanings can be drawn from the same process (Ferraro et al., 2015). The interpretation of adaptation and of the perceived roles of actors often varies along national to local planning structures. In the RAP process, national actors identified adaptation action for AIMS in terms of extension policy decisions, but at the local level many of the production choices were influenced by the availability of official extension support or the presence of NGOs. Having actors sit across the same table helped develop a broad consensus for action without enforcing a single definition of adaptation, thus respecting each other's view point. Where one level stops, participants from other levels step in to take adaptation planning to a logical conclusion. For example, the traditional chief of Orbili highlighted the need for multiple actors by saying that "*the ordinary farmer knows that something is happening. They don't know what to do with [that knowledge]*" (personal communication 2014).

This shared approach is the foundation of the RAP framework and helps participants overcome translation problems and the knowledge-action gaps. For example, while doing fieldwork at Lawra we observed that other environmental issues such as sanitation are often incorrectly framed as climate adaptation. The RAP stresses

the continuity of the process based on shared knowledge rather than deferring action or incorrectly representing others interest. This moves the discussion away from blame, to one of empathy and collective purpose. This multi-actor discussion acknowledges the inherent challenges and limitations at each level, thus allowing the RAP participants to move collaboratively towards solutions/adaptation interventions that satisfy everyone. The solutions may not always follow unified definition but are acceptable if these meet the needs of the participants across levels for adaptation. This also gives the underrepresented and marginal actors a voice. For example, many government officials were for the first time collaborating directly with farmers, and so had the opportunity to explain their positions and appreciate local challenges.

Leading and Sharing Responsibility for Adaptation Action

A problem in developing a shared understanding of the adaptation challenge (and the responses required) is deciding *who* leads the process and *how* responsibilities are shared among the various actors and participants. During the RAP process, identifying the most appropriate actors to champion the activities was difficult, as their roles and scopes for action are not always clear. Conventional organisations such as private sector for-profit organisations usually have a definite line of authority where action, activities, and roles are clear (Daft et al., 2010), while adaptation regimes need to be dynamic and fluid (Folke et al., 2005).

Here the role of boundary and bridging actors (Cash and Moser, 2000, Granovetter, 1973, Berkes, 2009), who can work across levels, is important to support both the other actors and the adaptation intervention itself. Bridging actors, because of their position, help translate ideas about adaptation as the emphasis changes from one level to another (e.g. from the national to the local level). According to Cash et al.

(2006), effective systems perform many functions that contribute significantly to boundary management (e.g. knowledge co-production, mediation, translation, and negotiation). Effective mediation appears to be the most important element in ensuring legitimacy through increased transparency, by bringing all perspectives to the table, providing rules of conduct, and establishing criteria for decision making (Ostrom, 2005). Regional governance in Ghana, for example, has the role of coordinating and translating into local action the information offered from the national government, and yet remains underutilised due to the lack of formal mandate, power or influence. One regional planning officer expressed serious reservations and frustration about the current fragmented approach, despite existing planning structures. As he stated “...if you bypass the region and go directly to the district, chances are that you will have difficulties with them. They may not see or may not have the interest that you wish them to get” (personal communication 2014).

Boundary organisations also support adaptation processes by maintaining the momentum created through the RAP, but can slow down when actors at any level fail to follow through. Clarifying these roles and keeping an element of accountability, feedback and flexibility, maintains effective action. However, this is challenging as was articulated by a regional NGO. Specifically, “many of these planning officers [at the district] do not have the requisite knowledge in participatory methodologies. This makes it difficult for them to engage people and collect information for planning” (personal communication 2014). Our research demonstrates that by understanding these channels, roles, links and the actions taken, the adaptation regime is made more robust, resilient, responsive, and functional. Identifying champions and allocating responsibility moves the process from theory to formal and concrete responses.

Practical Considerations for Planning RAP Applications

The RAP framework facilitates the participatory development of shared action plans and tests their robustness against local realities. The plans are built based on empirical data, and supported by input from people across multiple administrative levels. However, as any participatory process the RAP framework can require significant resources (in terms of time, budget and capacity) for its effective implementation.

Essential to RAP is a knowledgeable project leader who is sensitive to the challenges and appreciates the social, economic, political and cultural differences among the participants. While it is hard to quantify the time, resources and human commitment to implement RAP as they can vary depending upon the nature and context of the research setting, they can be substantial. In our case, RAP application required a few months of primary data collection to identify actor relations and local challenges, planning workshops (including selecting and inviting participants), developing adaptation interventions with expert input for RAP applications and securing the financial commitment of hosting community and RAP workshops (refer to Table 1).

However, in other settings the required resources might be much less. For instance, where strong baseline data is already available, the time required can be reduced substantially. Similarly, RAP workshop format may be altered to focus on one region or theme in more depth. To broaden its appeal and application as a practical planning and policy tool, RAP framework can be linked to established decision making frameworks such as UK Climate Impacts Programme's risk-uncertainty-decision making framework³ or the European Commission's adaptation support tool⁴. In short,

³ <http://www.ukcip.org.uk/wp-content/PDFs/UKCIP-Risk-framework.pdf>

⁴ <http://climate-adapt.eea.europa.eu/knowledge/tools/adaptation-support-tool>

RAP offers a structured process but one that matures with time, and resources through repeated application.

Conclusion

The RAP framework piloted in this paper offers a practical methodology for developing and implementing sound plans to deliver climate adaptation in agricultural settings. RAP is a highly participatory process that brings together stakeholders from different sectors and administrative levels to identify adaptation pathways and disconnections within the existing networks of actor. This enables them to identify deficits, opportunities and actions to improve the coordination (and ultimately the conditions) under which vulnerable populations cope with climate change. This in turn strengthens planned adaptation strategies and offers clearer implementation pathways.

The RAP framework highlights three important elements: 1) visualise actions across levels and actors to reduce the complexity of adaptation responses; 2) offer a shared space to actors from different levels to think and create collective narratives for adaptation without demanding explicit consensus; 3) identify key actors to allocate roles and responsibility for delivering effective adaptation plans through a collaborative process. By the end of the RAP process, participants should be clear on what actions are needed and who has responsibility for each.

Our results from piloting the RAP framework in the context of agriculture in Ghana demonstrate that the responsibility to plan and implement adaptation actions generally lies beyond the remit of a single actor (e.g., the national government). In some cases, coordinating action is complex, requiring concerted efforts by actors to establish formal channels of communication through Ghana's formal administrative structures.

While in other cases it is simply bringing together disconnected actors (across and between the national to the local level in Ghana) to take action. Using existing networks and actors engenders the necessary collaborative understanding and vision to motivate collective action that promotes unity, coherence, empowerment, efficiency and effectiveness in climate action. By adopting a participatory approach across all levels, a shared understanding of adaptation is developed, with strong ownership of the process as witnessed in the robust adaptation plans developed for AIMS and SAI by the participants of the RAP workshop.

Our application of RAP in Ghana's agricultural system demonstrates that robust action is essential to address the complexities of climate change by balancing the need for short-term responses and adapting to the long-term consequences. Participants identified several existing links that could be strengthened immediately to ensure a stronger flow of knowledge and resources to improve action. While others required sustained efforts to establish and institutionalise for longer term responses. This balanced approach supports the global objectives of the Paris Agreement 2015 of offering relief to developing countries to cope with the current impacts of climate change while building capacity to plan for future changes. The RAP framework and in turn robust action literature is strengthened by visualising the regime, developing a shared narrative of the challenge and identifying actors to lead and participate in adaptation. The RAP framework thus offers a valuable tool to policy makers, planners and others to develop robust plans that involve many actors spread across multiple levels. However, the framework is new and evolving. More applications (case studies) are needed in a variety of settings, sectors, and geographies to evaluate fully its broader utility and to refine the methodology. Given the positive results of this case, it seems to be worth more attention.

Acknowledgment:

This paper would not have been possible without the project and financial support of CGIAR Research Program on Climate Change Agriculture and Food Security (CCAFS). Support was also provided by the Environmental Change Institute (University of Oxford) and the Environment Institute (University of Adelaide). We would like to thank the wonderful community of Orbili, SIA team members, our local partners and workshop participants for piloting the RAP framework, and for Michael Kettlewell for his editorial assistance. The paper has also greatly benefited from the constructive comments of the two anonymous journal reviewers and the special issue editor, Alexandros Gasparatos.

10. DISCUSSION AND CONCLUSION

“If you are only talking of policy, policy, policy, and you don't have any input from the people, then the policy sometimes becomes very abstract or obsolete. You then have a policy that cannot be implemented properly.”—

Civil Society Organisation (Interview, Ghana 2013)

10.1. Introduction

This chapter draws together the insights from the whole project – from the early framing and motivation for the research to the findings from the four empirical chapters. These insights speak to the original framing enquiry on organising adaptation efforts: How do current policy goals become strategies? What are the organisational architectures? How are ideas about implementation linked to the organisational arrangements and finally, how are these arrangements to be implemented? This section is not a repeat of the discussion sections of each paper. Rather, it seeks to coalesce the key findings and synthesise a more general insight into organising adaptation to climate change.

The research started by surveying adaptation policy initiatives in the agricultural sectors in Nepal, Pakistan and Ghana before conducting detailed fieldwork in Ghana to identify the many state and non-state organisations active in adaptation and to map their interactions. I found critical patterns of linkages and also absences of linkages crucial in organising climate adaptation. Here I summarise the core claims and conclusions from the four papers, discuss what we learned before turning to the limitations and possible ways forward.

10.2. Summary of Core Claims and Conclusions

Table 4 summarises the core claims and conclusions from each of the paper, and how they address the three framing questions underpinning this research. Paper one uses organisation theory to frame adaptation initiatives as ‘meta-organisations’ that operate from national to local levels and how organisational structures and arrangements affect adaptation and are affected by the various organisational attributes. It emphasises the importance of structure and theory in studying adaptation as organisations rather than applying policy and governance to manage adaptation. Papers two and three move the analysis to the components within the meta-organisations and use network analysis to visualise how they behave within and are shaped by their environment. Emphasis is on the role of organisations to affect local adaptation capacity and the wider network. Comparing the emerging network with state structures reveals gaps and overlaps. Insights from all three papers inform recommendations for organising and reorganising adaptation. Paper 4 develops recommendations from the three earlier papers and offers adaptation built on robust action planning to enable organisations and local communities to take ownership and develop plans based on shared narratives for both immediate relief and longer-term responses. Combined the four papers offer insights on how organisations fundamentally shape the adaptation efforts in the country and in turn influence the adaptive (and/or maladaptive) responses of local populations.

Table 4: Summary of four empirical papers and key insights

Paper	Key Insights	Link with Research Questions
1) Emerging meta-organisations and adaptation to global climate change: Evidence from implementing adaptation in Nepal, Pakistan and Ghana Broad analysis of the planning and implementation structure in three countries – Nepal, Pakistan and Ghana. The paper defines this arrangement as ‘meta-organisation’ that comprise many autonomous organisations tackling adaptation.	Organisational structures affect understanding and implementation Meta-organisations set standards, defining purposes, and specifying appropriate means-ends criteria for inter-organisational and community design implementation structures Countries promote similar objectives, but meta-organisational structures are distinct, leading to different outcomes. These structures arise from the different needs for legitimacy and accountability, and the relative priority attached to adaptation	Current structures take on an implicit organisation form, exhibiting common characteristics such as a focus on aims, processes, and structures, yet are seldom recognised as organisations by their architects. Framing the country level regimes or initiatives as organisations or partial organisations, enables these initiatives to be viewed under a common organisational framework and draw general insights. Most adaptation initiatives are led by states that are formal, bureaucratic and rigid
2) Role of local networks in shaping community structures and adaptive capacity: Evidence from Ghana The paper studies bridging (external) relations of 58 vulnerable rural smallholders to evaluate adaptive capacity	Current models for adaptation fail to appreciate the importance of external local organisational relationships as crucial for understanding adaptive capacity of local populations. Local organisations provide important resources and knowledge not generated from within the community Not all external relations are equal resulting in variation in household’s adaptive capacity Local organisations and community networks provide links to distant organisations necessary for effective adaptation	The organisations that sit between local populations and everyone else are critical conduits for key resources and knowledge unavailable locally. But in the process directly impact the adaptive capacity of local populations and even shape their structures.

Paper	Key Insights	Link with Research Questions
3) Climate Change Adaptation ‘on the Ground’: A network analysis of organisation and policy in Ghana agriculture sector Analysis of emerging implementing structures for adaptation. Identifies communities of organisations, their roles and interactions with others in organising adaptation	State is important in organising adaptation, but its capacity to plan and implement is low Current structures tend to overlook the role of other important organisations. The paper identifies four organisational roles labelled ‘Agriculture Policy Incumbents’, ‘Climate Specialists’, ‘Arbiters and ‘Locals’. These organisation-communities comprise many organisations that exhibit common properties and perform specific roles.	States use hierarchical structures to organise adaptation that may be unsuitable. Identifying roles reveals the actions that constrain and facilitate adaptation. The results show a fragmented network with key roles missing.
Robust Adaptation Planning (RAP) Framework– Applications in Ghana’s Agricultural Adaptation Regime A five-step Robust Adaptation Planning (RAP) methodology to develop multi-organisation and multi-level plans Organisations and local communities are brought together to develop robust adaptation plans	Capturing the different motives, understanding and roles is important to develop RAP. It identifies key organisations to receive responsibility Comparing proposed networks with the actual structures reveals important organisations for organising adaptation, and the gaps and overlaps. Offering shared space helps create collective narratives without demanding explicit consensus	RAP framework enables plans to cover many perspectives and realities for both immediate relief and for the longer-term

Source: Author compilation

10.3. Lessons

Adaptation as an Organisational Challenge

Despite progress in adopting clear goals for adaptation, the results show the widely recognised fact that policy implementation and practice lag in most developing countries. One explanation for this slow progress is the sheer scale of the challenge. Another is that planned adaptation initiatives in Ghana, Nepal and Pakistan are still embryonic. Furthermore, adaptation literature concentrates on policy intent, rational planning, and science, but fails to address research about putting policy into action. This thesis demonstrates that implementing adaptation is not simply a funds disbursement issue or knowledge diffusion challenge, but is essentially one of organisation and capacity. This is the general finding and reflects the original focus upon theories of organisation, networks, and implementation.

Just as adaptation moves from a theoretical and scientific challenge to a policy goal, so too organisation theory has shifted its core assumptions from a closed system model of organisation to an open one that recognises interdependencies and influences of external elements on capacity, strategy, and linkages. The organisation and adaptation literatures thus share a common narrative and many concepts. Both acknowledge the importance of cohesion to function effectively, the need to reduce complexity by setting standards and structures that match objectives and the need to be adaptive when faced with uncertainties. The analysis using organisation theory provides tools and concepts to examine the dynamics and structures of adaptation, moving it from an abstract challenge to one of organisation.

Framing adaptation as an organisational challenge, directed attention to areas not covered by conventional adaptation research. The focus shifted from looking at the

effectiveness of the policy objectives to the organisational arrangements and their linkages needed to relocate resources crucial for adaptation. These new insights would have been missed using the standard approaches advocated in the adaptation literature.

The first paper shows that countries with young adaptation regimes develop structures that take on organisational attributes, which are unrecognised by their architects. These larger arrangements, or ‘meta-organisations’ become the means of delivering adaptation and by framing these regimes as complex organisations reveals how initiatives are distributed under a common organisational framework, which avoids narrow comparisons. This paper explains the differences in adaptation efforts of Nepal, Pakistan and Nepal that all shared similar policy objectives that were each implemented through different organisational arrangements. Studying the adaptation initiatives as organisational challenges yields insights that can feedback to improve the alignment of objectives and actions. This iterative process of feedback and learning loops enables meta-organisations to adapt by revisiting goals and roles and revising relational structures to improve outcomes.

The next two papers highlight the critical roles played by many organisations (within a meta-organisation) at the interface between the local populations and the central planners. They are the important conduits for resources, but these organisations are also actors in the process and, as intermediaries, affect the capacity of locals to adapt and can even shape their community structures. National institutions in turn affect these intermediaries and their linkages. Much current analysis ignores these intermediaries and their linkages because they are not part of the official state structures responsible for adaptation. My findings emphasise that organisational relationships matter but that it is also important to examine how they work and what they do within the wider networks to deliver adaptation. This organisational perspective in turn sheds light on the

proximity and role of organisations in influencing local adaptation efforts. Similarly, organisations act as a conduit for capturing the voice of local populations and directing attention and resources to their challenges. However, over dependence on external organisations raises questions on sustainability in the long term and the possibility of eroding social capital through maladaptive practices.

State Adaptation Policy Architecture

My investigation reveals the wide variety of methods to deal with climate change and the lack of agreed ‘best practices’ insights that can be shared. Despite such variations, one common theme is that the legitimate responsibility for delivering large policy issues, including adaptation, should reside primarily with the national government. Both Ghana and Nepal have state-led adaptation programmes. Even in Pakistan where a private sector initiative was promoting local adaptation, the emphasis was to pass responsibility back to the state. Climate change is a global problem that is probably driving all nations to take centre stage and to agree that adaptation is a fundamental human right, along with the more traditional rights to health and education, and to accept the commitment of government.

The first paper shows that control of adaptation initiative influences the types of organisations that dominate adaptation. In Ghana and Nepal state ownership of the process attracts state organisations to provide legitimacy but leads to the problems of bureaucracy. While state ownership does not preclude NGOs or other private organisations from participating, their efforts are often ignored by officials. The paper highlights the vital role played by organisations outside the formal structure.

Development literature suggests that external agents that bypass the state undermine the state's capacity to cope after the agents leave. However, this thesis shows that states that overlook important organisations that operate outside formal structures, risk difficulties. Acknowledging the dynamic interdependence between state and non-state organisations is essential for delivering effective adaptation. The motivation for this thesis is to build in-country capacity to deliver adaptation to climate change and so avoid repeated disasters. While all kinds of organisations necessarily play a role, my thesis respects the central role of a nation in building capacity and the need to avoid actions that undermine that capacity. All four papers also demonstrate that focusing solely on the state provides a partial view of the reality of organising adaptation. Hence, the organisational architecture is not only about strengthening government or focusing on outside organisations, but needs to be inclusive. Successful adaptation requires linking local knowledge to policy makers and vice versa. The additional evidence provided through the granular and organisation-centred approach supports this assertion.

Mismatch and Disconnect Between Plans and Practice

National governments are generally responsible for adaptation, exemplified by Ghana but governments are by nature formal, bureaucratic and hierarchical, which is reflected in their approaches to management. Increasingly, states are experimenting with decentralised governance, where policy is driven nationally but implementation is local, with each level exercising some autonomy. This decentralised form typically maps geographically and in theory this separation offers local ownership that fits in well with the nested and multi-level characteristic of adaptation. In reality, this separation does not run smoothly with political, financial and administrative overlaps and gaps.

State capacity is generally insufficient to plan, manage and organise adaptation independently because of the size of the challenge. States tend to use existing structures that may be unsuitable for adaptation that needs long term dynamism, which means there can be disconnects between the levels of governance. The analysis presented confirms that state structures tend to ignore the flexibility required and the role of the many external organisations. Organising adaptation requires concerted efforts by all organisations with government setting the policy and coordinating the provision of services provided by many sources within and out with government. There are clearly many variations in roles and activities, but the underlying logic of coordinated and interdependent efforts of state and non-state organisations is crucial.

My analysis of the Ghanaian case shows that many organisations instrumental in adaptation may operate outside the planned administrative structures and follow their own agendas. Even organisations operating within the structures often bypass planned processes to meet their individual needs that may be at odds with the overall adaptation goals.

The network analysis captures this variety of interaction and relations, which translate into ‘community’ roles that organisations adopt, such as resource providers or experts. My work with network analysis shows how it becomes possible to identify constraints and opportunities that the roles offer as well as overlaps and gaps. My results demonstrate a gap in Ghana (Paper three) where some ‘specialists’ (climate expertise) are absent (grassroots/community level), where their knowledge is needed most. This has profound impact on local adaptation efforts as many of the plans and initiatives lack credibility and are open to interpretation that leads to maladaptive practices. The way that these organisations form functional niches and relate to each other becomes obvious from community identification network analysis, but is difficult

to detect through conventional analysis because they transcend formal roles and structures. The organisation-centred network approach makes it possible to capture and report these details.

Bridging Gaps Between Plans and Structures

A theme common to all four papers is the recognition that climate change adaption is complex, ambiguous and immature. Successful adaptation must ensure collaboration among many disparate organisations to produce coherent responses. This requires inclusive policy initiatives that focus well beyond the internal structures of few central organisations to the wider organisational field, or what I call a meta-organisation.

There are often serious disconnects in ideas about responsibilities, capabilities, willingness and understanding of how the whole system works. This results in misalignment of policy and practice, ineffective flow of knowledge and resources that breeds mistrust and inhibits learning. This organisational perspective helps explain the misalignment and the delays in implementation. I have come to describe adaptation as a nested system, where impacts and responses may be focused but whose impacts are felt widely. Focusing without linkage causes problems and therefore studying organisations across all levels is crucial.

This then leads to the question how organisational structures can be shaped effectively in practice. Although there is a considerable lag between actions taken and observable outcomes, nonetheless, this research identifies several areas that can catalyse coordination, efficiency and effectiveness. One approach piloted in this research is the RAP framework (paper four) that offers a multi-level and multi-organisation planning

framework that allows for a stronger buy in based on collective knowledge. The RAP framework questioned many fundamental assumptions such as the role and autonomy of farmers and policy makers, the notion of higher and lower levels, the changing definitions of adaptation and the need for empathy and respect to encourage collective action. The findings from network analyses and additional social data support the overall RAP framework as an important starting point to focus on immediate actions and improve policy diffusion.

I have mapped a more complete adaptation architecture by using organisation and network tools and observed the organisational interactions that comprise it, identified important relationships and classified differentiated roles of these organisations. The RAP together with the other approaches provides a suite of tools that creates the shared understanding necessary for the adaptation task. Bringing disparate organisations under a common framework improves coordination and bridges gaps to organise adaptation effectively. This in turn meets the broader objectives under Paris Agreement and Ghana's INDC of good governance and inter-sectorial coordination for sustained adaptation action.

10.4. Limitations

Despite developing a rigorous research approach and design, this study has some limitations. Specific limitations are discussed in each empirical paper.

The research relied heavily on a single case (Ghana) to build the research analysis. While a single case study approach has considerable depth and detail, it may be difficult to generalize the results and conclusions. To address this, I have drawn on evidence from Nepal and Pakistan that very much supports the organisational approach

to understanding the problems of delivering adaptation. I have also ‘located’ Ghana in the appropriate political, economic and global context.

The data was collected over one year only rather than a longitudinal study over many years. Clearly this removes the iterative effect of time upon the whole adaptation process that may change network linkages, but it is unlikely to affect the organisational approach to delivering success. I also used interviews and other data sources to expand the horizon.

The study focused only on the early planning structures as many of them were not yet operational and therefore, I do not have data on the eventual outcomes and so must remain silent on this issue. However, I do not consider that this detracts from the core of my thesis, which concerns process. Time and experience may change what is delivered but if organisations and networks function inadequately there will be little change or success.

Finally, the research focused on adaptation efforts in agriculture and it proved difficult to separate adaptation efforts from ordinary agricultural development. For example, using improved seeds served both development and adaptation. Therefore, where separation was not possible, I included routine interventions in the data collection. This could bias the findings, but gives a more complete picture because agricultural adaptation and development are very much two sides of the same coin.

10.5. Ways Forward

The challenge in providing effective organisational responses lies in developing flexible, robust, systems that address the complexity and uncertainty about outcomes, the long-term nature of adaptation, and the breadth of organisations, roles, and local country dynamics. It is not my aim to prescribe an ideal ‘one size fits all’ structure.

Instead I consider that the organisation-centred approach is a good starting point to explore the nuances of implementing climate change adaptation. Focusing too narrowly on adaptation initiatives without viewing them as organisation fields and meta-organisations with delicate relations could miss key defects and other barriers to implementation. By examining responses closely one can reassess the challenges and modify the actions required.

The organisational approach offers a useful tool to support policy makers and planners in designing effective methods for organising adaptation. The strong influence of organisational roles, structures and interactions can be better articulated in national adaptation plans, including the INDC. This tool could also have wider application to other complex or ‘wicked’ problems. As the climate adaptation field matures, greater homogeneity and predictability in the structural designs and outcomes is likely. However, research is still needed to understand these emerging structures and the impacts of their organisational attributes on implementing adaptation strategies. The structure and behaviour of adaptation initiatives evolve, influenced by a host of factors such as the adaptation structures and incentives created by planners, the diverse interests of individual component organisations, existing relationships and structures, cultural norms, international policy, funding and many more. There remain lessons from complexity science to ensure outcomes match desires. Exerting central control, such as by a national authority under conditions of complexity may inhibit an (meta-) organisation’s capacity to grow and organise itself. If organisations influence what happens through their position and roles within a network their influence changes and ceases to be hierarchical and control becomes decentralised and distributed.

Having an appropriate design for adaptation that matches the organisational circumstances and context improves its effectiveness in meeting goals. However,

having a structurally sound organisation is only part of the successful approach for managing climate change adaptation. Successful uptake of adaptation nationally also depends on how effectively the designs link the many organisations holding resources and knowledge, the local planning units responsible for implementation, and the national and regional units responsible for planning, coordination and resource mobilisation, while simultaneously capturing needs of local communities affected by climate change and matching it with appropriate responses. The implementation design strategy is therefore critical.

There is still no widely accepted means of delivering climate resilience. In fact, the organisational perspective itself is still the exception and is a novel application in adaptation research. Encouraging organisational change using novel approaches could create variety. Successful measures must then be fed back to the organisations shaping adaptation. Selection could change which organisations are funded, based on reliable indicators. Component organisations may be incentivised to seek new alliances based upon feedback. Network analysis techniques can be used to help organisations and planners position themselves better within national structures. The challenge remains: How to put in place the right incentives, measures, feedbacks and selection to ensure that adaptation initiatives respond to real social and ecological needs? This thesis explores some of these questions in the early period of organising adaptation efforts of developing countries. Many questions remain around the circumstances under which organisational arrangements facilitate successful adaptation opportunities. Although, this study focused on developing countries, the research approach, methodology and insights are equally applicable to developed countries that face similar threats but may have different thresholds to adapt.

Future Research Options

This list is not exhaustive and covers some key research aspects originating from this thesis

- Study organising efforts for adaptation across many countries, regions and sectors in both developing and developed parts of the world to identify generalizable, scalable and replicable organisational models
- Track adaptation initiatives over time (temporal) to study how organising structures and roles of organisations evolve, and what factors affect the organisational design.
- Track flow of resources important for adaptation (e.g. funds, knowledge, technology) through emerging organisational network structures to identify the gaps, overlaps and bottlenecks in the structures. This would highlight what works and what does not in organising adaptation.
- Study key organisations active in adaptation to understand their role, motivation, capacity and capabilities in contributing to country adaptation efforts.
- Articulate the concept of adaptive network and adaptive organisations. Study how meta-organisations and component organisations evolve over time. Do these organisations follow the adaptive management frameworks they prescribe?
- Track and measure the planned objectives of the adaptation initiative based on the effective, efficient and equitable (E3) concept. Study metrics to define success for adaptation.

10.6. Conclusion

This research emerged out of my curiosity about the state of agriculture adaptation in developing countries. My motivation was based on the notion that while adaptation initiatives are designed to protect communities from adverse impacts of climate change, resources and knowledge seldom reach the most vulnerable to support their critical needs, demonstrating weaknesses in the adaptation regime. This was certainly the case in Pakistan, where repeated flooding caused huge devastation.

Resilience and adaptation of social, political, economic and ecological systems to climate change is a long-term process. Climate change policy and plans generally consider the impacts to be several decades in the future and actions are accordingly recommended to limit or adapt to the impacts of these future challenges. Yet the majority of the organisations involved are set up to deal with current challenges. Today's challenges are of course important. But a key question is how to create organisational structures and implementation strategies that not only focus on the present but also maintain momentum to deal with future challenges. Climate change affects everyone from farmers to local governments, NGOs, private sector to national agencies that must come together to develop a shared understanding of the challenges to produce the required resilience. The results show that there are too many gaps in translating national policy into effective local action plans. There are also the dynamics of power and influence between organisations that can become important when developing adaptation.

Adaptation is not a new concept, but organising adaptation is something that most developing countries are only just beginning to grapple with. Moving from policy to action raises fundamental questions of design, funding, roles of organisations and other operational elements. As countries plan and implement action, some questions are

being answered, but many remain. Organisation theory is a mature discipline that offers a novel means of addressing the dynamics and imperatives of adaptation to anthropogenic climate change. Organisation theory also shares many similarities with adaptation studies and has evolved from a closed system based on rational models to an open system that recognises external elements and the complexity within. I take advantage of this complementarity to advance the conversation and theory about organising adaptation. Using networks, the analysis moves beyond the structure of a single organisation to the plurality required for a successful adaptation regime. Network linkages illustrate how organisations actually behave so providing insights based on actions rather than assumptions.

The answer to the adaptation challenge does not necessarily lie in the conventional adaptation and social literature but requires a move across the boundaries of other academic disciplines, which helps to identify and target entry points and bottlenecks, and all aspects vital for successful adaptation. This coherent approach gives a cohesive voice that embraces diversity and the value of local knowledge. Harnessing the power of this broad perspective moves us closer to tackling the daunting challenge of climate change adaptation.

In conclusion, the four papers demonstrate that adaptation regimes and initiatives are better understood through organisation structures and inter-organisational linkages, the interplay within each organisation and also in the coordinating relationships across organisations. Viewing adaptation as an organisational challenge draws attention to the alignment of policy and practice to meet the needs of the target community. This organisational focus makes existing adaptation architectures transparent, allows for comparison of both structure and effect, and provides a basis for drawing general conclusions. With appropriate additional comparisons, these

conclusions can be shared to develop strong place-based RAP. This multidisciplinary approach enables us to study the translation of adaptation policy into action from local to international levels.

REFERENCES

- ADAMIC, L. & ADAR, E. 2005. How to search a social network. *Social Networks*, 27, 187-203.
- ADGER, W. N. 2006. Vulnerability. *Global Environmental Change*, 16, 268-281.
- ADGER, W. N. 2016. Place, well-being, and fairness shape priorities for adaptation to climate change. *Global Environmental Change*, 38, A1-A3.
- ADGER, W. N., AGRAWALA, S., MIRZA, M. M. Q., CONDE, C., O'BRIEN, K., PULHIN, J., PULWARTY, R., SMIT, B. & TAKAHASHI, K. 2007. Assessment of adaptation practices, options, constraints and capacity. *Climate change*, 717-743.
- ADGER, W. N., ARNELL, W. N. & TOMPKINS, L. E. 2005. Successful adaptation to climate change across scales. *Global Environmental Change*, 15, 77-86.
- ADGER, W. N., HUQ, S., BROWN, K., CONWAY, D. & HULME, M. 2003. Adaptation to climate change in the developing world. *Progress in Development Studies*, 3, 179-195.
- ADGER, W. N. & KELLY, P. M. 1999. Social Vulnerability to Climate Change and the Architecture of Entitlements. *Mitigation and Adaptation Strategies for Global Change*, 4, 253-266.
- ADNER, R. 2006. Match your innovation strategy to your innovation ecosystem. *Harvard Business Review*, 84, 98.
- AGRAWAL, A. 2010. Local institutions and adaptation to climate change. In: MEARNS, R. & NORTON, A. (eds.) *Social dimensions of climate change: Equity and vulnerability in a warming world*. Washington D.C.: World Bank
- AGRAWAL, A. & CHHATRE, A. 2011. Against mono-consequentialism: Multiple outcomes and their drivers in social-ecological systems. *Global Environmental Change*, 21, 1-3.
- AGRAWAL, A., NEPSTAD, D. & CHHATRE, A. 2011. Reducing Emissions from Deforestation and Forest Degradation. *Annual Review of Environment and Resources*, 36, 373-396.
- AHL, V. & ALLEN, T. F. H. 1996. *Hierarchy Theory: A Vision, Vocabulary, and Epistemology*, USA, Columbia University Press.
- AHRNE, G. & BRUNSSON, N. 2005. Organizations and meta-organizations. *Scandinavian Journal of Management*, 21, 429-449.
- AHRNE, G. & BRUNSSON, N. 2011. Organization outside organizations: the significance of partial organization. *Organization*, 18, 83-104.

- ALDRICH, H. 2008. *Organizations and environments*, Stanford, CA, Stanford University Press.
- ALDRICH, H. E. & RUEF, M. 2006. *Organizations evolving*, London, SAGE Publications
- ALLEN, C. R., ANGELER, D. G., GARMESTANI, A. S., GUNDERSON, L. H. & HOLLING, C. S. 2014. Panarchy: Theory and Application. *Ecosystems*, 17, 578-589.
- ALLISON, G. T. & ZELIKOW, P. 1999. *Essence of decision: Explaining the Cuban missile crisis*, New York, Longman
- AMBURGEY, T. L. & DACIN, T. 1994. As the left foot follows the right? The dynamics of strategic and structural change. *Academy of Management Journal*, 37, 1427-1452.
- ANDREA, L., SANTO, F. & JÁNOS, K. 2009. Detecting the overlapping and hierarchical community structure in complex networks. *New Journal of Physics*, 11, 033015.
- ANSELL, C. 2000. The Networked Polity: Regional Development in Western Europe. *Governance*, 13, 279-291.
- ANSELL, C. & TORFING, J. 2015. How does collaborative governance scale? *Policy & Politics*, 43, 315-329.
- ANTWI-AGYEI, P., FRASER, E. D. G., DOUGILL, A. J., STRINGER, L. C. & SIMELTON, E. 2012. Mapping the vulnerability of crop production to drought in Ghana using rainfall, yield and socioeconomic data. *Applied Geography*, 32, 324-334.
- ANWAR, M. R., LIU, D. L., MACADAM, I. & KELLY, G. 2012. *Adapting agriculture to climate change: a review*.
- ARMITAGE, D. R., PLUMMER, R., BERKES, F., ARTHUR, R. I., CHARLES, A. T., DAVIDSON-HUNT, I. J., DIDUCK, A. P., DOUBLEDAY, N. C., JOHNSON, D. S. & MARSCHKE, M. 2008. Adaptive co-management for social-ecological complexity. *Frontiers in Ecology and the Environment*, 7, 95-102.
- ASLAM, M. A., AMIR, P., RAMAY, S. A., MUNAWAR, Z. & AHMAD, V. 2011. National economic & environmental development study (NEEDS). www.unfccc.int/files/adaptation/application/pdf/pakistanneeds.pdf. Pakistan: The Ministry of Environment of Pakistan.
- AYERS, J. M. & HUQ, S. 2009. Supporting adaptation to climate change: What role for official development assistance? *Development Policy Review*, 27, 675-692.
- BARABÁSI, A.-L. & ALBERT, R. 1999. Emergence of scaling in random networks. *Science*, 286, 509-512.

- BARAL, P. 2013. *Getting planned adaptation right – A case study of Nepal's local adaptation plan for action (LAPA)* MSc Dissertation, University of Oxford.
- BATTISTI, D. S. & NAYLOR, R. L. 2009. Historical Warnings of Future Food Insecurity with Unprecedented Seasonal Heat. *Science*, 323, 240-244.
- BELL, S. & MORSE, S. 2013. How People Use Rich Pictures to Help Them Think and Act. *Systemic Practice and Action Research*, 26, 331-348.
- BERKES, F. 2009. Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. *Journal of environmental management*, 90, 1692-1702.
- BERKES, F. & FOLKE, C. 1998. *Linking social and ecological systems: Management practices and social mechanisms for building resilience*, Cambridge, Cambridge University Press.
- BERKES, F. & ROSS, H. 2016. Panarchy and community resilience: Sustainability science and policy implications. *Environmental Science & Policy*, 61, 185-193.
- BERRANG-FORD, L., FORD, J. D. & PATERSON, J. 2011. Are we adapting to climate change? *Global Environmental Change*, 21, 25-33.
- BIERMANN, F., BETSILL, M. M., GUPTA, J., KANIE, N., LEBEL, L., LIVERMAN, D., SCHROEDER, H., SIEBENHÜNER, B. & ZONDERVAN, R. 2010. *Earth system governance: a research framework*.
- BIERNACKI, P. & WALDORF, D. 1981. Snowball sampling: problems and techniques of chain referral sampling. *Sociological Methods & Research*, 10, 141-163.
- BIESBROEK, G. R., SWART, R. J., CARTER, T. R., COWAN, C., HENRICHS, T., MELA, H., MORECROFT, M. D. & REY, D. 2010. Europe adapts to climate change: Comparing National Adaptation Strategies. *Global Environmental Change*, 20, 440-450.
- BLAU, P. M. & SCHOENHERR, R. A. 1971. *The structure of organizations*, New York, NY : Basic Books.
- BLONDEL, V. D., GUILLAUME, J.-L., LAMBIOTTE, R. & LEFEBVRE, E. 2008. Fast unfolding of communities in large networks. *Journal of Statistical Mechanics: Theory and Experiment*, 2008, P10008.
- BODIN, Ö., CRONA, B. & ERNSTSON, H. 2006. Social networks in natural resource management: what is there to learn from a structural perspective. *Ecology and Society*, 11, r2.
- BODIN, Ö. & CRONA, B. I. 2009. The role of social networks in natural resource governance: What relational patterns make a difference? *Global Environmental Change*, 19, 366-374.
- BOKO, M., NIANG, I., NYONG, A., VOGEL, C., GITHEKO, A., MEDANY, M., OSMAN-ELASHA, B., TABO, R. & YANDA, P. 2007. Africa. *Climate change*

2007: *Impacts, adaptation and vulnerability. Contribution of working group II to the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC)*. Cambridge, UK.

BOLMAN, L. G. & DEAL, T. E. 2013. *Reframing organizations: Artistry, choice and leadership*, Jossey-Bass.

BORGATTI, S. P. & EVERETT, M. G. 1997. Network analysis of 2-mode data. *Social Networks*, 19, 243-269.

BORGATTI, S. P., EVERETT, M. G. & JOHNSON, J. C. 2013. *Analyzing social networks*, SAGE Publications Limited.

BORGATTI, S. P. & HALGIN, D. S. 2011. Analyzing affiliation networks. In: CARRINGTON, P. J. & SCOTT, J. (eds.) *The Sage handbook of social network analysis*. London: SAGE.

BORGATTI, S. P. & LOPEZ-KIDWELL, V. 2011. Network theory. In: CARRINGTON, P. J. & SCOTT, J. (eds.) *The SAGE handbook of social network analysis*. London: SAGE.

BORGATTI, S. P., MEHRA, A., BRASS, D. J. & LABIANCA, G. 2009. Network analysis in the social sciences. *Science*, 323, 892-895.

BOYLE, M. & DOWLATABADI, H. 2011. *Anticipatory Adaptation in Marginalized Communities Within Developed Countries*, Dordrecht, Springer Netherlands.

BROWN, T. 2009. *Change by design*, New York, HarperCollins.

BRYSON, J. M. 2004. What to do when stakeholders matter: stakeholder identification and analysis techniques. *Public Management Review*, 6, 21-53.

BRYSON, J. M., CUNNINGHAM, G. L. & LOKKESMOE, K. J. 2002. What to Do When Stakeholders Matter: The Case of Problem Formulation for the African American Men Project of Hennepin County, Minnesota. *Public Administration Review*, 62, 568-584.

BULMER, M. 1986. *Neighbours: The work of Philip Abrams*, Cambridge, Cambridge University Press.

BURT, R. S. 1984. Network items and the general social survey. *Social Networks*, 6, 293-339.

BURT, R. S. 2002. *Structural Holes: The social structure of competition*, Cambridge, Harvard University Press.

BURTON, I. 1997. Vulnerability and adaptive response in the context of climate and climate change. *Climatic Change*, 36, 185-196.

BUSCH, L. & JUSKA, A. 1997. Beyond political economy: actor networks and the globalization of agriculture. *Review of International Political Economy*, 4, 688-708.

- CAMERON, E. S. 2012. Securing indigenous politics: A critique of the vulnerability and adaptation approach to the human dimensions of climate change in the Canadian Arctic. *Global Environmental Change*, 22, 103-114.
- CAMPBELL, J. 1998. Institutional analysis and the role of ideas in political economy. *Theory and Society*, 27, 377-409.
- CAMPBELL, K. E. & LEE, B. A. 1991. Name generators in surveys of personal networks. *Social Networks*, 13, 203-221.
- CASH, D., ADGER, N., BERKES, F., GARDEN, P., LEBEL, L., OLSSON, P., PRITCHARD, L. & YOUNG, O. 2006. Scale and cross-scale dynamics: Governance and information in a multilevel world. *Ecology and Society*, 11.
- CASH, D. W., CLARK, W. C., ALCOCK, F., DICKSON, N. M., ECKLEY, N., GUSTON, D. H., JÄGER, J. & MITCHELL, R. B. 2003. Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences*, 100, 8086-8091.
- CASH, D. W. & MOSER, S. C. 2000. Linking global and local scales: designing dynamic assessment and management processes. *Global Environmental Change*, 10, 109-120.
- CASSIDY, L. & BARNES, G. D. 2012. Understanding household connectivity and resilience in marginal rural communities through social network analysis in the village of Habu, Botswana. *Ecology and Society*, 17.
- CCAFS 2015. Annual Report 2015: Change for the better. Available online at: bitly.com/ccafs2015. Copenhagen, Denmark: : CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).
- CHAMBERS, R. 1992. Rural appraisal: rapid, relaxed and participatory. *Discussion Paper 311*. Brighton: Institute of Development Studies
- CHAMBERS, R. 1994. Paradigm shifts and the practice of participatory research and development.
http://opendocs.ids.ac.uk/opendocs/handle/123456789/1761#.VXJEguuRZ_Y.
Working Paper 2. Brighton: Institute of Development Studies
- CHAMBWERA, M. & STAGE, J. 2010. Climate change adaptation in developing countries: issues and perspectives for economic analysis.
<http://pubs.iied.org/15517IIED.html>. London: International Institute for Environment and Development (IIED).
- CHANDLER, A. D. 1990. *Strategy and structure: Chapters in the history of the industrial enterprise*, Cambridge, MA, MIT Press.
- CHAUDHURY, A. S., HELFGOTT, A., THORNTON, T. F. & SOVA, C. 2016a. Participatory adaptation planning and costing: Applications in agricultural adaptation in western Kenya. *Mitigation and Adaptation Strategies for Global Change*, 21, 301-322.

- CHAUDHURY, A. S., THORNTON, T. F., HELFGOTT, A., VENTRESCA, M. J. & SOVA, C. 2017. Ties that bind: Local networks, communities and adaptive capacity in rural Ghana. *Journal of Rural Studies*, 53, 214-228.
- CHAUDHURY, A. S., VENTRESCA, M. J., THORNTON, T. F., HELFGOTT, A., SOVA, C., BARAL, P., RASHEED, T. & LIGTHART, J. 2016b. Emerging meta-organisations and adaptation to global climate change: Evidence from implementing adaptation in Nepal, Pakistan and Ghana *Global Environmental Change*, 38, 243-257.
- CHAUDHURY, A. S., VENTRESCA, M. J., THORNTON, T. F., HELFGOTT, A., SOVA, C., BARAL, P., RASHEED, T. & LIGTHART, J. 2016c. Emerging meta-organisations and adaptation to global climate change: Evidence from implementing adaptation in Nepal, Pakistan and Ghana. *Global Environmental Change*, 38, 243-257.
- CHILD, J. 1972. Organizational structure, environment and performance: The role of strategic choice. *Sociology*, 6, 1-22.
- CHIOTTI, Q. P. & JOHNSTON, T. 1995. Rural Conflict and Change Extending the boundaries of climate change research: A discussion on agriculture. *Journal of Rural Studies*, 11, 335-350.
- CHRISTENSEN, C. 2013. *The innovator's dilemma: When new technologies cause great firms to fail*, Harvard Business Review Press.
- CILLIERS, P. & SPURRETT, D. 1999. Complexity and post-modernism: Understanding complex systems. *South African Journal of Philosophy*, 18, 258-274.
- CLEARY, J. & HOGAN, A. 2016. Localism and decision-making in regional Australia: The power of people like us. *Journal of Rural Studies*, 48, 33-40.
- COLEMAN, W. D., SKOGSTAD, G. D. & ATKINSON, M. M. 1996. Paradigm Shifts and Policy Networks: Cumulative Change in Agriculture. *Journal of Public Policy*, 16, 273-301.
- CONWAY, D. & MUSTELIN, J. 2014. Strategies for improving adaptation practice in developing countries. *Nature Climate Change*, 4, 339-342.
- COOKE, B. & KOTHARI, U. 2001. *Participation: The new tyranny?*, London and New York, Zed Books Ltd.
- COX, M. 2008. Balancing Accuracy and Meaning in Common-Pool Resource Theory. *Ecology and Society*, 13.
- CROPPER, S., EBERS, M., HUXHAM, C. & SMITH RING, P. 2008. *The Oxford handbook of inter-organizational relations*, Oxford, UK, Oxford University Press.
- DACIN, M. T., VENTRESCA, M. J. & BEAL, B. D. 1999. The embeddedness of organizations: Dialogue & directions. *Journal of Management*, 25, 317-356.

- DAFT, R. L., MURPHY, J. & WILLMOTT, H. 2010. *Organization theory and design*, Cengage learning.
- DAVIDSON, D. 2016. Gaps in agricultural climate adaptation research. *Nature Clim. Change*, 6, 433-435.
- DAWSON, S. 1996. *Analyzing organizations*, Macmillan Publishing.
- DERESSA, T. T., HASSAN, R. M., RINGLER, C., ALEMU, T. & YESUF, M. 2009. Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change*, 19, 248-255.
- DIMAGGIO, P. J. & POWELL, W. W. 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48, 147-160.
- DONALDSON, L. 2001. *The contingency theory of organizations*, Sage.
- DONALDSON, T. & PRESTON, L. E. 1995. The Stakeholder Theory of the Corporation: Concepts, Evidence, and Implications. *Academy of Management Review*, 20, 65-91.
- DOREIAN, P. & FARARO, T. J. 1998. *The Problem of solidarity: Theories and models*, Oxford and New York, Routledge - Taylor & Francis Group.
- DOVERS, S. 2009. Normalizing adaptation. *Global Environmental Change*, 19, 4-6.
- DRAZIN, R. & VAN DE VEN, A. H. 1985. Alternative forms of fit in contingency theory. *Administrative Science Quarterly*, 30, 514-539.
- DUNLAP, R. E. & MCCRIGHT, A. M. 2011. Organized climate change denial. In: DRYZEK, J., NOORGARD, R. & SCHLOSBERG, D. (eds.) *The Oxford handbook of climate change and society*. Oxford: Oxford University Press.
- EAKIN, H., WINKELS, A. & SENDZIMIR, J. 2009. Nested vulnerability: exploring cross-scale linkages and vulnerability teleconnections in Mexican and Vietnamese coffee systems. *Environmental Science & Policy*, 12, 398-412.
- EISENHARDT, K. M. 1989. Building theories from case study research. *Academy of Management Review*, 14, 532-550.
- ELMORE, R. F. 1979. Backward Mapping: Implementation Research and Policy Decisions. *Political Science Quarterly*, 94, 601-616.
- ETWIRE, P. M., AL-HASSAN, R. M., KUWORNU, J. K. & OSEI-OWUSU, Y. 2013. Application of livelihood vulnerability index in assessing vulnerability to climate change and variability in Northern Ghana. *Journal of Environment and Earth Science*, 3, 157-170.
- ETZION, D., GEHMAN, J., FERRARO, F. & AVIDAN, M. 2015. Unleashing sustainability transformations through robust action. *Journal of Cleaner Production*.

- EVANS, P. B., RUESCHEMEYER, D. & SKOCPOL, T. 1985. *Bringing the state back in*, Cambridge, UK, Cambridge University Press.
- FANKHAUSER, S. 2010. The costs of adaptation. *Wiley Interdisciplinary Reviews: Climate Change*, 1, 23-30.
- FANKHAUSER, S., SMITH, J. B. & TOL, R. S. J. 1999. Weathering climate change: some simple rules to guide adaptation decisions. *Ecological Economics*, 30, 67-78.
- FAO 2012. The State of Food and Agriculture - Investing in Agriculture for a Better Future. FAO.
- FAO 2013. Climate-smart agriculture - Sourcebook. Rome: Food and Agriculture Organization of the United Nations. Available at: <http://www.fao.org/docrep/018/i3325e/i3325e.pdf>.
- FAYOL, H. 1954. General and industrial management.
- FERGUSON, J. 1990. *The anti-politics machine: "Development," depoliticization and bureaucratic power in Lesotho*, Cambridge, Cambridge University Press.
- FERRARO, F., ETZION, D. & GEHMAN, J. 2015. Tackling grand challenges pragmatically: Robust action revisited. *Organization Studies*.
- FLIGSTEIN, N. & MCADAM, D. 2012. *A theory of fields*, Oxford, UK, Oxford University Press.
- FOLEY, J. A., RAMANKUTTY, N., BRAUMAN, K. A., CASSIDY, E. S., GERBER, J. S., JOHNSTON, M., MUELLER, N. D., O'CONNELL, C., RAY, D. K. & WEST, P. C. 2011. Solutions for a cultivated planet. *Nature*, 478, 337-342.
- FOLKE, C. 2006. Resilience: The emergence of a perspective for social-ecological systems analyses. *Global environmental change*, 16, 253-267.
- FOLKE, C., CARPENTER, S., ELMQVIST, T., GUNDERSON, L., HOLLING, C. S. & WALKER, B. 2002. Resilience and sustainable development: building adaptive capacity in a world of transformations. *AMBIO: A Journal of the Human Environment*, 31, 437-440.
- FOLKE, C., HAHN, T., OLSSON, P. & NORBERG, J. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, 30, 441-473.
- FORD, J. D., BERRANG-FORD, L., LESNIKOWSKI, A., BARRERA, M. & HEYMANN, S. J. 2013. How to Track Adaptation to Climate Change: A Typology of Approaches for National-Level Application. *Ecology and Society*, 18.
- FORD, J. D., BERRANG-FORD, L. & PATERSON, J. 2011. A systematic review of observed climate change adaptation in developed nations. *Climatic Change*, 106, 327-336.

- FORTUNATO, S. 2010. Community detection in graphs. *Physics Reports*, 486, 75-174.
- FORTUNATO, S. & CASTELLANO, C. 2009. Community Structure in Graphs. In: MEYERS, R. A. (ed.) *Encyclopedia of Complexity and Systems Science*. Springer New York.
- FOX, S. 2000. Communities of practice, Foucault and actor-network theory. *Journal of Management Studies*, 37, 853-868.
- FÜSSEL, H.-M. & KLEIN, R. T. 2006. Climate change vulnerability assessments: An evolution of conceptual thinking. *Climatic Change*, 75, 301-329.
- FÜSSEL, H. M. 2007. Adaptation planning for climate change: concepts, assessment approaches, and key lessons. *Sustainability Science*, 2, 265-275.
- GALBRAITH, J. R. 1995. *Designing organizations: An executive briefing on strategy, structure, and process*, Jossey-Bass.
- GIBSON, C. C., OSTROM, E. & AHN, T. K. 2000. The concept of scale and the human dimensions of global change: a survey. *Ecological Economics*, 32, 217-239.
- GIDDENS, A. 1979. *Central problems in social theory: Action, structure, and contradiction in social analysis*, Berkeley, CA, University of California Press.
- GÓMEZ-BAGGETHUN, E., DE GROOT, R., LOMAS, P. L. & MONTES, C. 2010. The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes. *Ecological Economics*, 69, 1209-1218.
- GON 2010. National adaptation programme of action (NAPA). Kathmandu, Nepal: Ministry of Environment science and Technology, Government of Nepal.
- GON 2011. National framework on local adaptation plans for action (LAPA). Kathmandu: Ministry of Environment Science and Technology, Government of Nepal.
- GOODING, R. Z. & WAGNER, J. A. 1985. A meta- analytic review of the relationship between size and performance: The productivity and efficiency of organizations and their subunits. *Administrative Science Quarterly*, 30, 462-481.
- GOODMAN, L. A. 1961. Snowball sampling. *The Institute of Mathematical Statistics*, 32, 148-170.
- GOVERNMENT OF GHANA 2007. Food and Agriculture Sector Development Policy (FASDEP II) http://www.mofa.gov.gh/site/?page_id=598. In: MINISTRY OF FOOD AND AGRICULTURE (ed.). Ghana.
- GOVERNMENT OF GHANA 2010. Medium Term Agriculture Investment Plan (METASIP) 2011-2015 http://www.mofa.gov.gh/site/?page_id=2754. In: MINISTRY OF FOOD AND AGRICULTURE (ed.). Ghana.
- GOVERNMENT OF GHANA 2012. Ghana Population and Household Census - 2010 http://www.statsghana.gov.gh/docfiles/2010phc/Census2010_Summary_report_of_final_results.pdf. In: SERVICE, G. S. (ed.). Ghana.

- GOVERNMENT OF GHANA 2014. Ghana Shared Growth and Development Agenda (GSGDA) 11 - 2014-2017 - <https://s3.amazonaws.com/ndpc-static/pubication/GSGDA+II+2014-2017.pdf>. In: NATIONAL DEVELOPMENT PLANNING COMMISSION (ed.). Ghana.
- GOVERNMENT OF GHANA 2015a. Ghana's intended nationally determined contribution (INDC) and accompanying explanatory note http://www4.unfccc.int/ndcregistry/PublishedDocuments/Ghana%20First/GH_I_NDC_2392015.pdf. Ghana: Republic of Ghana.
- GOVERNMENT OF GHANA 2015b. Ghana's Third National Communication to the UNFCCC, 2015 - <http://www.unfccc.int/resource/docs/natc/ghanc3.pdf>. In: AGENCY, E. P. (ed.). Ghana.
- GRANOVETTER, M. 1976. Network Sampling: Some First Steps. *American Journal of Sociology*, 81, 1287-1303.
- GRANOVETTER, M. S. 1973. The strength of weak ties. *American Journal of Sociology*, 78, 1360-1380.
- GREEN, M. 2002. Development Theory and Practice. In: KOTHARI, U. & MINOGUE, M. (eds.) *Social Development: Issues and Approaches. Critical Perspectives*. Palgrave.
- GREINER, L. E. 1997. Evolution and revolution as organizations grow: A company's past has clues for management that are critical to future success. *Family Business Review*, 10, 397-409.
- GULATI, R., PURANAM, P. & TUSHMAN, M. 2012. Meta-organization design: Rethinking design in interorganizational and community contexts. *Strategic Management Journal*, 33, 571-586.
- GUNDERSON, L. H. & HOLLING, C. S. 2002. *Panarchy: Understanding transformations in human and natural systems*, Washington D.C. USA, Island Press.
- HAAS, P. M. 1989. Do regimes matter? Epistemic communities and Mediterranean pollution control. *International Organization*, 43, 377-403.
- HAJER, M. A. & WAGENAAR, H. 2003. *Deliberative policy analysis: understanding governance in the network society*, Cambridge, UK, Cambridge University Press.
- HANNEMAN, R. A. & RIDDLE, M. 2005. Introduction to social network methods. <http://faculty.ucr.edu/~hanneman/>. Riverside, CA: University of California Riverside.
- HANNEMAN, R. A. & RIDDLE, M. 2011a. A brief introduction to analyzing social network data. *The SAGE Handbook of Social Network Analysis*, 331-339.
- HANNEMAN, R. A. & RIDDLE, M. 2011b. Concepts and measures for basic network analysis. *The SAGE Handbook of Social Network Analysis*, 340-369.

- HAYTHORNTHWAITE, C. 1996. Social network analysis: An approach and technique for the study of information exchange. *Library & Information Science Research*, 18, 323-342.
- HELFGOTT, A. 2008. Situating strength-based approaches to community development in a systems thinking context: the Cambodia tales. *The Systemist*, 30.
- HELFGOTT, A., SOVA, C., THORN, J., CHAUDHURY, A., BAILEY, M., VERVOORT, J., ADEMILUYI, A. & GRIFT, E. V. 2014. Multi-Level Integrated Adaptation Governance Ghana workshop report. UK: CCAFS.
- HELTBERG, R., SIEGEL, P. B. & JORGENSEN, S. L. 2009. Addressing human vulnerability to climate change: Toward a 'no-regrets' approach. *Global Environmental Change*, 19, 89-99.
- HENDERSON, R. M. & CLARK, K. B. 1990. Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, 35, 9-30.
- HENDRIKS, C. 2002. Institutions of Deliberative Democratic Processes and Interest Groups: Roles, Tensions and Incentives. *Australian Journal of Public Administration*, 61, 64-75.
- HERTEL, T. W. & ROSCH, S. D. 2010. Climate Change, Agriculture, and Poverty. *Applied Economic Perspectives and Policy*.
- HILL, M. & ENGLE, N. L. 2013. Adaptive Capacity: Tensions across Scales. *Environmental Policy and Governance*, 23, 177-192.
- HILLMAN, A. J., WITHERS, M. C. & COLLINS, B. J. 2009. Resource Dependence Theory: A Review. *Journal of Management*.
- HOFFMAN, A. J. 2011. Talking Past Each Other? Cultural Framing of Skeptical and Convinced Logics in the Climate Change Debate. *Organization & Environment*, 24, 3-33.
- HOFFMAN, A. J. & VENTRESCA, M. J. 1999. The institutional framing of policy debates economics versus the environment. *American Behavioral Scientist*, 42, 1368-1392.
- HOFFMAN, A. J. & VENTRESCA, M. J. 2002. *Organizations, policy and the natural environment: institutional and strategic perspectives*, USA, Stanford University Press.
- HOLLAND, P. W. & LEINHARDT, S. 1973. The structural implications of measurement error in sociometry. *The Journal of Mathematical Sociology*, 3, 85-111.
- HOLLING, C. S. 2001. Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, 4.

- HOWDEN, S. M., SOUSSANA, J.-F., TUBIELLO, F. N., CHHETRI, N., DUNLOP, M. & MEINKE, H. 2007. Adapting agriculture to climate change. *Proceedings of the National Academy of Sciences*, 104, 19691-19696.
- HUITEMA, D., ADGER, W. N., BERKHOUT, F., MASSEY, E., MAZMANIAN, D., MUNARETTO, S., PLUMMER, R. & TERMEER, C. C. J. A. M. 2016. The governance of adaptation: choices, reasons, and effects. Introduction to the Special Feature. *Ecology and Society*, 21.
- HULME, M. 2009. *Why we disagree about climate change: understanding controversy, inaction and opportunity*, USA, Cambridge University Press.
- HULME, M., DOHERTY, R., NGARA, T., NEW, M. & LISTER, D. 2001. African climate change: 1900-2100. *Climate research*, 17, 145-168.
- HUNTJENS, P., LEBEL, L., PAHL-WOSTL, C., CAMKIN, J., SCHULZE, R. & KRANZ, N. 2012. Institutional design propositions for the governance of adaptation to climate change in the water sector. *Global Environmental Change*, 22, 67-81.
- HUQ, S. & REID, H. 2004. Mainstreaming Adaptation in Development. *IDS Bulletin*, 35, 15-21.
- IBARRA, H. & ANDREWS, S. B. 1993. Power, social influence, and sense making: Effects of network centrality and proximity on employee perceptions. *Administrative Science Quarterly*, 38, 277-303.
- IMPERIAL, M. T. 1999. Institutional analysis and ecosystem-based management: The institutional analysis and development framework. *Environmental Management*, 24, 449-465.
- IPCC 2013. Summary for policymakers. In: Climate change 2013: The physical science basis. Contribution of working group I to the fifth assessment report of the Intergovernmental Panel on Climate Change In: STOCKER, T. F., D. QIN, G.-K. PLATTNER, M. TIGNOR, S.K. ALLEN, J. BOSCHUNG, A. NAUELS, Y. XIA, V. BEX AND P.M. MIDGLEY (ed.) http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WGIAR5_SPM_brochure_en.pdf. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA: IPCC.
- IPCC 2014a. Africa. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change In: FIELD, C. B., V.R. BARROS, D.J. DOKKEN, K.J. MACH, M.D. MASTRANDREA, T.E. BILIR, M. CHATTERJEE, K.L. EBI, Y.O. ESTRADA, R.C. GENOVA, B. GIRMA, E.S. KISSEL, A.N. LEVY, S. MACCRACKEN, P.R. MASTRANDREA, AND L.L. WHITE (ed.) http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap22_FINAL.pdf. Cambridge, United Kingdom and New York, NY, USA: IPCC.
- IPCC 2014b. Annex II Glossary: Climate change 2014: Impacts, adaptation, and vulnerability. Part A: global and sectoral aspects. Contribution of working group

- II to the fifth assessment report of the Intergovernmental Panel on Climate Change. In: FIELD, C. B., V.R. BARROS, D.J. DOKKEN, K.J. MACH, M.D. MASTRANDREA, T.E. BILIR, M. CHATTERJEE, K.L. EBI, Y.O. ESTRADA, R.C. GENOVA, B. GIRMA, E.S. KISSEL, A.N. LEVY, S. MACCRACKEN, P.R. MASTRANDREA, AND L.L. WHITE (ed.) https://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-AnnexII_FINAL.pdf. Cambridge, United Kingdom and New York, NY, USA: IPCC.
- IPCC 2014c. Annex II: glossary [Mach, K.J, S. Planton and C. von Stechow (eds.)], Climate change 2014: synthesis report. Contribution of working groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change [core writing team, R.K. Pachauri and L.A. Meyer (eds)]. IPCC, Geneva, Switzerland.
- IPCC 2014d. Summary for policymakers. Climate change 2014: Impacts, adaptation, and vulnerability. Part A: global and sectoral aspects. Contribution of working group II to the fifth assessment report of the Intergovernmental Panel on Climate Change. In: FIELD, C. B., V.R. BARROS, D.J. DOKKEN, K.J. MACH, M.D. MASTRANDREA, T.E. BILIR, M. CHATTERJEE, K.L. EBI, Y.O. ESTRADA, R.C. GENOVA, B. GIRMA, E.S. KISSEL, A.N. LEVY, S. MACCRACKEN, P.R. MASTRANDREA, AND L.L. WHITE (ed.) http://ipcc-wg2.gov/AR5/images/uploads/WG2AR5_SPM_FINAL.pdf. Cambridge, United Kingdom and New York, NY, USA: IPCC.
- JANSSEN, M. A., BODIN, Ö., ANDERIES, J. M., ELMQVIST, T., ERNSTSON, H., MCALLISTER, R. R., OLSSON, P. & RYAN, P. 2006. Toward a network perspective of the study of resilience in social-ecological systems. *Ecology and Society*, 11, 15.
- JOHNSEN, T. E., LAMMING, R. C. & HARLAND, C. M. 2008. Inter-organizational relationships, chains and networks: a supply perspective. In: CROPPER, S., EBERS, M., HUXHAM, C. & RING, P. S. (eds.) *The Oxford handbook of inter - organizational relations*. Oxford: Oxford University Press.
- JOHNSON, A. W. & EARLE, T. K. 2000. *The evolution of human societies: from foraging group to agrarian state*, California, Stanford University Press.
- JONES, G. R. 2004. *Organizational theory, design, and change: Text and cases*, Upper Saddle River, NJ, Pearson/Prentice Hall.
- JONES, L., LUDI, E. & LEVINE, S. 2010. Towards a characterisation of adaptive capacity: a framework for analysing adaptive capacity at the local level. London: Overseas Development Institute.
- JUHOLA, S. & WESTERHOFF, L. 2011. Challenges of adaptation to climate change across multiple scales: a case study of network governance in two European countries. *Environmental Science & Policy*, 14, 239-247.
- KATZ, D. & KAHN, R. L. 1978. *The social psychology of organizations*.

- KELLY, P. M. & ADGER, W. N. 2000. Theory and Practice in Assessing Vulnerability to Climate Change and Facilitating Adaptation. *Climatic Change*, 47, 325-352.
- KENDALL, M. G. 1938. A new measure of rank correlation *Biometrika*, 30, 81-93.
- KENIS, P. & OERLEMANS, L. 2008. The social network perspective: understanding the structure of cooperation. In: CROPPER, S., EBERS, M., HUXHAM, C. & RING, P. S. (eds.) *Oxford handbook of inter-organizational relationships*. Oxford: Oxford University Press.
- KING, G., KEOHANE, R. O. & VERBA, S. 1994. *Designing social inquiry: scientific inference in qualitative research*, New Jersey, Princeton University Press.
- KLIJN, E.-H. 2008. Policy and implementation networks: Managing complex interactions. In: CROPPER, S., EBERS, M., HUXHAM, C. & RING, P. S. (eds.) *The Oxford handbook of inter - organizational relations*. Oxford: Oxford University Press.
- LAUMANN, E. O. & KNOKE, D. 1987. *The organizational state: Social choice in national policy domains*, Univ of Wisconsin Press.
- LAUMANN, E. O., MARSDEN, P. V. & PRENSKY, D. 1989. The boundary specification problem in network analysis. In: FREEMAN, L. C., WHITE, D. R. & RONMNEY, A. K. (eds.) *Research methods in social network analysis*. New Jersey: George Mason University Press.
- LAVE, J. & WENGER, E. 1991. *Situated learning: legitimate peripheral participation*, Cambridge, UK, Cambridge University Press.
- LAW, J. 1992. Notes on the theory of the actor-network: Ordering, strategy, and heterogeneity. *Systemic Practice and Action Research*, 5, 379-393.
- LAWRENCE, P. R. 1967. *Organization and environment : Managing differentiation and integration*, Boston, Boston : Division of Research, Graduate School of Business Administration, Harvard University.
- LAWRENCE, P. R. & LORSCH, J. W. 1967. Differentiation and integration in complex organizations. *Administrative Science Quarterly*, 12, 1-47.
- LAZARUS, R. J. 2008. Super wicked problems and climate change: Restraining the present to liberate the future. *Cornell L. Rev.*, 94, 1153.
- LEICHENKO, R. & O'BRIEN, K. 2008. *Environmental change and globalization: Double exposures*, Oxford, Oxford University Press.
- LEMO, M. C., BOYD, E., TOMPKINS, E. L., OSBAHR, H. & LIVERMAN, D. 2007. Developing adaptation and adapting development. *Ecology and Society*, 12, 26.
- LEMPERT, R. J. & SCHLESINGER, M. E. 2000. Robust Strategies for Abating Climate Change. *Climatic Change*, 45, 387-401.

- LENSKI, G. E. 1966. *Power and privilege: A theory of social stratification*, USA, UNC Press Books.
- LEVIN, K., CASHORE, B., BERNSTEIN, S. & AULD, G. 2012. Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change. *Policy Sciences*, 45, 123-152.
- LEWIS, P. 1992. Rich picture building in the soft systems methodology. *European Journal of Information Systems*, 1, 351-360.
- LIBEN-NOWELL, D., NOVAK, J., KUMAR, R., RAGHAVAN, P. & TOMKINS, A. 2005. Geographic routing in social networks. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 11623-11628.
- LIN, B. B. 2011. Resilience in Agriculture through Crop Diversification: Adaptive Management for Environmental Change. *BioScience*, 61, 183-193.
- LINCOLN, J. R. & MILLER, J. 1979. Work and friendship ties in organizations: A comparative analysis of relation networks. *Administrative Science Quarterly*, 181-199.
- LIPPER, L., THORNTON, P., CAMPBELL, B. M., BAEDEKER, T., BRAIMOH, A., BWALYA, M., CARON, P., CATTANEO, A., GARRITY, D., HENRY, K., HOTTLE, R., JACKSON, L., JARVIS, A., KOSSAM, F., MANN, W., MCCARTHY, N., MEYBECK, A., NEUFELDT, H., REMINGTON, T., SEN, P. T., SESSA, R., SHULA, R., TIBU, A. & TORQUEBIAU, E. F. 2014. Climate-smart agriculture for food security. *Nature Climate Change*, 4, 1068-1072.
- LYLE, G. 2015. Understanding the nested, multi-scale, spatial and hierarchical nature of future climate change adaptation decision making in agricultural regions: A narrative literature review. *Journal of Rural Studies*, 37, 38-49.
- MAGNAN, A. K., SCHIPPER, E. L. F., BURKETT, M., BHARWANI, S., BURTON, I., ERIKSEN, S., GEMENNE, F., SCHAAR, J. & ZIERVOGEL, G. 2016. Addressing the risk of maladaptation to climate change. *Wiley Interdisciplinary Reviews: Climate Change*, 7, 646-665.
- MANDELL, M. & KEAST, R. L. 2008. Voluntary and community sector partnerships: current inter-organizational relations and future challenges. In: CROPPER, S., EBERS, M., HUXHAM, C. & SMITH RING, P. (eds.) *The Oxford handbook of inter-organizational relations*. Oxford: Oxford University Press.
- MAPLE CROFT. 2011. *Climate change vulnerability index 2011* [Online]. Available: <http://maplecroft.com/about/news/ccvi.html> [Accessed January 10, 2015].
- MARCH, J. G. & SIMON, H. A. 1958. *Organizations*, Oxford, England, Wiley.
- MARIN, A. & WELLMAN, B. 2011. Social network analysis: An introduction. In: SCOTT, J. & CARRINGTON, P. J. (eds.) *The SAGE handbook of social network analysis*. London: SAGE Publication.

- MARSDEN, P. V. 1990. Network data and measurement. *Annual Review of Sociology*, 16, 435-463.
- MARSDEN, P. V. & FRIEDKIN, N. E. 1993. Network studies of social influence. *Sociological Methods & Research*, 22, 127-151.
- MASSEY, E. & HUITEMA, D. 2016. The emergence of climate change adaptation as a new field of public policy in Europe. *Regional Environmental Change*, 16, 553-564.
- MCCARTHY, J. J., CANZIANI, O. F., LEARY, N. A., D.J, D. & WHITE, K. S. 2001. *Climate change 2001: Impacts, adaptation, and vulnerability. Contribution of Working Group II to the third assessment report of the Intergovernmental Panel on Climate Change*, Cambridge, Cambridge University Press.
- MCCARTY, C. & BERNARD, H. R. 2003. *Social network analysis. Encyclopedia of community: From the village to the virtual world*, Thousand Oaks, CA, SAGE Publications, Inc.
- MCGEE, R. 2002. Participating in development. In: KOTHARI, U. & MINOGUE, M. (eds.) *Development theory and practice: Critical perspectives*. Palgrave.
- MCGRAY, H., HAMMILL, A., BRADLEY, R., SCHIPPER, E. L. & PARRY, J.-E. 2007. Weathering the storm: Options for framing adaptation and development. <http://www.wri.org/publication/weathering-storm>. Washington, DC: World Resources Institute.
- MCKITTERICK, L., QUINN, B., MCADAM, R. & DUNN, A. 2016. Innovation networks and the institutional actor-producer relationship in rural areas: The context of artisan food production. *Journal of Rural Studies*, 48, 41-52.
- MCPHERSON, M., SMITH-LOVIN, L. & COOK, J. M. 2001. Birds of a Feather: Homophily in Social Networks. *Annual Review of Sociology*, 27, 415-444.
- MCSWEENEY, C., NEW, M. & LIZCANO, G. 2010a. *UNDP Climate Change Country Profiles: Ghana*. [Online]. Available: <http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/>. [Accessed January 10 2017].
- MCSWEENEY, C., NEW, M. & LIZCANO, G. 2010b. *UNDP Climate Change Country Profiles: Nepal, Pakistan and Ghana*. [Online]. Available: <http://country-profiles.geog.ox.ac.uk/>. [Accessed January 10 2015].
- MERMET, L. 2011. Strategic environmental management analysis: Addressing the blind spots of collaborative approaches. *Working Paper No 5*. IDDRI.
- MESTI 2013. Ghana National Climate Change Policy - <https://s3.amazonaws.com/ndpc-static/CACHES/NEWS/2015/07/22//Ghana+Climate+Change+Policy.pdf>. In: MINISTRY OF ENVIRONMENT SCIENCE, T. A. I. (ed.). Ghana.
- MEYER, J. W. & ROWAN, B. 1977. Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology*, 83, 340-363.

- MIDGLEY, G. 2003. *Systems thinking*, London, UK, Sage Publications.
- MIKKELSEN, B. 2005. *Methods for development work and research: a new guide for practitioners*, New Delhi, SAGE Publications Pvt. Limited.
- MINTZBERG, H. 1979. *The structuring of organizations: A synthesis of the research*, Prentice-Hall International.
- MITCHELL, T. & MAXWELL, S. 2010. Defining climate compatible development. http://cdkn.org/wp-content/uploads/2012/10/CDKN-CCD-Planning_english.pdf. London: Climate & Development Knowledge Network
- MOLINI, V. & PACI, P. 2015. Poverty reduction in Ghana 2015: Progress and challenges <https://openknowledge.worldbank.org/handle/10986/22732>. Washington DC.: World Bank.
- MONK, A. & HOWARD, S. 1998. Methods & tools: The rich picture: a tool for reasoning about work context. *Interactions*, 5, 21-30.
- MOORE, F. C. 2012. Costing adaptation: Revealing tensions in the normative basis of adaptation policy in adaptation cost estimates. *Science, Technology & Human Values*, 37, 171-198.
- MOORE, J. 1996. The death of competition. *Fortune*. Time Inc.
- MOSSE, D. 2004. Is good policy unimplementable? Reflections on the ethnography of aid policy and practice. *Development and Change*, 35, 639-671.
- MUNASINGHE, M. 2003. Analysing the nexus of sustainable development and climate change: an overview. <http://www.oecd.org/env/cc/2510070.pdf>. Paris: OECD Development and Climate Change Project.
- NAAB JB, SISSOKO K, ZOUGMORE R, TRAORE B, AMADOU M, MOUSSA AS, FORCH W, GARLICK C, OCHIENG S, KRISTJANSON P & THORNTON PK 2011. Summary of Baseline Household Survey results: Lawra-Jirapa, Ghana - http://ccafs.cgiar.org/publications/summary-baseline-household-survey-results-lawra-jirapa-ghana#.VliS3b54x_Y. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).
- NAIR, S. & HOWLETT, M. 2016. From robustness to resilience: avoiding policy traps in the long term. *Sustainability Science*, 1-9.
- NCCAS 2012. National climate change adaptation strategy. *Climate change and development - Adapting by reducing vulnerability -* http://www.undp-alm.org/sites/default/files/downloads/ghana_national_climate_change_adaptation_strategy_nccas.pdf. Ghana: UNEP/UNDP.
- NELSON, G. C., ROSEGRANT, M. W., KOO, J., ROBERTSON, R., SULSER, T., ZHU, T., RINGLER, C., MSANGI, S., PALAZZO, A. & BATKA, M. 2009. Climate change: Impact on agriculture and costs of adaptation. <http://www.ifpri.org/sites/default/files/publications/pr21.pdf>. Washington DC: The International Food Policy Research Institute.

- NELSON, G. C., ROSEGRANT, M. W., PALAZZO, A., GRAY, I., INGERSOLL, C., ROBERTSON, R., TOKGOZ, S., ZHU, T., SULSER, T. B., RINGLER, C., MSANGI, S. & YOU, L. 2010. *Food Security, Farming, And Climate Change to 2050: Scenarios, Results, Policy Options*, Washington DC, International Food Policy Research Institute.
- NEWMAN, L. & DALE, A. 2005. Network structure, diversity, and proactive resilience building: a response to Tompkins and Adger. *Ecology and society*, 10, r2.
- NEWMAN, M. E. J. & GIRVAN, M. 2004. Finding and evaluating community structure in networks. *Physical Review E*, 69, 026113.
- NJOROGE, R., BIRECH, R., ARUSEY, C., KORIR, M., MUTISYA, C. & SCHOLZ, R. W. 2015. Transdisciplinary processes of developing, applying, and evaluating a method for improving smallholder farmers' access to (phosphorus) fertilizers: the SMAP method. *Sustainability Science*, 10, 601-619.
- NORTH, D. C. 1990. *Institutions, institutional change and economic performance*, Cambridge University Press.
- NOTENBAERT, A., KARANJA, S. N., HERRERO, M., FELISBERTO, M. & MOYO, S. 2012. *Derivation of a household-level vulnerability index for empirically testing measures of adaptive capacity and vulnerability*.
- O'BRIEN, K., ERIKSEN, S., NYGAARD, L. P. & SCHJOLDEN, A. N. E. 2007. Why different interpretations of vulnerability matter in climate change discourses. *Climate Policy*, 7, 73-88.
- O'BRIEN, K. L. & LEICHENKO, R. M. 2000. Double exposure: assessing the impacts of climate change within the context of economic globalization. *Global Environmental Change*, 10, 221-232.
- O'RIORDAN, T. & JORDAN, A. 1999. Institutions, climate change and cultural theory: Towards a common analytical framework. *Global Environmental Change*, 9, 81-93.
- OLIVER, C. 1990. Determinants of interorganizational relationships: Integration and future directions. *Academy of Management Review*, 15, 241-265.
- OLSON, M. 1965. *The logic of collective action: public goods and the theory of groups*, USA, Harvard University Press.
- ORUM, A. M., FEAGIN, J. R. & SJOBERG, G. 1991. *A case for the case study*, USA, University of North Carolina Press.
- OSTROM, E. 2005. *Understanding institutional diversity*, NJ, Princeton University Press.
- OSTROM, E. 2010a. A multi-scale approach to coping with climate change and other collective action problems. *Solutions*, 1, 27-36.

- OSTROM, E. 2010b. Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change*, 20, 550-557.
- PADGETT, J. F. & ANSELL, C. K. 1993. Robust action and the rise of the Medici, 1400-1434. *The American Journal of Sociology*, 98, 1259-1259.
- PADGETT, J. F. & POWELL, W. W. 2012. *The emergence of organizations and markets*, New Jersey, Princeton University Press.
- PAHL-WOSTL, C. 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*, 19, 354-365.
- PARMESAN, C. & YOHE, G. 2003. A globally coherent fingerprint of climate change impacts across natural systems. *Nature*, 421, 37-42.
- PARRY, M., ARNELL, N., BERRY, P., DODMAN, D., FANKHAUSER, S., HOPE, C., KOVATS, S., NICHOLLS, R., SATTERTHWAITE, D., TIFFIN, R. & WHEELER, T. 2009. *Assessing the costs of adaptation to climate change: a review of the UNFCCC and other recent estimates*, London, International Institute for Environment and Development and Grantham Institute for Climate Change.
- PELLING, M. 2010. *Adaptation to climate change: from resilience to transformation*, New York, Routledge.
- PELLING, M. & HIGH, C. 2005. Understanding adaptation: What can social capital offer assessments of adaptive capacity? *Global Environmental Change*, 15, 308-319.
- PERRY-SMITH, J. E. & SHALLEY, C. E. 2003. The social side of creativity: A static and dynamic social network perspective. *The Academy of Management Review*, 28, 89-106.
- PERSSON, A. & KLEIN, R. J. 2008. Mainstreaming adaptation to climate change into official development assistance: integration of long-term climate concerns and short-term development needs. *Stockholm Environment Institute, Stockholm*, 16.
- PFEFFER, J. & SALANCIK, G. R. 1978. The external control of organisations. *New York*, 175.
- PFEFFER, J. & SALANCIK, G. R. 2003. *The external control of organizations: A resource dependence perspective*, Stanford CA, Stanford University Press.
- PIERRE, J. & PETERS, G. B. 2000. *Governance, politics and the state*, New York, St. Martin's Press.
- PIERSON, P. 2004. *Politics in time: History, institutions, and social analysis*, Princeton, NJ, Princeton University Press.
- PODOLNY, J. M. & PAGE, K. L. 1998. Network Forms of Organization. *Annual Review of Sociology*, 24, 57-76.
- POWELL, W. 2003. Neither market nor hierarchy. *The sociology of organizations: classic, contemporary, and critical readings*, 315, 104-117.

- POWELL, W. W. & DIMAGGIO, P. 1991. *The new institutionalism in organizational analysis*, Chicago/London:, University of Chicago Press.
- POWELL, W. W. & DIMAGGIO, P. J. 2012. *The new institutionalism in organizational analysis*, University of Chicago Press.
- POWELL, W. W., KOPUT, K. W. & SMITH-DOERR, L. 1996. Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, 116-145.
- PUGH, D. S. 1973. The measurement of organization structures: Does context determine form? *Organizational Dynamics*, 1, 19-34.
- PUGH, D. S., HICKSON, D. J., HININGS, C. R. & TURNER, C. 1969. The context of organization structures. *Administrative Science Quarterly*, 14, 91-114.
- RAI, J. K. & PAUDEL, N. S. 2011. Discourses of Local Governance in Nepal: An Analysis of Legislation, Constitutional Processes and Civil Society Demands. In: ACTION, F. (ed.) *Discussion Paper Series 11*.
- REDFORD, K. H. & ADAMS, W. M. 2009. Payment for Ecosystem Services and the Challenge of Saving Nature. *Conservation Biology*, 23, 785-787.
- REID, H. & HUQ, S. 2007. Community-based adaptation: A vital approach to the threat climate change poses to the poor. *International Institute for Environment and Development (IIED). Briefing Paper*, London: IIED.
- RIBOT, J. 2010. Vulnerability does not fall from the sky: toward multiscale, pro-poor climate policy. *Social dimensions of climate change: Equity and vulnerability in a warming world*, 47-74.
- RIBOT, J. 2011. Vulnerability before adaptation: Toward transformative climate action. *Global Environmental Change*, 21, 1160-1162.
- RIBOT, J. C., MAGALHAES, A. R. & PANAGIDES, S. S. 1996. *Climate variability, climate change and social vulnerability in the semi-arid tropics*, Cambridge, Cambridge University Press.
- RIDDELL, R. C. 1999. The end of foreign aid to Africa? Concerns about donor policies *African Affairs*, 98, 309-335.
- RITTEL, H. & WEBBER, M. 1973. Dilemmas in a general theory of planning. *Policy Sciences*, 4, 155-169.
- RITTER, T. & GEMÜNDEN, H. G. 2003. Interorganizational relationships and networks: An overview. *Journal of Business Research*, 56, 691-697.
- ROBBINS, S. P. & JUDGE, T. A. 2010. *Organizational behavior*, Pearson Education Limited
- RUDEL, T. K. 2011. Local Actions, Global Effects? Understanding the Circumstances in which Locally Beneficial Environmental Actions Cumulate to Have Global Effects. *Ecology and Society*, 16.

- SABATIER, P. A. & WEIBLE, C. 2014. *Theories of the policy process*, Westview Press.
- SAGE, C. 2013. The interconnected challenges for food security from a food regimes perspective: Energy, climate and malconsumption. *Journal of Rural Studies*, 29, 71-80.
- SANDSTRÖM, A. C. & ROVA, C. V. 2009. The network structure of adaptive governance - A single case study of a fish management area. *International Journal of the Commons*, 4.
- SARPONG, D. B. & ANYIDOHO, N. A. 2012. Climate change and agricultural policy processes in Ghana.
- SATTERTHWAITE, D. 2011. Editorial: Why is community action needed for disaster risk reduction and climate change adaptation? *Environment and Urbanization*, 23, 339.
- SCHALATEK, L., NAKHOODA, S., BARNARD, S. & CARAVANI, A. 2013. Climate finance thematic briefing: Adaptation finance. *Climate finance fundamentals* - www.climatefundsupdate.org/themes/adaptation. Heinrich Boll Stiftung and ODI.
- SCHELLING, T. C. 1992. Some Economics of Global Warming. *The American Economic Review*, 82, 1-14.
- SCHIPPER, E. L. F. 2007. Climate change adaptation and development: Exploring the linkages. *Tyndall Centre for Climate Change Research Working Paper*, 107, 13.
- SCHIPPER, E. L. F., AYERS, J., REID, H., HUQ, S. & RAHMAN, A. 2014. *Community-based adaptation to climate change: scaling it up*, Oxon, UK, Routledge.
- SCHLENKER, W. & LOBELL, D. B. 2010. Robust negative impacts of climate change on African agriculture. *Environmental Research Letters*, 5, 014010.
- SCHOONHOVEN, C. B. 1981. Problems with contingency theory: Testing assumptions hidden within the language of contingency "theory". *Administrative Science Quarterly*, 26, 349-377.
- SCHROEDER, H. 2014. Governing access and allocation in the Anthropocene. *Global Environmental Change*, 26, A1-A3.
- SCOTT, J. 2012. *Social network analysis*, London, Sage.
- SCOTT, J. & CARRINGTON, P. J. 2011. *The SAGE handbook of social network analysis*, London, SAGE Publication.
- SCOTT, J. C. 1998. *Seeing like a state: How certain schemes to improve the human condition have failed*, New Haven, Yale University Press.
- SCOTT, R. W. & MEYER, J. W. 2012. The organization of societal sectors: Propositions and early evidence. In: POWELL, W. W. & DIMAGGIO, P. J. (eds.) *The new institutionalism in organizational analysis*. University of Chicago Press.

- SCOTT, W. R. 2013. *Institutions and organizations: Ideas, interests, and identities*, California, Sage Publications.
- SCOTT, W. R. & DAVIS, G. F. 2007. *Organizations and organizing : rational, natural and open system perspectives*, Upper Saddle River, NJ, Prentice Hall.
- SELZNICK, P. 1949. *TVA and the grassroots: A study in the sociology of formal organization.* , Berkeley, CA, University of California Press.
- SEN, A. 1984. *Resources, values and development*, Oxford, Blackwell.
- SHAFRITZ, J. M., OTT, J. S. & JANG, Y. S. 2011. *Classics of organization theory*, Wadsworth Publishing Company.
- SHAHID, J. 2014. Funding for environmental projects reduced to Rs 25m *Dawn Pakistan Newspaper* - <http://www.dawn.com/news/1110432>, June 04, 2014.
- SILVERMAN, D. 2013. *Doing qualitative research: A practical handbook*, London, SAGE Publications Ltd.
- SKOCPOL, T., EVANS, P. & RUESCHEMEYER, D. 1999. *Bringing the state back in*, Cambridge, Cambridge University Press.
- SLATER, S. F. & NARVER, J. C. 1995. Market orientation and the learning organization. *Journal of Marketing*, 59, 63-74.
- SMIT, B., BURTON, I., KLEIN, R. T. & WANDEL, J. 2000. An anatomy of adaptation to climate change and variability. *Climatic Change*, 45, 223-251.
- SMIT, B. & PILIFOSOVA, O. 2001. Adaptation to climate change in the context of sustainable development and equity. In: MCCARTHY, J. J., CANZIANI, O., LEARY, N. A., DOKKEN, D. J. & WHITE, K. S. (eds.) *Impacts, Adaptation and Vulnerability. IPCC Working Group II*, . Cambridge: Cambridge University Press.
- SMIT, B. & PILIFOSOVA, O. 2003. From adaptation to adaptive capacity and vulnerability reduction. In: SMITH, J. B., KLEIN, R. J. T. & HUQ, S. (eds.) *Climate change, adaptive capacity and development*.
- SMIT, B. & WANDEL, J. 2006. Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16, 282-292.
- SMITH, J. B. 1997. Setting priorities for adapting to climate change. *Global Environmental Change*, 7, 251-264.
- SMITHERS, J. & SMIT, B. 1997. Human adaptation to climatic variability and change. *Global Environmental Change*, 7, 129-146.
- SOLOMON, S., QIN, D., MANNING, M., CHEN, Z., MARQUIS, M., AVERYT KB TIGNOR, M. M. B. & MILLER, H. L. 2007. *Climate Change 2007: The Physical Science Basis (Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC))*, Cambridge, UK, Cambridge University Press.

- SOUZA, K., KITUYI, E., HARVEY, B., LEONE, M., MURALI, K. S. & FORD, J. D. 2015. Vulnerability to climate change in three hot spots in Africa and Asia: Key issues for policy-relevant adaptation and resilience-building research. *Regional Environmental Change*, 15, 747-753.
- SOVA, C. A. & CHAUDHURY, A. S. 2013. State of agricultural climate change adaptation policy in Nepal. <http://hdl.handle.net/10568/29008>. *Working Paper No.44*. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security.
- SOVA, C. A., CHAUDHURY, A. S., NELSON, W. A., NUTSUKPO, D. K. & ZOUGMORE, R. 2014. Climate change adaptation policy in Ghana: Priorities for the agriculture sector. <http://hdl.handle.net/10568/51804>. *CCAFS Working Paper No. 68*. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).
- SOVA, C. A., HELFGOTT, A., S. CHAUDHURY, A., MATTHEWS, D., F. THORNTON, T. & J. VERMEULEN, S. 2015. Multi-level stakeholder influence mapping: visualizing power relations across actor levels in Nepal's agricultural climate change adaptation regime. *Systemic Practice and Action Research*, 28, 383-409.
- SOVA, C. A., THORNTON, T. F., ZOUGMORE, R., HELFGOTT, A. & CHAUDHURY, A. S. 2016. Power and influence mapping in Ghana's agricultural adaptation policy regime. *Climate and Development*, 1-16.
- SOVACOO, B. K. 2011. Hard and soft paths for climate change adaptation. *Climate Policy*, 11, 1177-1183.
- SOYSAL, Y. N. 1994. *Limits of citizenship: Migrants and postnational membership in Europe*, Chicago, IL, University of Chicago Press.
- SPARROWE, R. T., LIDEN, R. C., WAYNE, S. J. & KRAIMER, M. L. 2001. Social Networks and the performance of individuals and groups. *Academy of Management Journal*, 44, 316-325.
- STANTURF, J., WARREN, M., CHARNLEY JR, S., POLASKY, S. C., GOODRICK, S. L., ARMAH, F. & NYAKO, Y. A. 2011. Ghana climate change vulnerability and adaptation assessment. *Washington: United States Agency for International Development*.
- STEENWERTH, K. L., HODSON, A. K., BLOOM, A. J., CARTER, M. R., CATTANEO, A., CHARTRES, C. J., HATFIELD, J. L., HENRY, K., HOPMANS, J. W., HORWATH, W. R., JENKINS, B. M., KEBREAB, E., LEEMANS, R., LIPPER, L., LUBELL, M. N., MSANGI, S., PRABHU, R., REYNOLDS, M. P., SANDOVAL SOLIS, S., SISCHO, W. M., SPRINGBORN, M., TITTONELL, P., WHEELER, S. M., VERMEULEN, S. J., WOLLENBERG, E. K., JARVIS, L. S., JACKSON, L. E. & MORTON, J. F. 2014. Climate-smart agriculture global research agenda: scientific basis for action
The impact of climate change on smallholder and subsistence agriculture. *Agriculture & Food Security*, 3, 1-39.

- STEIN, C., ERNSTSON, H. & BARRON, J. 2011. A social network approach to analyzing water governance: The case of the Mkindo catchment, Tanzania. *Physics and Chemistry of the Earth, Parts A/B/C*, 36, 1085-1092.
- STERN, N. H. 2006. Stern review the economics of climate change. S.l.: s.n.,.
- STONE, D. A. 1989. Causal Stories and the Formation of Policy Agendas. *Political Science Quarterly*, 104, 281-300.
- SUÁREZ, F. F. & UTTERBACK, J. M. 1995. Dominant designs and the survival of firms. *Strategic Management Journal*, 16, 415-430.
- TAI, A. P. K., MARTIN, M. V. & HEALD, C. L. 2014. Threat to future global food security from climate change and ozone air pollution. *Nature Clim. Change*, 4, 817-821.
- TAMBO, J. A. & ABDOULAYE, T. 2012. Climate change and agricultural technology adoption: the case of drought tolerant maize in rural Nigeria. *Mitigation and Adaptation Strategies for Global Change*, 17, 277-292.
- TANG, J., MUSOLESI, M., MASCOLO, C. & LATORA, V. 2009. Temporal distance metrics for social network analysis. <http://conferences.sigcomm.org/sigcomm/2009/workshops/wosn/papers/p31.pdf>. *Proceedings of the 2nd ACM Workshop on Online Social Networks*. Barcelona, Spain: ACM.
- TANTIPATHANANANDH, C., BERGER-WOLF, T. & KEMPE, D. 2007. A framework for community identification in dynamic social networks. <http://compbio.cs.uic.edu/~chayant/papers/frp652-tantipathananandh.pdf>. *Proceedings of the 13th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*. San Jose, California, USA: ACM.
- TAYLOR, F. W. 1914. *The principles of scientific management*, Harper.
- TELLIS, W. 1997. Application of a case study methodology. *The qualitative report [Online serial]*, 3(3). <http://www.nova.edu/ssss/QR/QR3-3/tellis2.html>, 3, 1-17.
- TERMEER, C., DEWULF, A. & VAN LIESHOUT, M. 2010. Disentangling scale approaches in governance research: Comparing monocentric, multilevel, and adaptive governance. *Ecology and Society*, 15.
- THOMPSON, J. D., ZALD, M. N. & SCOTT, W. R. 2003. *Organizations in action: Social science bases of administrative theory*, New Jersey, Transaction Publishers.
- THORNTON, T. F. & MANASFI, N. 2010. Adaptation—genuine and spurious: demystifying adaptation processes in relation to climate change. *Environment and Society: Advances in Research*, 1, 132-155.
- TOMPKINS, E. L. & ADGER, W. 2004. Does adaptive management of natural resources enhance resilience to climate change? *Ecology and society*, 9, 10.

- TSOUKAS, H. & KNUDSEN, C. 2005. *The Oxford handbook of organization theory*, Oxford, UK, Oxford University Press.
- TUBIELLO, F. N. & ROSENZWEIG, C. 2008. Developing climate change impact metrics for agriculture. *The Integrated Assessment Journal*, 8, 165-184.
- ULRICH, W. 1987. Critical heuristics of social systems design. *European Journal of Operational Research*, 31, 276-283.
- UN. 2012. *Food Security and Sustainable Future*
<http://www.un.org/en/sustainablefuture/food.shtml#facts> [Online]. [Accessed].
- UNDP 2007. Human Development Report- fighting climate change: human solidarity in a divided world.
http://hdr.undp.org/sites/default/files/reports/268/hdr_20072008_en_complete.pdf. New York: United Nations Development Programme.
- UNDP 2012. Nepal climate change support programme: Building climate resilience in nepal.
http://www.np.undp.org/content/dam/nepal/docs/projects/nccsp/UNDP_NP_NC_CSP%20Project%20Document.pdf: United Nations Development Programme.
- UNFCCC 2002. Annotated guidelines for the preparation of national adaptation programmes of action. Least Developed Countries Expert Group, UNFCCC.
- UNFCCC 2012. The National Adaptation Plan Process - A brief review. In: GROUP, L. E. (ed.).
- UNFCCC 2014. Information paper on experiences, good practices, lessons learned, gaps and needs in the process to formulate and implement national adaptation plans.
<http://unfccc.int/resource/docs/2014/sbi/eng/inf14.pdf>. United Nations Framework Convention on Climate Change.
- UNFCCC. 2015. *Submitted NAPAs* [Online]. Available:
http://unfccc.int/adaptation/workstreams/national_adaptation_programmes_of_action/items/4585.php [Accessed December 28, 2015].
- UNGER, D. & WANDERSMAN, A. 1985. The importance of neighbors: The social, cognitive, and affective components of neighboring. *American Journal of Community Psychology*, 13, 139-169.
- VAN DE VEN, A. H. & DRAZIN, R. 1984. The concept of fit in contingency theory. DTIC Document.
- VAN HORN, C. E., BAUMER, D. C. & GORMLEY, W. T. 2001. *Politics and public policy*, USA, SAGE - CQ Press.
- VENTRESCA, M. J. 2002. Global policy fields: Conflicts and settlements in the emergence of organized international attention to official statistics, 1853-1947.
<http://www.ipr.northwestern.edu/publications/docs/workingpapers/2002/IPR-WP-02-45.pdf>. USA: Kellogg School of Management.

- VERMEULEN, S. J., AGGARWAL, P. K., AINSLIE, A., ANGELONE, C., CAMPBELL, B. M., CHALLINOR, A. J., HANSEN, J. W., INGRAM, J. S. I., JARVIS, A., KRISTJANSON, P., LAU, C., NELSON, G. C., THORNTON, P. K. & WOLLENBERG, E. 2012. Options for support to agriculture and food security under climate change. *Environmental Science & Policy*, 15, 136-144.
- VERVOORT, J. M., THORNTON, P. K., KRISTJANSON, P., FÖRCH, W., ERICKSEN, P. J., KOK, K., INGRAM, J. S. I., HERRERO, M., PALAZZO, A., HELFGOTT, A. E. S., WILKINSON, A., HAVLÍK, P., MASON-D'CROZ, D. & JOST, C. 2014. Challenges to scenario-guided adaptive action on food security under climate change. *Global Environmental Change*, 28, 383-394.
- VIGNOLA, R., MCDANIELS, T. L. & SCHOLZ, R. W. 2013. Governance structures for ecosystem-based adaptation: Using policy-network analysis to identify key organizations for bridging information across scales and policy areas. *Environmental Science & Policy*, 31, 71-84.
- VINCENT, K. 2007. Uncertainty in adaptive capacity and the importance of scale. *Global Environmental Change*, 17, 12-24.
- WALKER, M. E., WASSERMAN, S. A. & WELLMAN, B. 1993. Statistical models for social support networks. *Sociological Methods & Research*, 22, 71-98.
- WASSERMAN, S. 1994. *Social network analysis : Methods and applications*, Cambridge, UK, Cambridge University Press.
- WEBER, M. 1978. *Economy and society: An outline of interpretive sociology*, Berkeley, CA, University of California Press.
- WEBER, M. 2009. *The theory of social and economic organization*, Simon and Schuster.
- WELLMAN, B. & WORTLEY, S. 1990. Different strokes from different folks: Community ties and social support. *American Journal of Sociology*, 96, 558-588.
- WILLIAMSON, O. E. 1979. Transaction-Cost Economics: The Governance of Contractual Relations. *The Journal of Law & Economics*, 22, 233-261.
- WITTMAYER, J. M. & SCHÄPKE, N. 2014. Action, research and participation: roles of researchers in sustainability transitions. *Sustainability Science*, 9, 483-496.
- WOODWARD, J. 1980. *Industrial organization : Theory and practice*, Oxford, UK, Oxford University Press.
- WORLD BANK 2010. Economics of adaptation to climate change - Synthesis report. . <http://documents.worldbank.org/curated/en/2010/01/16436675/economics-adaptation-climate-change-synthesis-report>. Washington D.C: World Bank.
- WOSSEN, T., BERGER, T., SWAMIKANNU, N. & RAMILAN, T. 2014. Climate variability, consumption risk and poverty in semi-arid Northern Ghana: Adaptation options for poor farm households. *Environmental Development*, 12, 2-15.

- YARO, J. A., TEYE, J. & BAWAKYILLENUO, S. 2015. Local institutions and adaptive capacity to climate change/variability in the northern savannah of Ghana. *Climate and Development*, 7, 235-245.
- YIN, R. K. 2009. *Case study research: Design and methods*, Sage.
- YOHE, G. & TOL, R. S. J. 2002. Indicators for social and economic coping capacity—moving toward a working definition of adaptive capacity. *Global Environmental Change*, 12, 25-40.
- YOUNG, O. R. 2002. *The institutional dimensions of environmental change: Fit, interplay, and scale*, Cambridge, MA, MIT Press.

SUPPLEMENTARY DATA

APPENDIX PAPER 1

Appendix A - Data Collection Process

We conducted extensive field research from 2012 to 2014 in Ghana and Nepal on the focal adaptation initiatives. Through exploratory interviews with key informants and country data, we selected climate vulnerable local communities/area in each country as a starting point for our research. We organised detailed diagnostic workshops and follow up interviews in the selected communities/areas to identify the local development and climatic challenges and linkages of the community members with external organisations. This ground level knowledge and analysis set the basis for our research and identification of organisational actors for detailed interviews. To study the implementation design across levels, we identified key organisations at local, district, region and national levels relevant to adaptation using actor mapping and networking techniques. Detailed semi-structured interviews were conducted of the identified organisations including national ministries, local agencies, I/NGOs, funders, research organisations, academia, private sector organisations, project developers, consultants and local community groups. In total, we conducted 102 interviews in Nepal and 92 interviews in Ghana (See Appendix 2 for interviewee details), excluding community level interviews.

We triangulated the interview data through multiple interviews within the same organisations, network analysis, walk through exercises to trace activity at multiple scales, and content analysis of relevant policies and laws to agriculture adaptation (Sova et al., 2014, Chaudhury et al., 2017, Sova and Chaudhury, 2013). The analysis was

stopped when we did not identify any further significant organisations. The selection of local, district and regional organisational interviewees, was influenced by the focal local community/area. Other communities/areas may lead to different sub-national organisations. However, at the national level the organisations relevant for the focal adaptation initiative across the country are similar.

For Pakistan, we did not conduct any direct field research, but instead used detailed proprietary data of the LAPA managers (also an author on this paper) for the LAPA development. This included details of stakeholders meetings for the LAPA formulation, the developed LAPA documents for the 13 district LAPA and limited interviews of key personnel.

Sample Interview Questions (Nepal and Ghana)

1. Please specify your organisational type (*Government, Private, NGO, Funder, Academia, etc.*)
2. Please describe the main objectives/interests of your organisation and the geographic reach of your organisation (i.e. districts, constituency, regions etc.).
3. Does your organisation work in climate change sector or with organisations from focal adaptation initiative (Nepal LAPA, Ghana NCCAS)? What is your role?
4. What are the key operational challenges of the focal adaptation initiative? Is the planned adaptation mechanism (Nepal LAPA or Ghana NCCAS) designed appropriately to reach climate vulnerable communities? Please explain?
5. What are the key operational challenges that your organisation faces in implementing climate change adaptation, what can be improved? How do you identify these climate change challenges and adaptation strategies?

6. What resources does your organisation have access to for contributing to adaptation implementation? (e.g. expertise, funds, human resource, legislation authority, network)
7. Who are the key decision makers in your organisation for climate change or climate change adaptation activities?
8. Which organisations does your organisation regularly interact with in respect of the focal adaptation initiative? (Government, I/NGOs, Political Party, Private Sector, Funders, Community Groups, Academia etc. - Identify type and purpose of relationships)
9. What are the most important policies in environmental change, climate change, adaptation and agriculture, and how do these impact your organisation?
10. What constitutes measure of success for the adaptation projects/plans your organisation is involved in? (e.g. reaching X number of people, or releasing X amount of funds). How do you measure it?
11. Can you give examples of successful projects? What worked and what did not?
12. Is there an impact of administrative and fiscal decentralisation on your organisation?
13. What do you think of the multiple funding channels (Government, line ministries, I/NGOs, bilateral etc.)? Is there a need to centralise these funding flows? Who should manage this process?
14. Who should be the main funder for climate change adaptation? Who should be the main recipient of climate change adaptation funding?
15. Name the top 5-10 organisations in climate change adaptation.

Identifying organisational attributes

We transcribed and coded the interview data to identify the key themes about the focal adaptation initiative. We analysed these themes in light of the policy and implementation documents (e.g. LAPA frameworks, NCCAS document, national climate change policy, the formulated LAPA plans, budget guidelines). We further interviewed key organisations involved in developing the focal adaptation initiative in each country (e.g. I/NGOs, environment ministries, consultants). From the initial themes, interviews, content analysis and broader organisational literature we narrowed down six organisational attributes relevant to the adaptation initiatives in the three countries. For example, nature of work force is an important attribute in Nepal and Pakistan but is not strictly applicable in Ghana, as the meta-organisation does not directly influence the selection of workforce. This aspect was not included in our analysis but clearly warrants further consideration. The list below on organisational attributes is not exhaustive but offers a good starting point for our meta-organisational analysis.

- Size and age of initiative
- Formalisation of Initiative
- Institutional environment
- Participant organisations and their roles
- Goals and objectives of initiative
- Operational core processes
- Funding source and availability

Appendix B - Interviewee Details

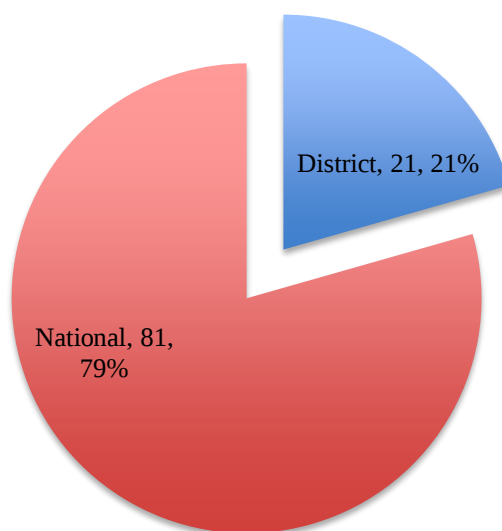
NEPAL

Category	Type of Organisation	Number of Interviews
National Organisations		
Government Agencies	Ministries (Agriculture, Environment, Local Development, Finance, Physical Planning, National Planning), Alternative Energy Center, Social Welfare Council, Election Commission, National Climate Change Support Unit,	16
I/NGOs	WWF, OXFAM, ICIMOD, CAN, Winrock, ISET, HCI, HIMCCA, CARE, Rupantaran, CDKN, Practical Action, IDS, Youth Initiative IDE, HUDEP, The Communicator	28
Academia/Research	Tribhuvan University, South Asia Institute, IRRI, CIMMYT, Agriculture Research Council, Government Research Institutes	6
Donors/Funders	UNDP, USAID, World Bank, DANIDA, Swiss Development Council, International Finance Corporation, EU, GEF- Small Grants Programme,	13
Political Parties	Congress, UCPN- Maoists, Communist Party	3
Private Sector	Clean Energy Development Bank, ACE Development Bank, Himalayan Agri Business, Alliance Nepal	6
Media	BBC Media Action, Nepal Forum of Environmental Journalists, The Himalayan	4
Associations	Association of Districts, Villages, Community Forest Users, Chamber of Commerce	5
Sub-Total – National Interviews		81
District Organisations		
Government Agencies	District Development Committee (DDC), District Departments (Agriculture, Livestock, Local Governance), Village Development Committee (VDC)	11
I/NGOs	IDE, World Vision, NGO Federation	3
Private Sector	Agriculture Development Bank, Local Input Providers, Nirdhan Microfinance Bank, AICL	6
Research	CIMMYT	1
Sub-Total – District Interviews		21
TOTAL INTERVIEWS		102

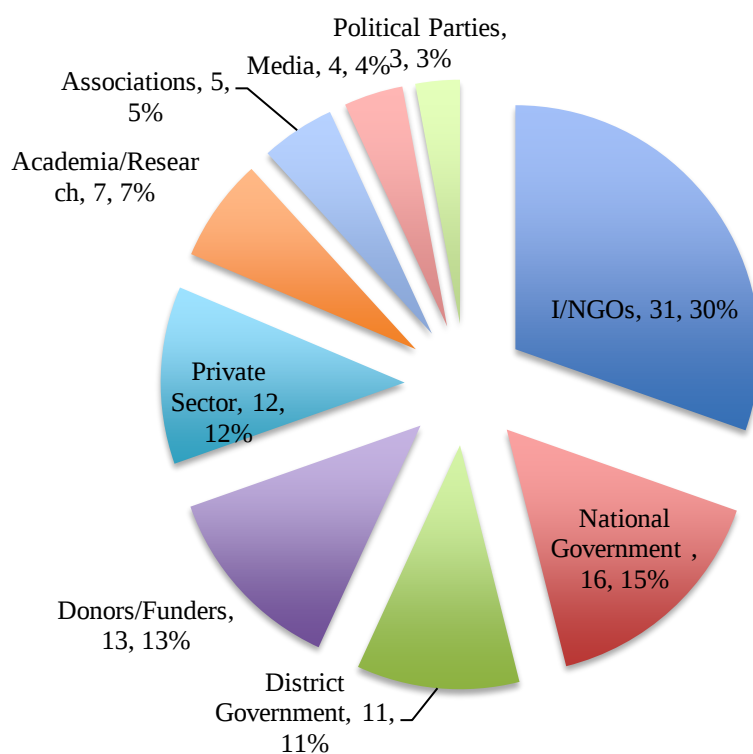
Notes:

- In some cases multiple interviews were conducted with personnel within the same organisation, but often from different departments or roles.
- In addition to the organisational interviews, selected community members from Beora community in our focal district of Rupandehi were interviewed to understand the local climatic challenges and external interactions of the members with local organisations

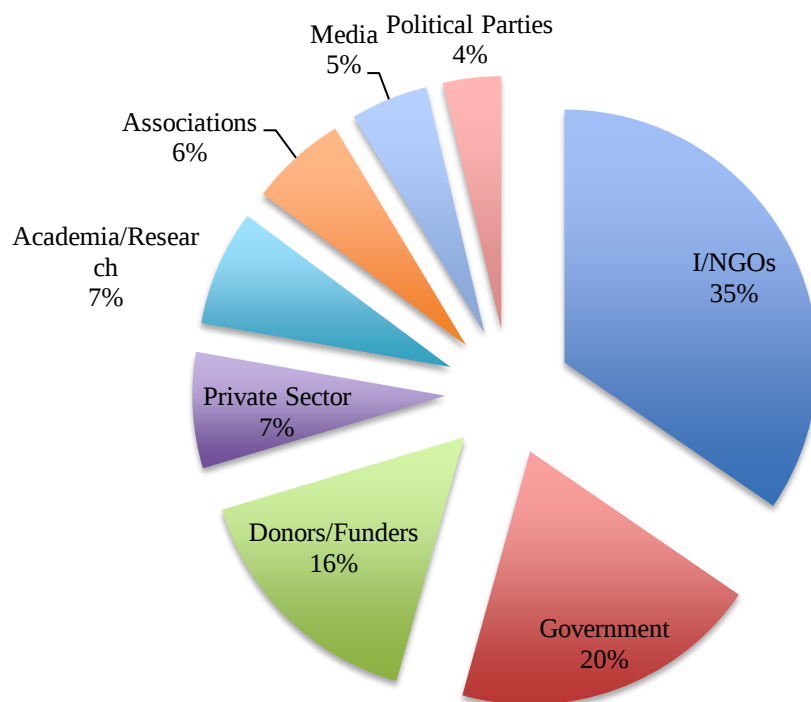
Multi-Scale Interviews



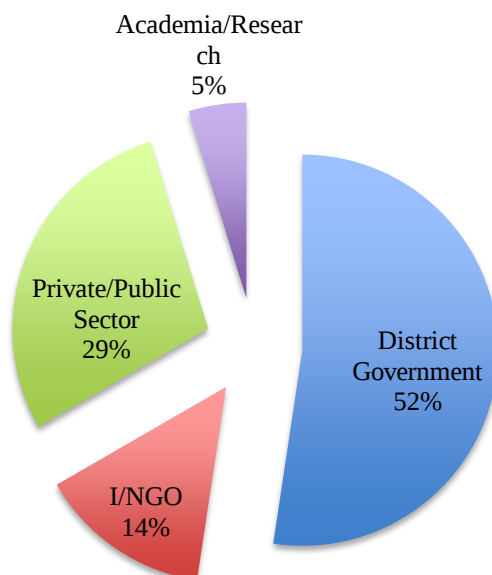
Interview Break-up - Total



National Interviews



District/Local Interviews



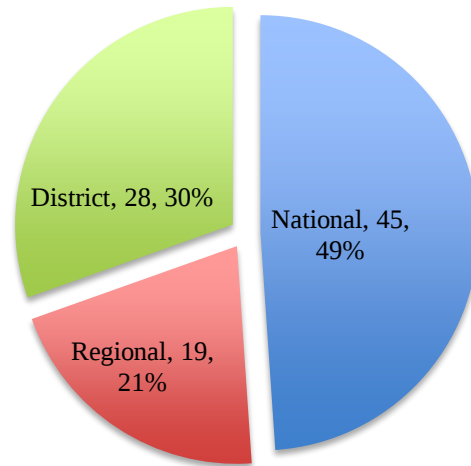
GHANA

Category	Type of Organisation	Number of Interviews
National Organisations		
Government Agencies	Ministries (Agriculture, Environment, Local Government, Finance, National Planning), Environmental Protection Agency, National Disaster Agency, Meteorological Agency, Cocoa Board	14
I/NGOs	GIZ, CAN Int, Solidaridad, Ghana Wildlife, CARE, Religious Board, Development Institute, IDE, SNV, Peasant Farmers Association	11
Academia/Research	University of Ghana, Government Research Institutes	5
Donors/Funders	UNDP, CIDA, World Bank, IFAD, GEF Small Grants, JICA	6
Political Parties	NDC, NPP	2
Private Sector	Association of Ghana Industry, Syngenta, Wienco, Guinness Ghana, Agriculture Development Bank	5
Trans-national Bodies	AGRA, FARA	2
Sub-Total – National Interviews		45
Regional Organisations		
Government Agencies	Regional Coordinating Council, Regional Departments (Agriculture, Finance, Budgets), Environmental Protection Agency, Meteorological Agency, Ghana Social Opportunity Programme, National Disaster Agency	14
I/NGOs	CARE, PLAN	2
Private Sector	Agriculture Input Providers	3
Sub-Total – Regional Interviews		19
District Organisations		
Government Agencies	District Assembly, District Departments (Agriculture, Business Support, Cooperatives, Forestry)	15
I/NGOs	IDE, Peace Corp	4
Political Parties	NDC, NDC, Youth Wing	2
Private Sector	Agriculture Input Providers	3
Religious Bodies	Church, Missions	2
Traditional Authorities	Paramount Chief, Sub Chief	2
Sub-Total – District Interviews		28
TOTAL INTERVIEWS		92

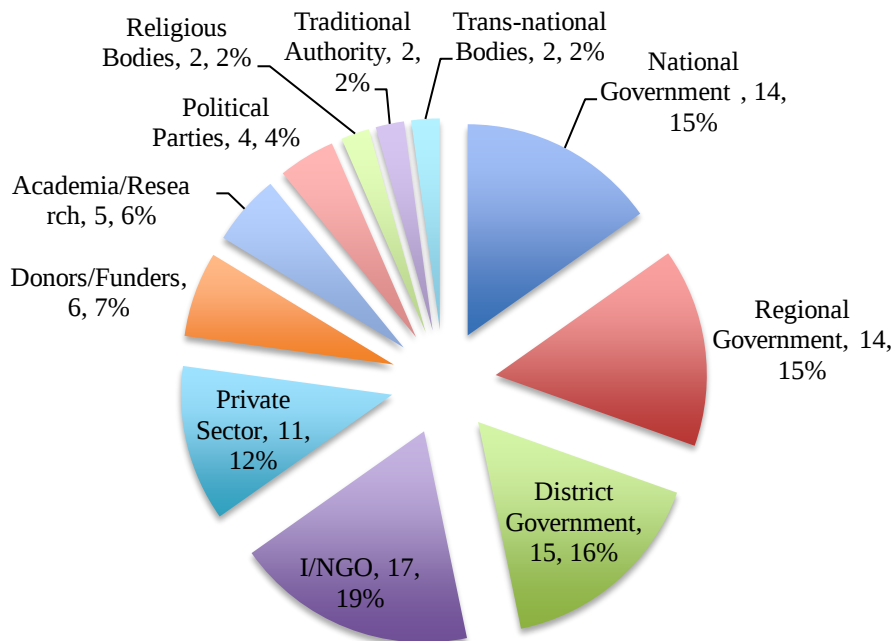
Notes:

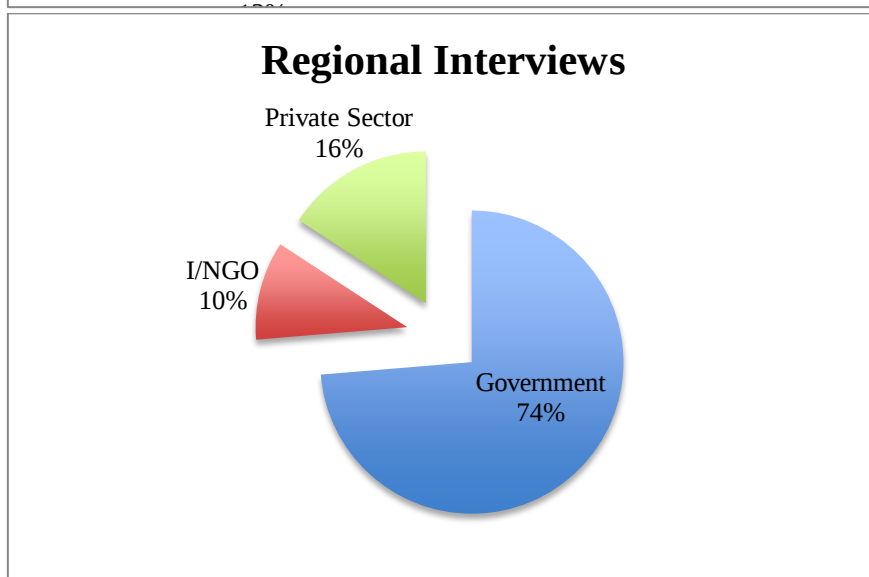
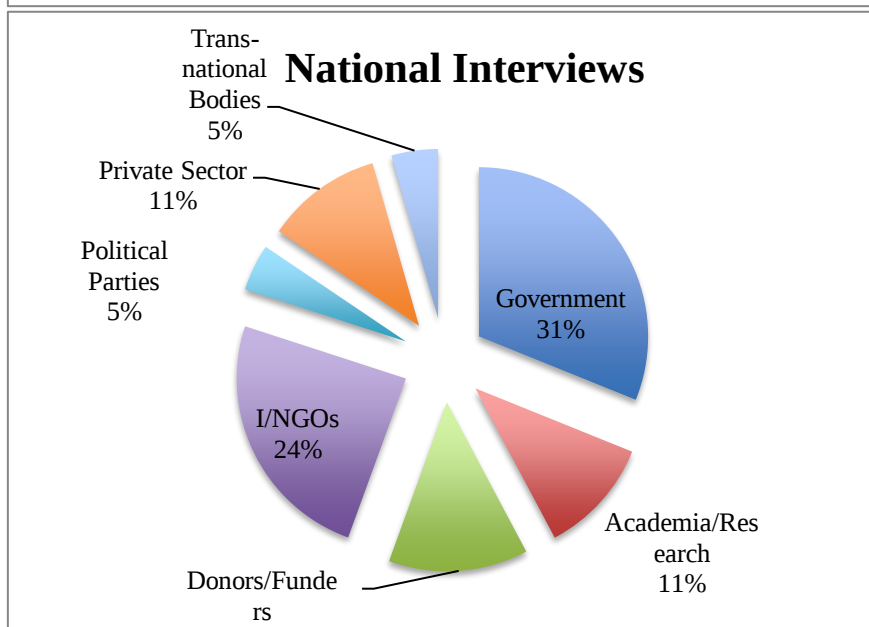
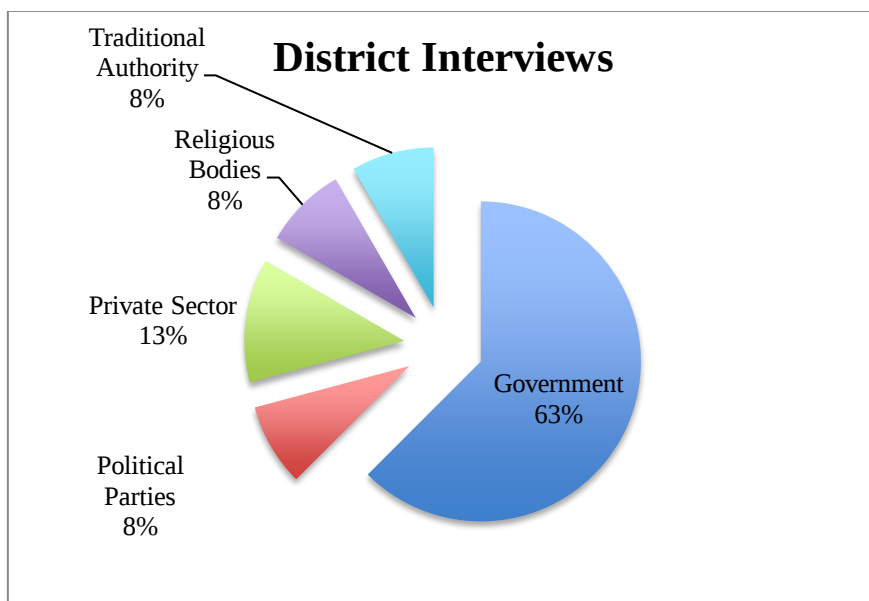
- In some cases, multiple interviews were conducted with personnel within the same organisation, but often from different departments or roles.
- In addition to the organisational interviews, 56 community members from Orbili Village in our focal district of Lawra were interviewed to understand the local climatic challenges and external interactions of the community members with local organisations

Multi-Scale Interviews



Interview Break-up - Total





APPENDIX PAPER 2

Appendix A – Average Household Head Profile in Orbili Village, Upper West Ghana

Attribute	Average* Household Head	Range
Gender	Male	Majority of household heads are men supported by women
Age	43	22-80
Land Ownership	Owned	99% self-owned
Land (Acres)	7	2-30
Education	No	Over 90% have no formal education
Farming Activity	Rain fed farming and dry-season vegetable farming	Major crops - Maize, millet, groundnuts and vegetables
Income Source	3 or more sources of income	~65% have 3 or more sources of income from farming, vegetable farming, livestock, labour, charcoal, trading and employment
Main Farming Challenges	Unpredictable rains, lack of access to tractors and shortage of funds for labour	Rains, tractors, soil fertility, funding for labour & fertilisers, pests, winds and seeds
Improvements planned on farm	Better land management practices	71% planning improvements for land management, ridges tractors, livestock and fertiliser management
Source for addressing farming challenges	Self-help, agriculture department and community members	Self-help, community members, agriculture department, NGOs, market dealers and god
Funding source for farming	Self-funded	75% self-funded with limited support from NGOs, community groups and agriculture department
Climate Change Awareness	Yes	87% aware of climate change impacts on farming
Source for climate change awareness	Radio and community members	Radio, community members, market dealers, church, self-observation, elders and NGOs

*Average based on top 2-3 answers or identified by over 50% of household heads. Source: Authors primary data on 97% community coverage (n=56).

Appendix B – Household Attributes and Relational Data

Ranked by Degree	Name (Initials)	Gender	Age	Education (1=primary, 0=none)	Land Size (Acres)	Livelihood Diversity (No of sources)	Dry Season Farming (1=yes, 0=no)	Knowledge of Climate Change (1=yes, 0=no)	Total Relations with Local Actors	Total Relations with Households- Degree Centrality	Betweenness Centrality
1	KW	M	31	1	3	5	1	1	9	55	15.41
2	RD	M	45	0	4	3	1	1	5	55	15.41
3	BM	M	37	0	3	2	1	1	6	55	15.41
4	UD	M	32	0	8	3	1	1	6	54	14.24
5	DZ	F	36	1	15	4	1	1	8	53	5.56
6	NW	M	54	0	3	3	1	1	4	53	5.56
7	KN	M	35	0	5	3	1	1	4	53	5.56
8	YS	F	30	0	4	4	1	1	5	53	5.56
9	EY	M	26	0	8	2	1	0	5	53	11.70
10	TG	F	25	0	6	4	1	1	5	53	5.56
11	KK2	M	75	0	6	2	1	0	5	52	11.40
12	IB	M	60	0	6	3	1	1	4	52	4.64
13	MD	M	45	0	10	4	1	1	3	52	4.64
14	MA	M	35	0	10	4	1	1	5	52	10.20
15	GL	M	30	0	5	2	1	0	5	52	10.20
16	IT	M	29	0	10	3	1	0	3	52	4.64
17	IK	M	24	0	5	4	1	0	3	52	4.64
18	IN	M	22	0	10	3	1	1	4	52	10.20
19	ED1	M	29	1	10	2	1	1	5	51	4.40
20	IG	M	70	0	13	1	0	0	4	51	3.21
21	GN	M	46	0	4	3	1	0	3	51	4.40
22	PS	M	37	0	3	3	1	0	3	51	4.40
23	MB	M	37	0	4	2	1	0	3	51	4.40
24	NK	M	33	0	7	5	1	1	5	51	2.76
25	MY	M	32	0	16	4	1	1	4	51	4.40
26	NS	M	23	1	15	4	1	1	3	50	1.65
27	NR	M	48	0	3	3	1	1	4	50	1.65
28	ZK	M	45	0	4	2	1	1	3	50	1.65
29	BN	M	40	0	5	2	1	1	4	50	1.65
30	GS	M	35	0	8	3	1	1	3	50	1.65
31	Chief	M	60	0	10	4	1	0	4	49	0.94
32	KI	M	60	0	6	2	1	1	2	49	0.94
33	NS1	M	50	0	30	3	0	0	2	49	0.94
34	ET	M	48	0	6	2	1	1	2	49	0.94
35	ED	M	40	0	9	3	1	1	2	49	0.94
36	KG	M	38	0	4	2	1	1	3	49	0.94
37	KY	M	33	0	6	3	1	1	2	49	0.94
38	KM	M	26	0	5	3	1	1	2	49	0.94
39	DN	M	60	0	5	1	0	0	4	48	3.69
40	GN1	M	49	0	7	2	1	1	4	48	3.20
41	NA	M	40	0	3	2	1	1	3	48	0.87
42	MD1	M	35	0	9	2	1	1	4	48	3.20
43	TK	M	30	0	2	4	1	1	4	48	2.23
44	ND	M	36	1	4	2	1	1	2	47	0.74
45	WG	F	50	0	3	2	1	1	2	47	1.17
46	KK1	F	33	0	6	5	1	1	2	47	0.74
47	DI	M	27	0	2	3	1	0	2	47	0.74
48	KK3	M	50	0	2.5	2	1	1	1	43	0.00
49	DY	M	45	0	6	3	1	1	2	39	5.60
50	DZ1	M	70	0	8	2	0	1	1	37	0.00
51	DK	M	60	0	6	1	0	0	1	30	0.00
52	KK	M	50	0	1.5	1	0	0	2	27	0.36
53	GT	M	48	0	10	2	1	0	2	25	0.13
54	ZD	F	60	0	5	1	0	1	1	23	0.00
55	BD	M	80	0	5	0	0	0	1	11	0.00
56	LN	M	45	0	10	3	1	1	1	11	0.00
Total					5	384		48	39	2626	-
Mean				42	-	7	3	-	-	47	4.05
SD +/-				14	-	5	1	-	-	10	4.3

Appendix B presents selected household attributes, bridging relations and centrality measures of households for testing correlation (Kendall Tau). The data was collected through surveys, semi-structured interviews, interaction protocol, and community workshops. The households are ranked based on the centrality measures of degree and betweenness, extracted from their bridging relations with local organisations.

Appendix C – Bridging Relation Data Collection Protocol Form

NAME OF INTERVIEWER:	START TIME: END TIME:
DATE OF INTERVIEW:	HEAD OF HOUSEHOLD Y/N
NAME OF INTERVIEWEE:	AGE: GENDER:
VILLAGE:	INTERVIEW NO:

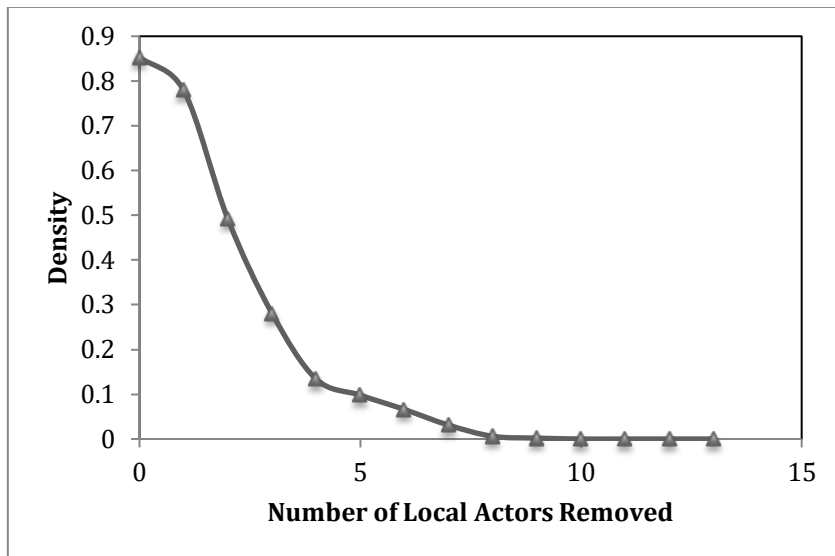
Framing Question to Household: Whom do you regularly interact with outside of your community for knowledge and resources?

	Local Organisation (1)	Local Organisation (2)	Local Organisation (3)	Local Organisation (4)
Length: How long have you known this organisation? Follow up: When did you last meet this organisation?				
Frequency: How many times do you interact with this organisation per month /year?				
Type: What is the purpose of interactions? Please describe 1-Knowledge 2-Resources				
Usefulness: Do you find the interactions useful? (Please ask for details about interaction and specifics on the usefulness of interactions) Note: Ask about last interaction with local organisation?				

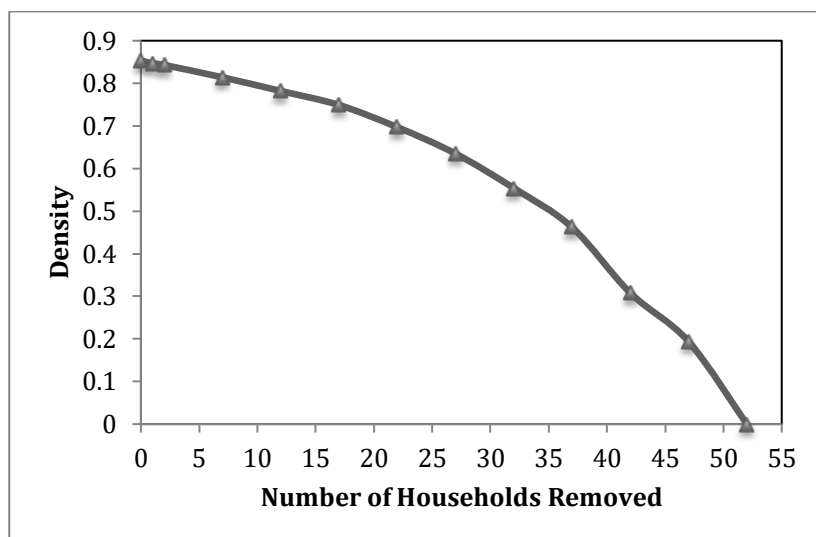
Appendix D – Sensitivity of community network structure

To understand the sensitivity of the community network structure to relations with local organisations, we applied the redundancy measure i.e. the buffering capacity of the community network in case of loss of an organisation. High redundancy shows that if an organisation is lost, others can fill the position and continue functioning without disrupting the network, thus leading to more stable structure (Bodin et al., 2006). We iteratively removed local organisations from the network, starting with the most central organisation, and observed the impact on the density of the extracted community network (Figure a). We repeated this process removing central households from the community network (Figure b).

Figure a shows a steep slope of the density curve. By removing only two local organisations from the network, the density of the community network drops significantly to almost half. This leads to a fragmented network with many households no longer interconnected, highlighting that the community network structure is highly sensitive to the work of local organisations. Figure b on the other hand shows a much flatter density curve. Removing the central households from the network does not significantly affect the density of the community structure. Many links in the network makes the loss of a household less disruptive. While the departing household would lose its network position and the associated benefits, the extracted one-mode community structure remains intact and densely connected as many other households offer potential shortest paths to other households through the local organisations.



(a)



(b)

Supplementary Figures: Impact of removing local organisations and households (starting with the most central) on the density of the community network

APPENDIX PAPER 3

Appendix A – Detail of Organisation-Communities and Relational Data

Rank	Name of Organisation	Category	Weighted Degree Total	Weighted Degree Intra-Community
The Agriculture Policy Incumbents				
1	Ministry of Food and Agriculture	Government - National	189	88
2	International Development Partners	International Institutions	113	73
3	University of Ghana	Academia/Research	110	73
4	Private Sector	Private Sector	84	65
5	GIZ	NGOs	67	49
6	International Fund for Agriculture Development	International Institutions	72	48
7	Farmer Groups	Associations/Media	57	46
8	Alliance for a Green Revolution in Africa	International Institutions	51	42
9	Forum of Agricultural Research in Africa	International Institutions	44	41
10	Government Research Institutes	Academia / Research	67	35
11	Agriculture Development Bank	Private Sector	54	34
12	Ghana Meteorological Agency	Government - National	55	31
13	Ghana Cocoa Board	Government - National	39	31
14	International Institutions (Others)	International Institutions	35	30
15	Japan International Cooperation Agency	International Institutions	43	24
16	SNV	NGOs	34	24
17	Weinco - Private Sector	Private Sector	32	24
18	Solidaridad	NGOs	23	23
19	Association of Ghana Industry	Associations/Media	32	20
20	Sub-African Organisations	International Institutions	17	17
21	Ghana Wildlife Society	NGOs	27	15
22	Guinness Ghana	Private Sector	22	13
23	National Parliament	Government - National	19	8
			1,286	854
The Climate Specialist				
1	Non-Governmental Organizations (Others)	NGOs	123	58
2	Ministry of Environment, Sci, Tech & Innov	Government - National	105	47
3	Environmental Protection Agency	Government - National	100	60
4	Care International	NGOs	93	58
5	Government Ministries, Depts and Agencies	Government - National	73	32
6	United Nations Development Programme	International Institutions	61	33
7	Global Environmental Facility	International Institutions	55	22
8	Climate Platforms	Associations/Media	46	30
9	The Development Institute	NGOs	43	31
10	CAN Ghana	NGOs	42	28
11	Peasant Farmers Association	NGOs	39	26
12	Canadian Int Development Agency	International Institutions	39	23
13	Religious Board Network	NGOs	27	23
14	International Climate Agencies - UNFCCC	International Institutions	18	18
15	Media	Associations/Media	14	11
16	Political Parties	Associations Media	3	2
			881	502

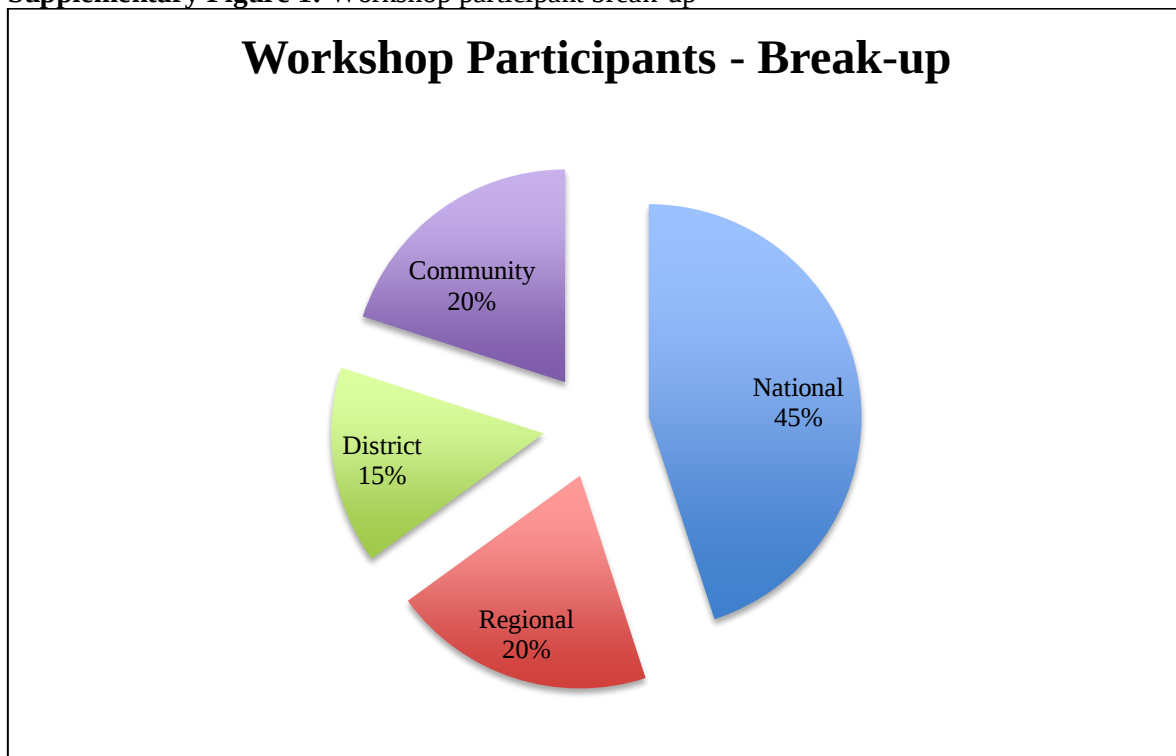
	The Arbiters			
1	Ministry of Finance	Government - National	89	28
2	District Assembly (Lawra)	Government - District	78	55
3	National Development Planning Commission	Government - National	73	31
4	District Agriculture Department Office	Government - District	66	45
5	Regional Coordinating Council	Government - Regional	58	29
6	National Disaster Management Organization	Government - National	58	27
7	Ministry of Local Govt and Rural Dev	Government - National	51	35
8	Regional Agriculture Office	Government - Regional	41	25
9	Development Programmes-SADA/NRGP	Local Projects	37	19
10	District Business Support Unit	Government - District	29	17
11	Ghana Social Opportunity Project	Local Projects	27	19
12	Local Projects	Local Projects	17	15
13	National Climate Change Committee	Government - National	16	6
14	Ministry of Communication	Government - National	12	9
15	District Departments	Government - District	10	10
16	Regional Departments	Government - Regional	7	7
17	Assembly Members (Lawra)	Government - District	7	6
18	Town Committees	Government - District	3	3
			679	386
	The Locals			
1	Local Community -Orbili	Community/Traditional Auth	60	42
2	IDE Ghana	NGOs	37	11
3	IDE District Office	NGOs	31	30
4	Rural Banks	Private Sector	20	11
5	Traditional Authority	Community/Traditional Auth	18	12
6	Market Dealers	Private Sector	16	15
7	Ministry of Chieftaincy & Traditional Affairs	Government - National	11	6
8	Community Groups	Community/Traditional Auth	9	9
9	Church	Community/Traditional Auth	6	6
			208	142
TOTAL			3,054	1,884

APPENDIX PAPER 4

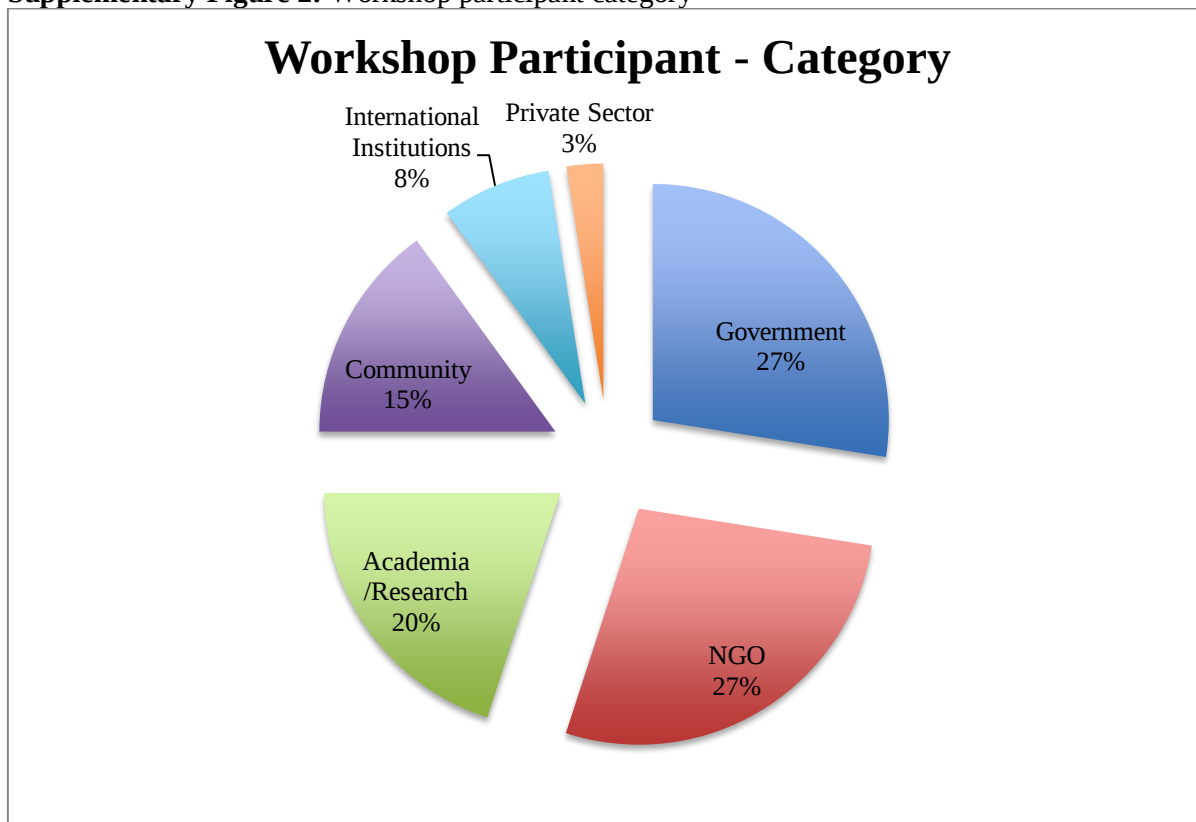
Appendix A: List of Participants for RAP Workshop –Accra

	National Level Participants	Category
1	Ministry of Food and Agriculture	Government
2	Ministry of Food and Agriculture	Government
3	The Development Institute	NGO
4	National Development Planning Commission	Government
5	National Development Planning Commission	Government
6	Peasant Farmers Association	NGO
7	Ghana Meteorological Agency	Government
8	African Development Bank	Private Sector
9	FAO Ghana	International Institution
10	FAO Ghana	International Institution
11	Ministry of Finance	Government
12	Engineers without Borders	NGO
13	RELBONET	NGO
14	WWF	NGO
15	The International Stingless Bee Centre	NGO
16	CSIR-ARI	Academia / Research Institute
17	CSIR-ARI	Academia / Research Institute
18	CSIR-ARI	Academia / Research Institute
	Regional Level Participants	
19	CSIR-ARI	Academia / Research Institute
20	CARE	NGO
21	CIDA	International Institution
22	CSIR-SARI	Academia / Research Institute
23	CSIR-ARI	Academia / Research Institute
24	CARE	NGO
25	RCC Planning Officer	Government
26	ACEP	NGO
	District Level Participants	
27	District Agriculture Department	Government
28	District Agriculture Department	Government
29	Lawra District Assembly	Government
30	Lawra District Assembly	Government
31	IDE	NGO
32	CSIR-ARI	Academia / Research Institute
	Community Level Participants	
33	Orbili	Community
34	Orbili	Community
35	Orbili	Community
36	Orbili	Community
37	Teater Farmers Coop	Community
38	Boo Naylor Disabled Farmers Association	Community
39	NANDIREP	NGO
40	UDS Institute of Continuing Education	Academia / Research Institute

Supplementary Figure 1: Workshop participant break-up

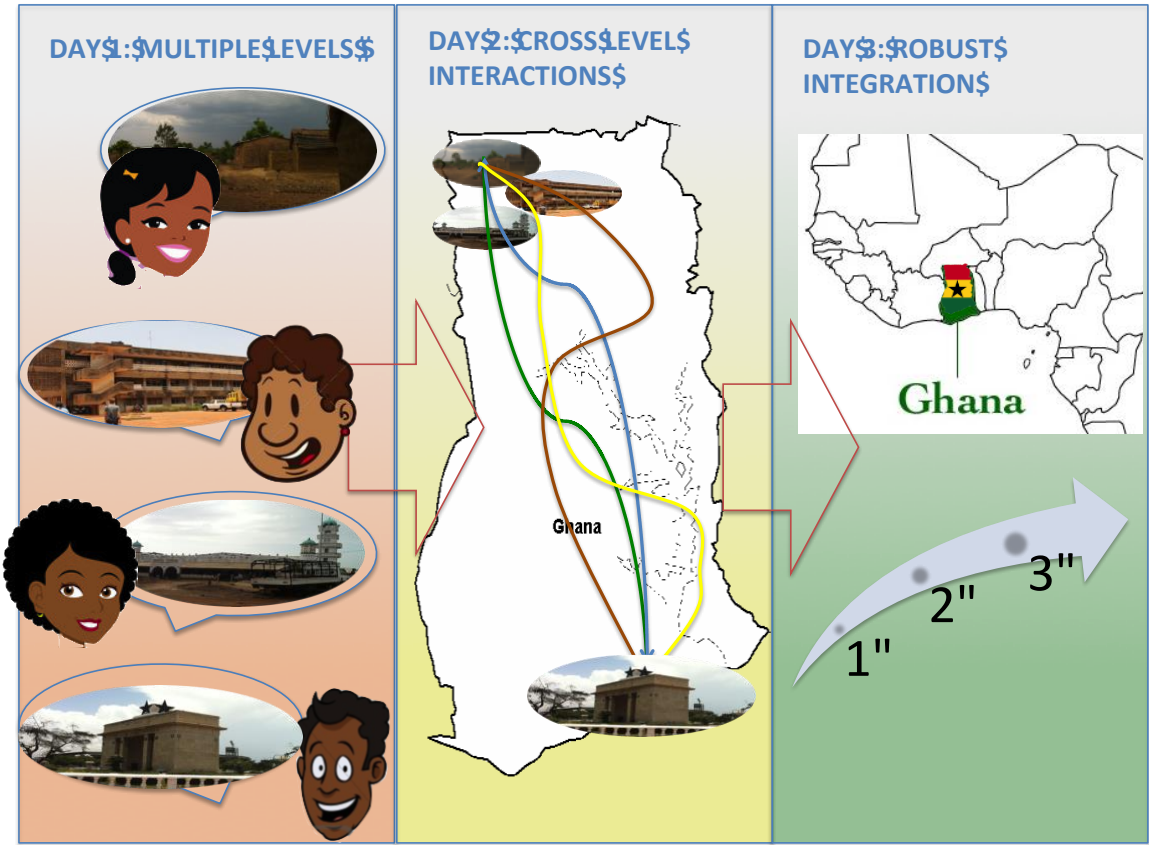


Supplementary Figure 2: Workshop participant category



The workshop was supported by a team of experienced researchers and workshop facilitators (10), translators (3), note takers (4) and support staff (4).

Supplementary Figure 3: Visual agenda for Ghana multi-level integrated adaptation governance workshop



Supplementary figure 3 shows the visual agenda of the workshop spread over three days. However, the structure and duration can be varied depending on the individual circumstances.

Appendix B: Proposed Action Plans

Agriculture Information System (AIMS)

Action	Champion	Approval	Consulted	Informed	Time
Advocacy of Extension Gap	Civil Society, Peasant Farmers Association, Development Institute (DI)	Ministry of Food and Agriculture (MOFA) and Policy Planning Division (PPMED)	AGRA NGO (Have done similar advocacy in this area)	National Development Planning Commission (NDPC)	
Improving investment in Agriculture (10% allocation of budget under Maputo Declaration on Agriculture)	AGRA (have done work in this area)		AGRA		
Leadership for agriculture extension policy development	MOFA – Extension Service Directorate and PPMED	Chief Director of MOFA	PPMED	Minister of Agriculture for buy-in	
Document Review (FASDEP II, METASIP, 2002 Extension Policy)	PPMED Policy Unit	Director PPMED			
Buy-in and consultation from the Agriculture Sector Working Group	Relevant NGO		Agricultural Sector Annual Review	PPMED Head of Policy	
Consulting/ modifying existing curriculum	National Accreditation Board, Ghana Education Service Tertiary Education Unit		University of Cape Coast, Ghana Legon, UDS	CSIR Graduate School (forthcoming)	
Baseline data on existing extension services	Ghana Statistical Services, MOFA Statistical Research Department (SRID)		SRID, Regional M&E officers, and District MIS officers		
Use of E-extension tools like Esoko	MOFA E-agriculture initiative via the IT department and Chief Director's Office				
Improved national service participation in extension and on-the-job training	District Director of Agriculture and the National Service Secretariat		District Assembly		
Improved frequency of regional meetings	MOFA Regional Director of Agriculture, CSIR Coordinator in Upper West				
Increased farmer field schools and demonstrations	Project Driven [Development partners], District Department of Agriculture, CSIR		NGOs, and CSOs, FAO		
Improved community organization for adoption	Community Contact, Extension Supervisor		Chief, Sub-chiefs, and District units		

Sustainable Agriculture Inputs (SAI)

Action	Champion	Approval	Consulted	Informed	Time
Delay in cash transfer of subsidy by government to importers/manufactures, leading to delay in fertiliser availability <i>(The reason is that while expenditure is clear, the revenue is an estimate that often falls short. Part is the dependence on foreign grants to plug budget deficit (example Euro 40m held by EU))</i>					
Setup of advocacy group comprising ministries of agriculture and finance, donors and fertiliser suppliers to plan and coordinate quantity, timing, funding of fertiliser import	National Development Planning Commission (NDCP)	National Cabinet	MOFA, Donors, Ministry of Finance, National Fertiliser Companies	NGO, District Assembly, Peasant Farmer Association	
Accountability of District and Regional Directors/ Procurement					
Monitoring evaluation and tracking system at the region and district level to monitor the quantity of fertiliser entering the district and region – “ESOKO” system	Network of Rural NGO	Regional and District Assembly (RCC + DA)	Regional Directors of Agriculture, District Chief Executive, Regional/District Fertiliser Input dealers	Farmers/ NGOs	
Power to take action/report the officials found in violation of the policy	Network of Rural NGO	Regional and District (RCC + DA)	Regional directors of Agriculture, District Chief Executive, Regional/District Fertiliser Input dealers	Regional Security Council, Police	
Illegal sale of subsidized fertiliser to Burkina Faso and other districts at higher price:					
Inclusion of farmer representative in fertiliser allocation committee at district level in the allocation of quotas and quantity received for timely dissemination of fertiliser availability	Local NGO	Regional /District Directors of Agriculture, District Chief Executive	Regional /District directors of Agriculture, District Chief Executive Association of Farmers	Farmer groups/associations, Input dealers, Association of Award-Winning Farmers	

Farmers selling fertiliser subsidy passbook to Dealers because of lack of funds					
Generating alternate sustainable livelihood options for generating funds for fertiliser purchase - Village saving schemes, Micro Credit from banks – Assistance from Peasant Farmers Association	Network of Rural NGO		Regional /District Directors of Agriculture, District Chief Executive	Farmers	
Low Extension to Farmer Ratio (Challenge for knowledge dissemination)- Not focusing on national policy for extension services but at community level to bridge the extension gap					
Community based training of farmers (show case)- “Talking Book” tools	NDPC and Community Contact		Regional and District Assembly	Farmers	
Motivating volunteering by offering “Best Volunteer Award” through dedicated district budgets	Agriculture Development Bank		Regional and District Assembly	Farmers	
Linking national service-Training on agriculture service and deputing in districts/villages	Ministry of Finance		NDPC	Farmers	
Training is usually done by projects (NGOs) during projects but not sustainable. Need to institutionalize it through using the formal concept of “Contact Farmer”	Community Contact		Regional and District Assembly	Farmers	