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Understandings, Indicators, and Implications of Enhanced  
Adaptive Capacity within Agricultural Development  
Interventions in Northern Ghana

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Submitted in accordance with the requirements for the degree of  
Doctor of Philosophy

Science Policy Research Unit  
University of Sussex

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Declaration of Originality

I hereby declare that this thesis has not been, and will not be, submitted in whole or in part to another University for the award of any other degree.

Signed \_\_\_\_\_

RTaylor

## UNIVERSITY OF SUSSEX

Rachael Taylor, DPhil Science Policy Research

Understandings, Indicators, and Implications of Enhanced Adaptive Capacity within  
Agricultural Development Interventions in Northern GhanaSummary

Enhanced adaptive capacity is increasingly being pursued as an objective of agricultural development interventions due to the perceived vulnerability of smallholder farming communities to a range of shocks and stresses. This research used two case studies of agricultural development interventions in Northern Ghana to examine diverse understandings of adaptive capacity, potential indicators of enhanced adaptive capacity, and the implications of this for sustainable agricultural livelihoods. The thesis reviews relevant theoretical literature to situate the study among complex adaptive systems thinking and sustainability discourses. Associated policy documentation is reviewed to set the context in which, and identify why, development interventions seek to enhance adaptive capacity. The primary methods of data collection were interviews, focus groups, and ethnography, as well as secondary data in the form of documentation from the case studies. Multiple understandings of adaptive capacity were identified in both case studies, including ‘formal’ understandings of the projects’ funders and management, and ‘informal’ understandings of field staff and participating farmers. The findings contribute to theory, policy and practice through explicit recognition of the diversity of understandings of adaptive capacity, which has not been appreciated or analysed previously. Indicators of enhanced adaptive capacity emerged from the findings. Findings show how features of social capital were integral to enhanced adaptive capacity and played a dominant role in beneficial outcomes, even when not the priority of the interventions. This implies a set of indicators of enhanced adaptive capacity that can inform theoretical discourse, policy and programme planning, and monitoring and evaluation in practice. Finally, this research identified the role of social capital in contributing to enhanced adaptive capacity, which supports sustainable agricultural livelihoods. These findings contribute lessons for similar ongoing and

future agricultural development interventions and recommend a focus on features of social capital rather than physical and technological capital.

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### List of Abbreviations and Acronyms

ACCRA – Africa Climate Change Resilience Alliance

ASTI – Agricultural Science and Technology Indicators

ATPS – African Technology Policy Studies Network

AU – African Union

BMZ – Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung  
(Federal Ministry for Economic Cooperation and Development, Germany)

CAADP – Comprehensive African Agriculture Development Programme

CBO – Community-Based Organisation

CGIAR – Consultative Group on International Agricultural Research

CIARD – Coherence in Information for Agricultural Research for Development

CIMMYT – International Maize and Wheat Improvement Center

CIP – International Potato Centre

CODE-WA – Community Management of Crop Diversity to Enhance Resilience, Yield  
Stability and Income Generation in Changing West African Climates

COP – Conference of Parties

CRP – CGIAR Research Programme

CSIR – Council for Scientific and Industrial Research

CT – Community Trainer

DfID – Department for International Development

ECOWAS – Economic Community Of West African States

ECOWAP – Economic Community Of West African States Agricultural Policy

EPA – Environment Protection Agency

FAO – Food and Agriculture Organization of the United Nations

FASDEP – Food and Agriculture Sector Development Policy

GAINS – Ghana Agricultural Information Network System

GAPP – Ghana AGRIS Pilot Project

GDP – Gross Domestic Product

ICRISAT – International Crop Research Institute for the Semi-Arid Tropics

IRWG – Interagency Resilience Working Group

LEISA – Low External Input Sustainable Agriculture

MEST – Ministry of Environment, Science, Technology, and Innovation

METASIP – Medium-Term Agricultural Sector Investment Plan

MOFA – Ministry of Food and Agriculture

NARS – National Agricultural Research System

NAPA – national Adaptation Programmes of Action

NCCAS – National Climate Change Adaptation Strategy

NDPC – National Development Planning Commission

NEPAD – New Partnership for Africa’s Development

NGO – Non-Governmental Organisation

OFSP – Orange-Fleshed Sweet Potato

PRA – Participatory Rural Appraisal

SADA – Savanna Agricultural Development Agency

SARI – Savanna Agricultural Research Institute

STI – Science, Technology and Innovation

UK – United Kingdom

UN – United Nations

UNDP – United Nations Development Programme

UNFCCC – United Nations Framework Convention on Climate Change

USAID – United States Agency for International Development

VSLA – Village Savings and Loans Association

## Chapter 1 – Introduction

The stated need to enhance adaptive capacity is increasingly becoming a priority issue for international development concerns (e.g. Ensor, 2011). Despite this, there has not been an in depth study into how ‘adaptive capacity’ is understood by different actors within the international development sector. In addition, there has been very little consideration of how enhanced adaptive capacity may be identified in practice and the consequences of this for achieving objectives of sustainability. This research set out to address these gaps in knowledge and understanding by empirically and conceptually contributing to theoretical, policy, and practice-based discourses on adaptive capacity.

### 1.1 Background and Context

This section introduces the background to the concept of adaptive capacity, providing the context for this research, and outlines why there is a need for detailed analysis of understandings of adaptive capacity. This discussion relates adaptive capacity to sustainability and introduces other associated terms.

#### 1.1.1 The Concept of Adaptive Capacity

The concept of adaptive capacity is not a new one and it has been present in international development policy and practice discourses for several decades. However, since the early 1990s the concept has increasingly been associated with climate change following the establishment of the United Nations Framework Convention on Climate Change (UNFCCC). Within climate change discourse, adaptive capacity has begun to emerge as a priority area for development interventions during the past ten years. The practice-based discourse around adaptive capacity suggests that through enhancing adaptive capacity of communities and societies in developing countries, they will be better able to adapt to shocks and stresses which may occur due to climate change (Turnbull et al, 2013). As Ensor (2011) suggested, objectives of development interventions indicate that being able to adapt to climate change will make communities and societies more sustainable through reduced vulnerability, reduced poverty, and increased human welfare.

That discourse largely overlooks historical efforts to increase the adaptive capacity of communities which have been perceived as vulnerable to change (e.g. Adger et al 2006). It also overlooks the need of communities to adapt in response to other forms of change apart from climatic, although the term adaptive capacity has become predominantly associated with climate change.

### 1.1.2 Understandings of Adaptive Capacity

The term ‘adaptive capacity’ has been used widely in global development discourse, with different framings and meanings. These multiple and diverse understandings of adaptive capacity are often related to the terms ‘sustainability’ and ‘resilience’ but those terms have also become widely used with diverse interpretations. Cilliers (1998) suggested that

“[t]he word ‘postmodernism’ has acquired so many different meanings that it has become impossible to define it. Literature on postmodernism has proliferated to such an extent that it has become difficult to know exactly what position it is that one has to engage with” (Cilliers, 1998, p113).

The same statement can be applied to ‘sustainability’, ‘resilience’, and ‘adaptive capacity’ (e.g. Wheeler, 2012). While there is existing literature examining different understandings of the terms sustainability and resilience (e.g. Dresner, 2008; Scoones, 2007, Folke, 2006), this type of analysis of adaptive capacity does not yet exist. It is not only likely, but expected, that individuals and institutions working at different scales and with different purposes would hold differing understandings of adaptive capacity. Yet, in most cases the discourse does not acknowledge this and the term is used by multiple institutions with an assumed common understanding of what adaptive capacity means.

It is useful to selectively refine existing discourse about adaptive capacity by analysing the diverse ways in which the term is understood within development interventions. This is important because it will provide clarity to the diverse perceptions of the objectives of development interventions which seek to enhance adaptive capacity. Through an examination of how diverse understandings of adaptive capacity relate to the objectives of development interventions, it may be possible to evaluate any impacts or outcomes resulting from the projects. This may provide a framework through which potential indicators of enhanced adaptive capacity can be assessed. In addition, identifying processes which result in enhanced adaptive capacity may improve

opportunities for facilitating beneficial processes. Thus, this research contributes to improving adaptive capacity within development interventions. As development interventions increasingly seek to enhance adaptive capacity in the face of growing threats from change, this research provides a timely contribution to development practice, as well as a pertinent contribution to associated policy and theory. By contributing clarity to diverse understandings of adaptive capacity and a framework for indicators and processes which may enhance adaptive capacity, this research may improve opportunities for ongoing and future development interventions with similar objectives. This in turn may support the sustainability of agricultural livelihoods for smallholder farmers living in poverty, as discussed in Chapter 7.

### 1.1.3 The Relationship between Sustainability and Adaptive Capacity

The concepts of sustainability and adaptive capacity are closely related and an awareness of the relationship is often assumed or implied (e.g. Pelling, 2011). It is important to review both concepts of ‘sustainability’ and ‘adaptive capacity’ together in order to gain an understanding of the context of each term. The framing of adaptive capacity and its enhancement interacts with and responds to the framing of sustainability. Thus, as this study examines diverse understandings of adaptive capacity it must consider these in relation to understandings of sustainability as an overarching objective of agricultural development interventions.

Sustainability has become a widely-used term in recent decades which has resulted in multiple uses and understandings of what it means to be sustainable and what constitutes sustainability. Sustainability became a buzzword following the publication of the World Commission on Environment and Development Report, *Our Common Future*, in 1987 (WCED, 1987). The definition given in that report, commonly referred to as the Brundtland Report, continues to be one of the most widely used. The report had the concept of sustainable development as a central theme, defining this as development which “meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p8). The understanding of sustainability used in the Brundtland Report has a focus on equity within and between generations (Dresner, 2008). Central to the discourse of sustainability is the need for continued socio-economic development in a manner which does not further degrade the resource base and environment on which life depends. Framings of sustainability will be reviewed in Section 2.3 and the relationships between understandings of sustainability

and adaptive capacity are considered in Section 2.7. The understandings of sustainability and how they relate to adaptive capacity within the two case studies in this research are examined in Sections 5.2.6 and 5.6.4. Chapter 7 will examine the implications of enhanced adaptive capacity for sustainability with agricultural livelihood systems.

In the context of this research, sustainability is understood as the capability of a system to maintain its primary function, in this case, the provision of agricultural livelihoods. It is widely considered that adaptive capacity is a desirable trait to help achieve social, environmental and economic sustainability (e.g. Folke et al, 2002; Hahn et al, 2008). However, although adaptive capacity is associated with sustainability, the relationship between the two concepts is often implied or assumed rather than being presented as an explicit description of how adaptive capacity contributes towards sustainability of a system. This research intends to address this by first examining indicators of enhanced adaptive capacity within the two case studies. Secondly, by identifying the impact of project outcomes on the sustainability of agricultural livelihoods this research explores the implications of enhanced adaptive capacity on sustainability.

Within sustainability and adaptive capacity discourses, adaptive capacity is associated with other terms including adaptation, mitigation, resilience, transformation, and vulnerability. In particular, adaptive capacity is frequently referred to in relation to resilience with the implication that enhanced resilience of a system increases its sustainability (e.g. Folke et al, 2002; Dixon and Stringer, 2015; Foxon et al, 2009). Here, resilience follows the definition given by Walker et al (2002), which suggested that resilience is “the potential of a system to remain in a particular configuration and to maintain its feedbacks and functions, and involved the ability of the system to reorganise following disturbance-driven change” (page 6). The association between these terms is particularly prevalent in complex adaptive systems literature originating at the Santa Fe Institute which proposes an adaptive cycle within resilience thinking (Holling and Gunderson, 2002; Walker and Salt, 2006). Chapman (2016) identifies “the role of adaptive capacity – the ability to learn and adapt to change – in maintaining the resilience of socio-ecological systems” (Chapman, 2016, p11). Chapman also perceives resilience using the understanding from Walker et al (2002) above. This directly associates adaptive capacity with the concept of resilience and places both terms within a social-ecological systems framing.

Whether assumed or explicit, the potential for adaptive capacity to contribute towards sustainability is important in the context of this research because development interventions often aim to increase or create sustainability as an overarching objective. In response to this, the research examines the outcomes of enhanced adaptive capacity within two case studies and the implications of this for increasing the social, environmental and economic sustainability of agricultural livelihoods (e.g. Dresner, 2008). The focus in this study is on the overarching objective of sustainability of agricultural livelihoods because development interventions often identify this as a potential route out of poverty among populations vulnerable to risks (Christiaensen and Demery, 2007). The following section outlines the role of agricultural livelihoods within development interventions.

## 1.2 Agricultural Development Interventions

Developing countries are widely considered to be more vulnerable to climatic shocks and stresses than developed countries, as suggested by the Intergovernmental Panel on Climate Change (Oppenheimer et al, 2014). Developing countries, here referring to low and middle-income countries and also sometimes referred to as the Global South, are considered to be vulnerable due to high levels of poverty, limited physical and economic infrastructure, and low levels of education, when compared with developed countries, or the Global North. Partly owing to this perceived vulnerability, developing countries are frequently the target or beneficiary of international development interventions intended to minimise the risks or impacts associated with climate change.

Development interventions at any scale typically have an overarching objective of improving the wellbeing of individuals, communities, and societies, indicated through measures of socio-economic development incorporated into the Human Development Index (HDI; White, 2008). While the HDI as a measurement of poverty and development has been criticised (ibid), the indicators incorporated into reflect the overarching objectives of improving human wellbeing found in typical development interventions. Although this may be an overarching objective of development in general, specific interventions may seek to achieve this through meeting objectives that contribute to improved human wellbeing. In the case of this research, the focus is on

development interventions which seek to increase the sustainability of agricultural livelihoods. In this context, the sustainability of agricultural livelihoods is considered to contribute to improved human wellbeing by providing nutritious food and a reliable income to pay for education, healthcare, and infrastructure.

The capacity of societies to adapt in response to shocks and stresses, whether climatic, environmental, economic, political, social, or other forms of change, can reduce vulnerability by minimising risks and optimising benefits from the change. Vulnerability is often understood as a combination of exposure, sensitivity, and adaptive capacity of a system to shocks and stresses (Paavola, 2006). Adaptive capacity may reduce vulnerability of individuals, communities, or societies, by enabling routes which reduce exposure to shocks and stresses (Pelling, 2011). In addition, adaptive capacity may reduce the sensitivity of people to shock and stresses, increasing their resilience. The association between reduced vulnerability and adaptive capacity, and the perceived vulnerability of developing countries, has led to an increasing number of development interventions focusing on enhancing adaptive capacity of communities, governance structures, institutions, livelihoods, and infrastructure.

### 1.2.1 Agricultural Development

Agriculture is the main livelihood source for the majority of the population in most developing countries. In addition, smallholder farmers are those most likely to be living in extreme poverty (Diao, 2010; Christiaensen and Demery, 2007). Poverty is often seen as a cause of vulnerability to change and those living in poverty are most likely to be farmers. In cases where farmers are living in extreme poverty, their agricultural livelihoods provide a critical source of food and income to pay for basic needs, thereby supporting the survival of farmers and their families. Thus, in order to reduce vulnerability and increase the social, environmental and economic sustainability of large sectors of the population, many development interventions focus specifically on agricultural initiatives. Furthermore, agricultural development is widely thought to provide the most effective options for poverty reduction:

“Agricultural growth generally has a higher return in terms of poverty reduction (that is, a higher “participation effect”) than an equal amount of growth in other sectors, because the majority of poor people in the developing world (and especially in Sub-Saharan Africa) directly depend on agriculture for their livelihood.” (Christiaensen and Demery, 2007, p4)



This highlights the rationale of development interventions to concentrate efforts on agricultural livelihoods.

Adaptive capacity plays an important role within agricultural livelihoods by supporting pathways to reduce vulnerability and increase the sustainability of agricultural livelihoods in variable and heterogeneous contexts. By supporting sustainable agricultural livelihoods, adaptive capacity plays a crucial role in the survival and wellbeing of farmers living in poverty and their families. Subsequently, this research will examine enhanced adaptive capacity within agricultural development interventions.

### 1.2.2 Smallholder Farmers in Northern Ghana

Further to the above discussion about vulnerability in developing countries and the prevalence of agriculture as a livelihood source, agriculture in dryland areas is particularly vulnerable to environmental degradation and climatic shocks and stresses. Drylands, which incorporate areas with a ratio of precipitation and potential evapotranspiration within the range from dry sub-humid to arid, characteristically have strong seasonality of rainfall and poor soils. Farming in dryland areas is largely rain fed, resulting in growing seasons which are limited in length. In addition, soils typically have low nutrient content, poor structure, and low water and nutrient retention (Millar et al, 1996).

Concerns regarding the threats of climate change and the associated increased temperatures, reduced rainfall, and increased frequency of extreme weather events, are particularly pertinent for dryland areas. Efforts to increase the sustainability of agricultural livelihoods in developing countries have, in recent years, converged with efforts to enhance adaptive capacity to climate change. As a result, many agricultural development interventions which focus on enhancing adaptive capacity cite climate change as a primary concern, as documented by Yaro (2010). In light of these considerations, both of the case studies investigated in this research are located within the dryland area of Northern Ghana.

Although a range of potential case studies in a number of African countries were considered for this research, Northern Ghana was identified as a suitable region for a number of reasons. Firstly, a number of the African countries considered as suitable due to the presence of agricultural livelihoods within dryland areas were experiencing periods of reduced security, violence and unstable governance. Due to the need to spend

long periods of time in the case study area, these countries were considered to be unsuitable for fieldwork due to security concerns. Secondly, two agricultural development interventions with similar objectives to enhance adaptive capacity, although through different processes (see Section 3.5), were identified in Northern Ghana and were willing to host the researcher for data collection. Finally, the official language of Ghana is English which meant that although translators were required for talking with farmers, translators which could speak English were easy to identify.

Northern Ghana is semi-arid and has only one season of rainfall each year (Antwi-Agyei, 2012). In the three administrative regions of Northern Ghana, between 65 and 80 percent of the population of working age engage in agriculture as their main livelihood source (Ghana Statistical Service, 2012). The majority of these farmers are smallholders, farming less than three hectares. In addition, levels of extreme poverty are much higher in the semi-arid north of Ghana than in the sub-humid south, with 63% and 20% of the population living in poverty, respectively (The World Bank, 2011).

There are a number of agricultural development interventions which focus on enhancing adaptive capacity and stimulating adaptation among smallholder farmers in Northern Ghana, for example, the Adaptation Learning Programme for Africa initiative implemented by CARE International (CARE, 2010). Two agricultural interventions which were implemented in areas of Northern Ghana, and which cited objectives of enhancing adaptive capacity and increasing the sustainability of agricultural livelihoods, were identified for this research. These case studies will be introduced fully in Section 3.5.

### 1.3 Theoretical Approach

There are two bodies of literature which underpin the theoretical approach adopted in this research, with other approaches providing a wider context to the theoretical discussion around adaptive capacity and sustainability. The ‘Pathways to Sustainability’ literature originating from the STEPS Centre (Leach et al, 2007) is considered alongside complex adaptive systems literature. Both bodies of literature are examined in depth in Chapter 2 and inform the Theoretical Framework (Section 2.7) and Analytical Framework (Section 4.6). There are similarities and overlaps in the two

bodies of literature and both make reference to social-ecological systems as an underlying theoretical approach.

Humans have developed societies, cultures, livelihoods and ways of life over centuries and millennia. Social features of life, constituting interactions between humans and human interactions with their surroundings, have developed in accordance with the features the surrounding environments and their ability to sustain life. The human, social features have evolved to rely on interaction with, and an interdependence on, the environmental and ecological attributes of their surroundings (Folke et al, 2005). These co-evolved interactions and interdependence between human and environmental elements of a system have been termed social-ecological systems (Rammel et al, 2007). Societies that employ livelihoods which directly rely on natural resources are intrinsically part of social-ecological systems because of the interactions with and dependence on ecological functions. Thus, the concept of social-ecological systems may be useful for understanding dynamics in rural livelihoods in the context of Northern Ghana.

### 1.3.1 Pathways to Sustainability

In the context of this research, sustainability is framed as a social, environmental, economic, political, and technological concept which requires sustainability within both space and time. The Pathways to Sustainability literature recognises that sustainability is dynamic and there are diverse potential pathways towards sustainability (Leach et al, 2010). That approach uses systems thinking and acknowledges that systems function at different scales. Leach et al (2007) recognise that complexity exists within dynamic sustainability and propose that, in order to achieve system sustainability, complex dynamics must be considered.

A New Manifesto suggests that environmental sustainability, alongside poverty reduction and social justice, can only be achieved with innovative ways of approaching these challenges (STEPS Centre, 2010). The publication proposes that innovation is required in multiple domains of development, not only in science and technology, but also in practice-based institutions, collective behaviours and social relations (ibid). This research is concerned with these complex and dynamic processes which construct social capital for enhancing adaptive capacity in agricultural communities.

### 1.3.2 Complex Adaptive Systems

Complex adaptive systems is a branch of complexity theory which originated at the Santa Fe Institute and has its roots in ecology. Complex adaptive systems are considered to be greater than the whole of the sum of their parts due to the importance of interdependent relationships among system components. Characteristics of complex adaptive systems include emergent behaviours, non-linearity and unpredictability, nested hierarchies, and dynamic interactions among the system (Rammel et al, 2007).

Social-ecological systems are often considered as complex adaptive systems because they contain features of non-linearity and diversity with the capacity to develop networks and learning processes. This creates the ability for reactive or proactive behaviour, enabling adaptation to change (Norberg & Cumming, 2008a). Outcomes of complex adaptive systems can be unpredictable because of interactions and functions at a range of spatial and temporal scales. System outcomes are created by the whole system rather than dependent on the behaviour of just one element or interaction (Low et al, 2003).

The complex adaptive systems concept may be helpful in understanding rural livelihood dynamics in settings which experience the interface of multiple socio-economic and environmental features. One such setting is Northern Ghana where the majority of the population obtain their livelihood from agriculture among heterogeneous and variable social and environmental conditions. The occurrence of changing dynamics among these conditions indicates the need for adaptive capacity of agricultural livelihoods to enable livelihood responses to change, shocks, and stresses. The complex interactions between socio-economic and environmental conditions associated with adaptive capacity of agricultural livelihoods in Northern Ghana may be better understood through a complex adaptive systems lens. As such, this research adopts a complex adaptive systems approach to understanding interactions, processes, feedbacks, and system behaviours.

## 1.4 Outline of Thesis

This introductory chapter outlines the background to this research and why it is both necessary and timely. The reasons for focusing on enhanced adaptive capacity within agricultural development interventions in the dryland area of Northern Ghana are

explained. The theoretical approach adopted for this research is briefly introduced, providing background information on the Pathways to Sustainability and complex adaptive systems literature.

The following chapter explores the theoretical background to this research through an examination of relevant literature. The evolution of concepts of agricultural systems is discussed and the theoretical background of social-ecological systems and complex adaptive systems are considered in that context. Then literature on the concept of adaptive capacity is examined, identifying characteristics which some have considered to constitute adaptive capacity (e.g. Walker and Salt, 2006; Brooks and Adger, 2004; Carpenter et al, 2001). The concepts of sustainability and resilience, as used within the Pathways to Sustainability literature from the STEPS Centre and the complex adaptive systems literature from the Santa Fe Institute, are examined in depth. Social capital and its relationship with sustainable agricultural livelihoods is discussed, before considering the different construction of formal and informal institutions and farmer participation. Finally, the chapter presents the theoretical framework for this research, from which five research questions are developed.

Chapter 3 examines relevant policy documentation associated with agricultural development and the need for adaptation and adaptive capacity. This considers the global and international scales, including documentation from the United Nations Framework Convention on Climate Change and the African Union, before examining national policy and governance documentation in Ghana. The chapter then introduces the bio-physical and socio-economic context in Northern Ghana and the ways in which this differs to that of Southern Ghana. The chapter concludes by introducing the two case studies of agricultural development interventions.

Chapter 4 outlines the methodology used for this research, first situating the study within a constructivist epistemology. The use of a case study approach is discussed and the background for using principles of policy and programme evaluation is explained. The data collection and data analysis methods are outlined, providing a rationale for the use of each. The chapter then considers the ethics of this research as well as the possible limitations of the study. The chapter concludes by outlining the analytical framework.

Chapters 5, 6 and 7 present an empirical analysis of the research findings in response to the research questions set out in Section 2.8. Chapter 5 examines the diverse understandings of adaptive capacity within the two case studies. This chapter identifies

the role of political economy and social framings in determining the presence of multiple understandings of adaptive capacity existing within each case study. Chapter 6 considers indicators of enhanced adaptive capacity within the associated farming communities and the prevalence of features of social capital among the indicators. The evidence of enhanced adaptive capacity impacting on project outcomes is examined and the two case studies are compared. Chapter 7 discusses the implications of enhanced adaptive capacity and project outcomes on contributing to sustainable agricultural livelihoods among the participating farming communities. Lessons for similar ongoing and future agricultural development interventions are outlined.

The thesis concludes with a summary of the research findings and a discussion of how these findings contribute towards theoretical, methodological, policy, and practice-based discourses. Chapter 8 concludes with recommendations for agricultural development interventions which seek to enhance adaptive capacity and areas where further research is required.

## Chapter 2 – Literature Review and Theoretical Background

This chapter reviews literature from theory and practice relevant to the study. Discussion explores topics related to agricultural systems and concepts of adaptive capacity and sustainability. The literature review informs the theoretical background of this research and situates it in a theoretical context. From this background, a theoretical framework is developed from which five research questions are drawn.

### 2.1 Agricultural Systems

Agricultural systems have been discussed in a range of forms including small-scale, commercial, or input-intensive agricultural systems, agricultural research systems, agricultural innovation systems, agro-ecological systems, value chain systems, and food security systems (e.g. FAO, 2013a; Sumberg et al, 2012). How agricultural systems have been conceived has evolved over time and this has shaped the nature of agricultural research and development over decades. This section particularly focuses on the conceptualisation of agricultural systems in developing countries in order to provide a context in which to situate the case studies for this research. However, the concepts of agricultural systems discussed here also apply to developed countries. The agricultural systems discussed in the following sections is not intended to be an exhaustive list of conceptualisations, instead focusing on those which are most relevant for this research.

#### 2.1.1 The Evolution of Agricultural Systems Concepts

Traditionally, agricultural systems were considered to be subsistence systems which drew on local environmental characteristics (Christiaensen and Demery, 2007). Agricultural systems were described within rural livelihood systems that provided crops for consumption and sale, pasture for livestock, as well as timber, fuel wood and non-timber forest products (e.g. Jackson, 2005; Dewalt, 1994). Traditional agricultural practices and crops grown varied throughout the world due to differences in vegetation type, climate, soil and topography (Conway and Barbier, 1988). Socio-economic demand and the variations in environmental characteristics and ecosystems led to agricultural systems which incorporated monocrop tree plantations, agroforestry,

shifting agriculture (or slash-and-burn), and intercropped systems (Fernandes et al, 2002).

In the middle of the 20<sup>th</sup> Century the Green Revolution resulted in changes in agricultural systems in some regions of developing countries. Research institutes in Mexico and then The Philippines led a move towards large-scale mechanised agriculture which used monocrop systems with pesticide and fertiliser inputs (Glaeser, 2011). The science-led formalised research approach provided opportunities for increasing crop yields: in the seven years following 1961, maize yields in Mexico doubled using research outputs from Norman Borlaug's team at the International Maize and Wheat Improvement Center (CIMMYT; Ibid). Mechanised monocrop systems were disseminated throughout much of Latin America and Asia which saw increased yields per hectare and per unit of labour.

The approach of agricultural development adopted during the Green Revolution has been criticised for a number of reasons (e.g. Kerr, 2012). The development of agricultural technologies proposed a 'silver bullet' style solution to increase yield per hectare which could be applied across diverse environments and contexts. Green Revolution technologies were largely unsuitable for marginal environments, such as drylands, and were not suitable for smallholder farmers due to the need for large areas of land when using large agricultural machinery (Mortimore et al, 2009). Furthermore, the input-intensive production practices of the Green Revolution were costly for farmers living in poverty (Kerr, 2012). A further criticism of the Green Revolution is that the intensified production practices depleted soil fertility and cause land degradation over wide areas, resulting in a reliance on chemical inputs (ibid).

In addition to the above criticisms of the Green Revolution approach to extensification and intensification, McKeon (2015) suggested that this resulted in a wider shift in the adoption of technological approaches to agriculture. Through an approach to agricultural development which drew heavily on research based at formal institutes, a top-down transfer-of-technology model of agriculture emerged into mainstream production (McKeon, 2015). This approach focused on increasing yields per hectare of monocrop production through intensification. An agricultural systems approach developed which focused on technology-driven production and became incorporated into international research institutes (Conway and Barbier, 1988).

The Green Revolution led to the instigation of the Consultative Group on International Agricultural Research (CGIAR), a group of 15 research centres globally,



each of which has a mandate for specified crop types or a particular biome or ecosystem. The expansion in the number of international agricultural research institutes focused agricultural development on research and changed funding routes for CGIAR centres. The modern diversity in agricultural systems globally stems not only from the wide variation in ecosystems and environmental characteristics but also from decades of targeted development through extensification and intensification from the CGIAR centres and National Agricultural Research Systems (NARS).

Starting in the 1980s rhetoric moved towards environmental sustainability, which sought to support equitable socio-economic development (e.g. Conway and Barbier, 1988). With a continued focus on formal agricultural research and development, incentives to consider agriculture within broader ecosystems included the possibility of agricultural production which conserved environmental services while also providing social and economic benefits. The agro-ecological systems concept followed with a suggestion that agriculture which efficiently made use of natural ecological processes would be more sustainable than large-scale monocrop farms (Ibid). Agro-ecological systems are discussed further in the following section.

There was also a move to consider equality, empowerment and social justice in agriculture for development. Beginning with Farming Systems Research in the 1970s and gaining pace throughout the 1980s and '90s, there were increasing calls for farmers to participate in agriculture research and development initiatives (e.g. Chambers, 1983). This brought an emphasis on the social elements and needs of agriculture and rhetoric turned to a concept of combined social-ecological systems, discussed in Section 2.1.4. Within the formal agricultural research system, 'farmer participation' became buzzwords and were incorporated into localised initiatives for larger-scale research programmes (Ashby, 2009). There have continually been challenges and discord between incorporating formal scientific research outputs with local-level indigenous knowledge and heterogeneous contexts (McKeon, 2015). Formal and informal institutions and the challenges of incorporating the two are discussed more fully in Section 2.5.

In many areas a disconnection between agronomic research outputs and smallholder farming systems continues, a divide which farmer participation in agricultural research and development attempted to resolve (see Section 2.6; Sumberg et al, 2003; Sumberg et al, 2013). Since the 1950s, ongoing discussion regarding

smallholder farmers has debated what agriculture can contribute to socio-economic development (Christiaensen and Demery, 2007), discussed further in Section 2.3.

As Brooks and Loevinsohn, (2011) suggested, broadly, agricultural systems can be considered to consist of any individual, organisation or institution that is engaged with agriculture or food production activities. This commonly includes farmers, extension officers, food production agents, those involved with marketing and trade, and researchers and academics (e.g. Ericksen, 2008). Agricultural systems are also understood to encompass the range of activities these actors engage in, as well as the infrastructure, inputs, processes, and research involved (Hall, 2007).

These conceptualisations of agricultural systems are associated with other systems concepts which can be applied to agricultural systems but are not exclusively so. Figure 2.1 indicates the ways in which different concepts of systems are related and how these may be linked to sustainable agricultural livelihoods. This framework of concepts from relevant literature will be expanded in Section 2.3 and will provide a basis for the theoretical framework proposed in Section 2.7.

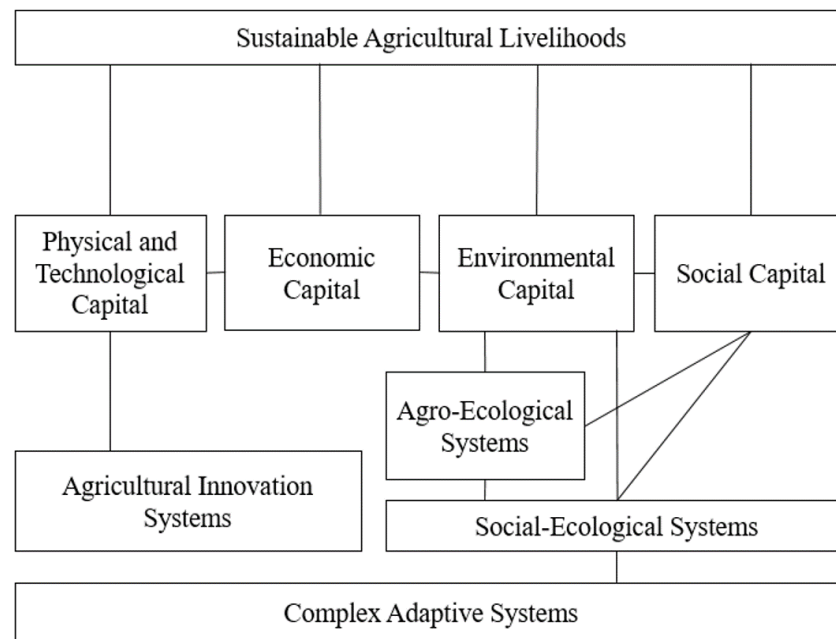


Figure 2.1 Framework indicating the relationships between relevant conceptualisations of agricultural systems and capitals which may contribute to sustainable agricultural livelihoods

This section has given a brief overview of some of the conceptualisations of agricultural systems which have evolved over the past 70 years. The following sections

expand on the concepts of agricultural innovation systems and agro-ecological systems. Subsequent sections introduce associated concepts which may be applied to agricultural systems and systems thinking within agricultural development planning.

### 2.1.2 Agricultural Innovation Systems

The World Bank (2012a) has extended the agricultural systems concept to agricultural innovation systems. Innovation within agriculture was key to increased crop yields during the Green Revolution in the 1960s and 1970s (Glaeser, 2011). The Green Revolution has been criticised for many reasons, including for over-looking smallholder farms and marginal environments, such as drylands (e.g. Mortimore et al, 2009; Oasa, 2011). Innovation within agricultural systems has been suggested as essential for increasing production for smallholder farmers and ensuring sustainable agriculture in marginal environments. Uphoff (2002) has, for example, proposed that innovation and experimentation will help farmers and agricultural systems not only maintain crop output when facing the challenges of environmental degradation and climate change, but to increase production for poverty reduction and increased demand.

Brooks and Loevinsohn (2011) suggested that an agricultural innovation systems approach considers the whole system and combined features of formal and informal institutions, as well as those system functions that are beyond the innovation activity. In this study, formal institutions are understood as organisations, businesses, institutes, industries, or other establishments which have a specified mandate and function. Informal institutions are understood as shared norms and values, practices, and ways of living among an identified group of individuals. The World Bank have adopted the approach of incorporating formal and informal institutions within agricultural innovation systems:

“The innovation systems concept ... extends beyond the creation of knowledge to encompass the factors affecting demand for and use of new and existing knowledge in novel and useful ways. Thus, innovation is viewed in a social and economic sense and not purely as discovery and invention.” (The World Bank, 2007, p7)

Furthermore, Hall and Clark (2010) suggested that agricultural innovation systems acknowledge the role of organisational innovation and the function that civil society, farmers and informal institutions play within innovation. A World Bank publication, *Enhancing Agricultural Innovation* (2007), suggests that a farmer’s innovation capacity

is increased through enhanced adaptability and the tendency of social organisations to adapt.

A central feature of the agricultural innovation systems concept is the recognition of innovation at levels beyond formal research institutions and the presence of interactions between formal and informal institutions and between public and private organisations (Hall et al, 2003). Despite this recognition, a dominance of formal agricultural innovation being transferred, or disseminated, to farmers persists in many agricultural development and research systems:

“There is a tendency towards the uni-directional flow of improved information rather than an engagement of localised knowledge in a process of co-construction or facilitating participatory research.” (Whitfield, 2016, p149)

### 2.1.3 Agro-Ecological Systems

The concept of agro-ecological systems centres on an understanding of the ecological processes involved in agricultural systems. This has been interpreted in a number of ways, with some focusing on how human activities disrupt ecological processes for agricultural production (e.g. Vandermeer, 1995), some aiming to utilise natural ecological processes to enhance crop production (e.g. Pretty, 2002a), and others considering how ecological and social elements of agricultural systems are inter-related and have co-evolved (e.g. Altieri, 2002a). Méndez et al (2016) suggested that interactions between social, economic, environmental and political components are complex and understanding these interactions has been considered to provide a potential route towards realising long-term goals of sustainable agro-ecosystems. Gliessman (2005) suggested that innovations in agricultural practices and technologies are only effective if they contribute to long-term sustainability by functioning in equilibrium with the agro-ecological system.

Conway (1987) suggested that agro-ecological systems have a recognised goal of crop production which is directed by human activities through interaction with ecological and biophysical components of the system. An agro-ecological systems perspective considers the complexity of interactions between ecological, biological, chemical, physical, economic and cultural components of an agricultural system (Gliessman, 2005).

“Agroecosystems are communities of plants and animals interacting with their physical and chemical environments that have been modified by people to produce food, fibre, fuel and other products for human consumption and processing.” (Altieri, 2002a, p41)

Méndez et al (2016) proposed that agro-ecological systems consider the role of the biophysical and ecological systems surrounding agricultural activities. This acknowledges the role of soil microbiology, ecosystem services and biological diversity as features of ecological systems which can be utilised to support agricultural production (Altieri, 2002a). Gliessman (2005) proposes that there are four principal processes which are altered within ecosystems when they are disrupted by humans for agriculture. The flow of energy, nutrient cycling, the regulation of populations, and the dynamics of equilibrium all take different forms once agricultural processes become the recognised function of an ecosystem (ibid). Altieri (2002a) suggested that by understanding the biophysical and ecological processes that are interacting with human agricultural activities, there is greater scope for optimising agricultural production sustainably. González de Molina (2016) took Altieri's suggestion further by proposing that the inclusion of political ecology within agro-ecology debates and practice could support the social, ecological, and economic sustainability of agro-ecological production.

Social justice and political contestation of mainstream industrialised agriculture have become central components of the concept of agro-ecology (e.g. McKeon, 2015) and, as Jones and Eshleman (2016) suggested, these socio-political aspects of agro-ecology have become incorporated into the 'food sovereignty' movement. Guzman and Woodgate (2016) explained the history of agro-ecology discourses, identifying agrarian social thought as comprising the foundations from which agro-ecology as a concept and practice emerged. They go further by suggesting that this social thought is constructed by the ecology of the social context, and that environmental sociology may provide a suitable concept through which to analyse agro-ecology (Ibid). Although comprising a different body of literature, environmental sociology has some commonalities with the concept of social-ecological systems, such as co-evolution and interdependence. Likewise, agro-ecological systems discourses have similarities with those of a social-ecological systems approach (e.g. Carpenter et al, 2001), although social-ecological systems are not applied solely to agricultural systems.

Agro-ecology presents an approach to agricultural production which sits in opposition to industrialised agriculture. This is relevant in the context of this research because the contested framings of agricultural production are prevalent in Ghana, as examined in Sections 3.2 and 3.3. Furthermore, the social justice connotations of agro-

ecology and opposition of industrialised agriculture is found within one of the case studies used for this research, introduced in Section 3.5.3. Agro-ecology provides an alternate discourse and practice to that of science and technology-led agricultural innovation systems introduced in the previous section.

#### 2.1.4 Social-Ecological Systems

Anthropogenic, social systems are intrinsically linked to natural environmental, ecological systems. Adams (2009) suggested that development will only be sustainable if social and environmental development are considered together. Combined social-ecological systems function at multiple scales temporally and spatially (Folke et al, 2005). Such systems are often recognised as co-evolutionary systems, meaning the combined social and ecological elements of the system have evolved together to function effectively while integrated with the other elements of the system (Rammel et al, 2007). Social-ecological systems are conceptually considered as complex adaptive systems (see Section 2.1.5), as is the case with agro-ecological systems.

Complexity is intrinsic to adaptive social-ecological systems because multiple causal relationships at different scales can result in dynamic, nonlinear and diverse responses to change (Norberg and Cumming, 2008a). A change may be required in only one influencing factor for all other factors or relationships to need to respond through adaptation or resistance to ensure the system continues to function effectively (Rammel et al, 2007). The nonlinearity of interactions in complex systems can result in potentially self-reinforcing and self-organising processes within the system (Norberg and Cumming, 2008b).

Among others, Norberg and Cumming (2008a) and Levin (1998) have considered social-ecological systems as complex and adaptive because they contain elements of diversity and asymmetry, and they have the capacity for the formation of networks and for information processing.

#### 2.1.5 Complex Adaptive Systems

A system can be considered as individual components which function collectively through interactions and have a self-regulating feedback. Many systems can be conceptually considered to be complex adaptive systems (Simon, 1962).

“CASs [complex adaptive systems] are made up of interacting components (the system) whose interactions may be complex (in the sense of nonlinear) and

whose components are diverse and/or have a capacity for learning that generates reactive or proactive adaptive behavior [sic].” (Norberg and Cumming, 2008a, p2)

The multitude of possible interactions at different rates and scales can result in unpredictable outcomes. The functions or properties of a complex adaptive system cannot be determined from the study of individual components as outcomes are derived from collective interactions (Low et al, 2003). Through these interactions, complex adaptive systems are non-linear in nature, by which the whole system is greater than the sum of its constituent parts (Holland, 2014). Non-linearity can make a system unpredictable and the cause of outcomes may only be identified in hindsight (Burns and Worsley, 2016). Through understanding the nature and scope of relationships in a complex adaptive system, it may become possible for individuals, institutions, or societies to influence emergent behaviours.

Other characteristics of complex adaptive systems include dynamic diversity, the capacity for emergent behaviours, feedbacks, and nested hierarchies termed a panarchy. Holling et al (2002) described a panarchy as a non-authoritative hierarchy of systems which function or interact at different spatial or temporal scales and are nested together.

Complex adaptive systems can be seen in a variety of systems at a range of scales, for example, from the biosphere to microbial ecosystems (Levin, 1998), from global economic systems to an organisation (Holling and Gunderson, 2002), or from food systems to a smallholder farm (Ericksen, 2008). Agro-ecological systems and food systems have been perceived as complex (Gleissman, 2005; Ericksen et al, 2010). The global food system can be conceptualised as multiple complex adaptive systems at different temporal and spatial scales, which interact within a nested panarchy of systems. The local system of farming, processing and consumption at a community level can itself be conceived as a complex adaptive system. At this scale the food system must frequently interact with diverse human and non-human features while adapting to multiple influences as they change over time.

Hall and Clark (2010) have characterised cropping systems as complex adaptive systems, identifying the farmer as the central feature of the system to which all other features are linked. They reported a case study of an evolutionary farming system from northern Uganda where agricultural practices had evolved and adapted according to

environmental conditions over 150 years. In one district a pest had blighted cassava production during the previous 10 years. In response to this, farming and livelihood activities in this district had evolved to take a different form to other areas and sweet potato became a staple crop (ibid).

The communities studied by Hall and Clark (2010) had to adapt their farming activities to survive food shortages and earn an income. The farmers had to respond to the complexities of climatic and environmental conditions as well as to their social, cultural and economic needs, and adapt to the sudden occurrence of the pest. This example not only indicated the intrinsic complexity of agriculture but also the necessity of adaptability for poor rural farmers to survive in variable and unreliable environments.

Complex adaptive systems thinking informs the theoretical and analytical frameworks in this research. Complex adaptive systems are useful in this context because they recognise scope for a multitude of possible influences and outcomes, allowing for a diversity of potential outcomes. In addition, drawing heavily on a social-ecological systems framing, complex adaptive systems thinking is appropriate for considering the biophysical and social, economic and political features of an agricultural livelihood system. In providing a framework for this study, complex adaptive systems thinking sits alongside a Pathways to Sustainability approach which will be outlined in Section 2.3.2.

#### 2.1.6 Systems in Agricultural Development Planning

The conceptualisation of agriculture within agro-ecosystems and social-ecological systems thinking can be beneficial for policy and planning for agricultural development interventions (Conway, 1987). Systems theory suggests that system components sit within a hierarchy of interactions. Simon (1962), for example, suggested that the functioning of a system cannot be understood through analysis of single components or levels within the hierarchy. The nested scales of a hierarchical system have been conceptualised as panarchy which proposes that the scales, or levels of a system only function as they do because of their position within, and interactions with, other levels of the system (Holling et al, 2002).

Conway (1987) considered this understanding of system hierarchies as beneficial for agricultural policy and planning because it highlights the importance of viewing the whole agricultural system together. He suggested that rather than individual components of agricultural systems having their own policies and development plans,



policy and planning should acknowledge the interactions between the components and hierarchical levels within the whole system (ibid). Conway (1987) proposed that conceptualising agricultural systems as agro-ecosystems presents a holistic way to perceive large, complex agricultural systems to aid in planning development interventions.

Altieri (2002b) highlighted the need for a thorough understanding of environmental and socio-economic conditions in areas targeted by agricultural development initiatives. He suggested that application of natural resource management using an agro-ecology approach must consider local agricultural practices while attempting to alleviate poverty. Allen (1993) suggested that an integrated environmental and socio-economic approach is necessary to maintain or increase agricultural yields and prevent land degradation in marginal environments.

#### 2.1.7 Climate-Smart Agricultural Systems

Concerns about the potential threats caused by climate change has driven a move to develop agricultural systems which are ‘climate-smart’. Climate-smart agriculture refers to agricultural production which is resilient to climate change while also helping to mitigate future climatic change (FAO, 2013a). Discourse surrounding climate-smart agriculture has increased since 2010 when the Food and Agriculture Organization of the United Nations (FAO) presented a definition of the concept during the Hague Conference on Agriculture, Food Security and Climate Change. The FAO definition of climate-smart agriculture continues to be the most widely used and identifies three aspects to the concept:

“1. sustainably increasing agricultural productivity and incomes; 2. adapting and building resilience to climate change; 3. reducing and/or removing greenhouse gases emissions, where possible.” (FAO, 2013a, page ix)

This understanding of climate-smart agriculture considers economic, social, and environmental aspects of agriculture within changing conditions. The concept has also been adopted by international bodies including the United Nations (FAO, 2013a), CGIAR (CCAFS and FAO, 2014), and The World Bank (The World Bank, 2016).

Climate-smart agriculture has been adopted as an agricultural systems approach because climate change influences food production at a large-scale. Scherr et al (2012) proposed that agricultural systems could be reframed within climate-smart landscapes in order to incorporate the many dynamic social, economic, biophysical and environmental

features of sustainable agriculture in the face of climate change. The FAO guide to climate-smart agriculture also frames the concept at a landscape-scale because climate change could have impacts on land, vegetation, water, and weather (FAO, 2013a). The FAO suggested that climate-smart agriculture is a new approach, rather than a reframing of an old approach, because it considers multiple features of food and agricultural systems (ibid). The FAO publication provides discussion about water, soil, and energy management in the context of climate-smart agriculture, as well as detailing a range of agricultural practices and interventions considered as ‘climate-smart’ (FAO, 2013a).

Although the FAO (2013) and others (e.g. ICIPE, 2011; Bogdanski, 2012) have suggested that climate-smart agriculture provides a rounded approach to sustainable agriculture in the face of threats from climate change, the concept has also been criticised. Wheeler and von Braun (2013) argued that ensuring that agriculture is resilient to climate change is important but does not ensure a sustainable food system. They suggested that the entire food system needs to be adjusted to enable global food security in the face of climate change, with adaptation and mitigation ensuring a climate-smart food system.

Neufeldt et al (2013) have also presented a critique of climate-smart agriculture, arguing that the concept allows any form of developed agriculture. A climate-smart agriculture approach allows for large-scale, input-intensive, monocrops of genetically modified crops, to smallholder, agroecological, diverse organic crops. Both of these farming practices have features which could be considered to support climate resilience, mitigation of climate change, and sustainable food systems. In recognising that the broad approach of climate-smart agriculture may be a positive feature for adopting it in diverse contexts, Neufeldt et al (2013) suggested this results in a lack of clarity. They suggested that a social-ecological systems (see Section 2.1.4) approach to innovative agriculture within a safe operating space is a more effective framing of sustainable global food security in a changing world.

The discourse on climate-smart agriculture in policy, practice, and theory has increased in recent years and has been used as an approach for development interventions. The Africa Climate Change Resilience Alliance (ACCRA) was implemented by non-governmental organisations including Oxfam GB, World Vision and CARE International, and funded by the UK Department for International Development and the Climate & Development Knowledge Network (CDKN, 2012). ACCRA was implemented in Uganda, Mozambique, and Ethiopia from 2009 to 2013

and sought to understand how development interventions can increase the resilience of rural livelihoods to climate change. A feature of the ACCRA initiative was the development of a Local Adaptive Capacity Framework to assess adaptive capacity among development interventions in the three case study countries (ACCRA, 2012). Thus, the ACCRA initiative associated climate-smart agriculture with adaptive capacity in response to threats from climate change. The ACCRA framework for local adaptive capacity will be discussed further in Section 2.2.1.

Although this study is not primarily considering development initiatives which state their focus is on climate-smart agriculture, the discourse around this concept is relevant here because it is the source of some discourse on adaptation and adaptive capacity in the context of agriculture. The following section examines the concept of adaptive capacity in more detail and Section 2.2.1 considers this in the context of climate change discourse.

## 2.2 Adaptive Capacity

This section outlines the concept of adaptive capacity and its relationship with related terms such as adaptation, adaptability, and adaptiveness. A range of literature reviewing the concept of adaptive capacity will be discussed, highlighting the diversity of understandings of adaptive capacity and lack of clarity surrounding the term. This will inform the theoretical framework, research questions and hypotheses in this research, outlined in Section 2.7 and 2.8.

Ensor (2011) suggests that adaptive capacity can help systems to respond to change and sustain function despite shocks and stresses. Adaptation is the result of a process of change in response to change; adaptive capacity facilitates those processes (Ensor, 2011). If an individual, community or system does not have the capacity to adapt it will stagnate within changing surroundings, conditions or circumstances. Wells (2013) proposed that change is a dynamic, complex process and a lack of ability to adapt in response to change may result in reduced sustainability and restricted opportunities for survival. Norberg et al (2008) suggested that an individual, community or system may have the capacity to adapt to some types or scale of change but not to others, thus adaptive capacity itself is complex and dynamic. Adaptation is a response variously to short-term episodic shocks or long-term enduring stresses, because adaptive

capacity allows for a change in structure or function to the current conditions (whether short or long-term) or anticipated conditions.

Adaptability is the capacity of a system to employ adaptation strategies. This understanding requires a definition of adaptation. Brooks (2003) defined adaptation as “adjustments in a system’s behavior [sic] and characteristics that enhance its ability to cope with external stress” (p8). Gallopín (2006) suggested that an adaptation is the trait, action, or process within the structure or functioning of the system used to alter the system’s characteristics. Adaptation can be either anticipatory to expected change or reactive to experienced change (Smit and Wandel, 2006). The term adaptiveness is used to describe the state of being adapted (Gallopín, 2006).

There are many definitions of adaptability for different purposes and fields of study, some of which remain contested (Smit and Wandel, 2006). Brooks (2003) argued that adaptive capacity is the ability of a system to continue functioning by altering (or adapting) behaviour or characteristics in response to change. Rammel et al (2007) suggested that adaptive capacity requires the ability to identify and interpret stimuli for change and respond by balancing the feedbacks in the system to mitigate for the perceived change. Adaptive capacity is an aspect of strengthening resilience required for the sustained functioning and existence of the system (Carpenter et al, 2001). In the context of human security, O’Brien and Leichenko (2008) suggested that adaptive capacity is effective when functioning at a local scale. They suggested that interventions intended to support adaptation to climate change must focus on adaptive capacity of those living in poverty or risk increasing the vulnerability of the poor (ibid). Chandler and Reid (2016) framed adaptive capacity in the context neoliberalism and likened it to the capacity to make choices as outlined in Sen’s entitlements approach to development (Sen, 1999).

Adaptive capacity is often assessed in part through vulnerability indicators which may identify interactions, processes and factors which support or hinder the development of adaptive capacity (e.g. Gallopín, 2006). Adger et al (2007) suggested that there are some generic indicators for adaptive capacity including the income, education and health status of an individual or system as a whole. However, societal and environmental heterogeneity results in varied indicators for adaptive capacity and variability of indicators over time leads to dynamic capacity. Some indicators may be specific to certain types of shock, stress or impact (ibid). Components of adaptive capacity may also vary between adaptations intended to limit negative impacts from

change or those designed to optimise from benefits resulting from change. Brooks and Adger (2004) suggested that there cannot be a full, pre-determined list of indicators for, and components of, adaptive capacity prior to entering a field site for assessment.

Much recent discussion of adaptation and adaptive capacity has, by comparison, focused exclusively on the need to adapt to climatic variability and change (e.g. Smit and Wandell, 2006; van Aalst et al, 2008; Pelling, 2011) rather than on the broader conceptualisation of adaptation referred to in older literature. This has in part come out of the United Nations Framework Convention on Climate Change (UNFCCC) which contains a mandate for each developing country to prepare and submit an adaptation needs assessment as part of their communications to the Convention (Mace, 2006; see Section 3.1.2).

Although adaptation to climate change dominates recent discourses, Wells (2013) argued that complex adaptive systems must respond to a large range of types of changes, and at multiple temporal and spatial scales. Social, cultural, political, economic, environmental, and climatic changes, and the interactions between them, can all influence the sustainability of agricultural systems.

For the purposes of this research, adaptive capacity is understood as facilitating processes of change in a system when it adapts in response to change. Adaptive capacity can help systems to respond to change caused by shocks and stresses. Change is a dynamic process with multiple complex interactions and, thus, adaptive capacity is also dynamic in responding to change. The understanding of adaptive capacity and its potential components as adopted in this research are outlined further in the theoretical framework in Section 2.7. The following sections explore the emerging prevalence of adaptive capacity in climate change discourse, agricultural development interventions and features of adaptive capacity identified in practice and theory-based discourse.

### 2.2.1 Climate Change and Adaptive Capacity

As discussed above, much contemporary discourse on adaptation and adaptive capacity concentrates exclusively on climate change. In climate change discourse, adaptive capacity is framed as the ability to adapt to experienced or anticipated changes in the climate (e.g. Williams et al, 2015). Although the understanding of adaptive capacity adopted in this research relates to change more broadly than only climatic, discussion of the discourse surrounding climate change is pertinent here because it is the source of the increasing attention given to adaptive capacity in theory, policy and

practice. This section explores some of the different framings of what may constitute adaptive capacity within climate change discourse.

Lemos et al (2013) argued that vulnerability to climate change is primarily caused by social, economic, and political inequalities. They suggested that adaptive capacity is needed to reduce these inequalities, thereby responding to climate change risks and meeting human development objectives. Lemos et al (2013) and Eakin et al (2014) differentiated between generic and specific adaptive capacity in relation to climate change adaptation. They suggested that generic adaptive capacities are those related to socio-economic development while specific adaptive capacities are those concerned with climate risk management. Eakin et al (2014) suggested that sustainable adaptation can be achieved when a system, community, or individual has both high generic capacity and high specific capacity.

Magee (2013) suggested that community-based adaptation is an effective approach to supporting communities to respond to climate change. He proposed community-based workshops to identify local understandings of climate change and their needs for enhancing adaptive capacity. Magee (2013) suggests that assessment of human, social, natural, physical, and financial capitals could identify existing adaptive capacity and areas in which this capacity is low. These five capitals will be discussed further in Section 2.4.2.

Shackleton et al (2015) suggested that barriers to learning and knowledge could be a cause of low adaptive capacity in developing countries. Baird et al (2014) argued that climate change adaptation can be supported through adaptive co-management of resources. They suggested that adaptive governance and co-management could facilitate learning and enhance adaptive capacity. This may support adaptation strategies which are appropriate in contexts of changing climates due to local-level management of resources. Learning and adaptive governance as potential components of adaptive capacity will be discussed further in Sections 2.2.3 and 2.2.5 respectively.

Glatzel et al (2015) suggested that climate-smart adaptation within agricultural development interventions could support vulnerable farmers. The ACCRA initiative, discussed in Section 2.1.7, considered adaptive capacity in the context of building resilience of farmers through agricultural development interventions. Despite a central focus on adaptive capacity within development interventions, ACCRA documentation does not specify the adopted understanding of how adaptive capacity contributes to resilience or sustainability. The association between the concepts is implied as the

initiative uses the term ‘resilience’ in its title and refers to maintaining livelihoods in the face of change (ACCRA, 2012).

The framework of local adaptive capacity adopted by the ACCRA initiative identified five characteristics of adaptive capacity which were then assessed in the three case study countries (ACCRA, 2012). The five characteristics in the ACCRA framework are: the asset base; institutions and entitlements; knowledge and information; innovation; and flexible forward-thinking decision-making and governance (ibid). Ludi and Levine (2011) suggested that development interventions could do more to enhance adaptive capacity among communities in Ethiopia by supporting continual learning and innovation. These potential components of adaptive capacity will be discussed further in Section 2.2.3. Ludi and Levine (2011) argued that development interventions are able to support farmers and pastoralists to increase their resilience to climate change through enhanced adaptive capacity.

The following section considers the concept of adaptive capacity within agricultural development interventions, building on the relevance of agriculture in development discussed in Sections 1.2 and 2.1.6.

### 2.2.2 Agricultural Development and Adaptive Capacity

There is growing discussion globally regarding building adaptation to climate change into national and international policy, particularly considering agricultural adaptation (IFAD, 2013). Some regions already experience climatic extremes such as flooding and droughts, which are expected to worsen and become more frequent as climate change continues (e.g. Boko et al, 2007). For example, many areas of West Africa have been experiencing increased flooding, droughts and unreliable rainfall during the agricultural season (e.g. Oppenheimer et al, 2014). This has an impact on crop yields, agricultural practices and livelihood security. Codjoe et al (2011) suggested that in central Ghana, some rural communities are adapting to unreliable rainfall and drought by developing water harvesting and irrigation methods. Adaptations such as these will need to be implemented throughout large areas to ensure agricultural production and food and income security as climate change continues. Furthermore, additional and incremental adaptations are likely to be required within agricultural and livelihood systems as climate and environmental change increasingly have a negative impact on communities in these areas (ibid).

Vermeulen et al (2013) proposed that adaptation planning within agricultural systems is most appropriate when it combines knowledge of climate impacts from modelling with localised adaptive capacity. This suggestion poses a challenge to policy-makers and practitioners to integrate adaptation through national and international policy while allowing scope for localised variability resulting from and contributing to local adaptive capacity. While Vermeulen et al (2013) highlighted the role of local adaptive capacity within agricultural systems, in most dryland areas there is not a national policy infrastructure to promote the development of adaptability.

As a result of the lack of policy which supports local adaptive capacity development, the enhancement of adaptive capacity within rural agricultural communities has frequently been taken up by local non-governmental organisations (NGOs) and extension agencies (Gubbels, 2011). Laube et al (2011), for example, argued that adaptive capacity has increasingly been recognised as an essential component of agricultural development initiatives as it has been considered to support livelihood and food security.

Vermeulen et al (2013) suggested that employing adaptive capacity approaches to agricultural adaptation planning is most effective for short-term climatic change and variability. Uphoff (2002) suggested that it is short-term climate variability and shocks, such as droughts and flooding, which most threaten agricultural production through damage to crops. This suggests that adaptive capacity within social institutions could play a central role in adaptation and risk-reduction strategies to climate shocks. The following sections discuss attributes that are considered to support adaptive capacity within a variety of systems.

### 2.2.3 Innovation and Learning

Walker and Salt (2006) proposed that innovation and collective learning can represent adaptation within complex adaptive systems. In addition, innovation and collective learning may also contribute to enhancing adaptive capacity (e.g. Ensor, 2011; Turnbull et al, 2013), and, thus, may be useful indicators of adaptive capacity. The adaptive cycle involves self-organisation and renewal through innovation and novelty, and processes of combined action and knowledge among system components (Holling and Gunderson, 2002). The World Bank (2007) consider innovation as “the application of knowledge (of all types) ... [and] an interactive process through which



knowledge acquisition and learning take place” (p19). On that view, innovation and learning are intrinsically linked.

“Adaptive capacity of an SES [social-ecological system] is related to the existence of mechanisms for the evolution of novelty or learning.” (Carpenter et al, 2001, p765). This suggests that innovation may be needed for, or beneficial to, adaptive capacity. Furthermore, adaptive capacity reflects learning within a system and learning is central to adaptive capacity (ibid).

Innovation and learning within systems may come about through co-operative interactions. Rammel et al (2007) argued that adaptation can occur through co-evolution, whereby the multiple components of a social-ecological system evolve and learn collectively through reciprocal interactions. Carpenter et al (2001) suggested that social networks are necessary to drive innovation through experimentation and collective learning, whilst Leach et al (2012) discussed how innovation needs both social and technological initiatives to provide diverse options.

#### 2.2.4 Diversity

Leach et al (2012) proposed that diversity is an important property for providing pathways to sustainability by allowing for multiple options during periods of change. Within a combined social-ecological system, it is necessary to consider diversity in terms of the system as a whole rather than diversity within a system component. The diversity of traits, or characteristics, within and between systems can be related to system functioning through diverse interactions (Norberg et al, 2008).

Diversity of characteristics within systems can assist sustainability because different components will respond differently to change, with some responses proving more successful than others (Norberg et al, 2008). The allowance for diverse responses to change can give scope for some components to respond in ways which are unsuccessful in maintaining function but for the system as a whole to continue. Thus, diversity creates opportunity for successful adaptation and collective learning allows for those adaptations to be shared throughout the system.

Folke et al (2005) suggested that diversity within and between institutions spreads the risks associated with disturbance, shocks and stresses. The contribution that diverse institutions can provide increases the incidence of innovation and thus enhances adaptive capacity (ibid). However, Folke et al (2005) cautioned that there are also risks

involved in bringing together multiple, diverse institutions, for example, there may be discontent should they represent differences in conceptualisation and cultural interests.

Within the need for diversity within a system there is an assumed level of redundancy, in that a system keeps multiple diverse options available but will not require all of them and some options become redundant. As Low et al (2003) suggested: “When the sources of risk to a system are relatively independent, redundancy is a major structural attribute that reduces the overall risks to the survival of a system” (p104). Norberg et al (2008) proposed that, in resource-poor societies, maintaining more options than appears to be necessary may prove challenging due to the cost of keeping alternatives available. However, when some options are damaged or destroyed during periods of external shocks or stresses, the value of creating multiple options becomes apparent (Low et al, 2003).

#### 2.2.5 Adaptive Governance

Governance incorporates all discourse and processes between stakeholders which create rules, regulations or social norms and instigate collective action or coordination (e.g. Stirling, 2007; Folke et al, 2005). Folke et al (2005) proposed that adaptive governance consists of the social features of a system that allow for adaptability with governance processes, including social networks, interactions, social memory, self-organisation and institutions. Dietz et al (2003) argued that adaptive governance has become an important component of natural resource management due to its ability to respond within complex adaptive systems. Folke (2006) argued that adaptive governance requires four features: an understanding of complex ecosystem dynamics, management practices which allow for continued learning from ecosystem feedbacks, developing adaptive capacity, and incorporating institutions and social networks into governance systems (p262).

Folke et al (2005) suggested that adaptive governance requires social responses to ecological dimensions and conditions within combined social-ecological systems. This response may draw on learning at different scales of the system. Folke et al (2005) proposed that adaptive co-management is central to adaptive governance, with social capital, networks, leadership and trust as the principal features of this. Adaptive co-management incorporates the sharing of power across multiple institutions at nested scales and requires a flexible structure to respond to change (Folke et al, 2005).

Adaptive governance draws on informal institutions to support the management of natural resources required for agricultural productivity. Low et al (2003) suggest that the presence of diverse governance structures is effective due to the ability to respond to heterogeneity within systems. They proposed that redundancy and diversity can be beneficial in circumstances where governance structures allow for conflict resolution, knowledge sharing, and substitution.

## 2.3 Sustainability

Section 1.1.3 introduced the relationship between the concepts of sustainability and adaptive capacity. This outlined why it is necessary to consider adaptive capacity in the context of overarching objectives to increase the sustainability of systems, in this case agricultural livelihood systems. This section explores the concept of sustainability through its relevance to agricultural development interventions, components of sustainability, and sustainability within systems thinking. This introduces the Pathways to Sustainability approach which forms part of the basis for the theoretical framework in Section 2.7.

### 2.3.1 Sustainable Development in Agriculture

Over the past 25 years, the growing discourse regarding sustainability has been diffused into development agendas globally. This accelerated with the publication of Agenda 21 in 1992 which was adopted by 178 countries at the *Rio Earth Summit* (Dresner, 2008). As Adams (2009) suggested, Agenda 21 recognises the need for poverty reduction and improvement of socio-economic indicators globally, while also ensuring that development and livelihoods are sustainable for the current population and future generations. The concepts presented in Agenda 21 were built into policy and practice of international development organisations, research institutes and international financial institutions during the following years (Dresner, 2008). The rhetoric calling for sustainable development has continued and now forms the centre of the universal Sustainable Development Goals (United Nations, 2015). Wells (2013) suggested that complexity and sustainability discourses have been developing alongside one another with frequent overlap.

Frequently, sustainability policy and practice have given emphasis to ensuring that the environmental conditions and natural capital on which rural communities depend are not further degraded, and in some cases efforts have been made to enhance or restore ecosystem services (e.g. Mortimore et al, 2009). Natural resource management, biodiversity conservation, and water resource and forest management have become integrated with some socio-economic development agendas (e.g. Borri-Feyerabend et al, 2007; Pretty, 2005).

Fernandes et al (2002) identified sustainable agricultural development as a focus area for poverty reduction and sustaining or improving existing natural capital. Agriculture has been targeted because in most rural areas of developing countries a large proportion of the population is engaged in agricultural livelihoods. The theory, policy and practice surrounding this focus assumed that increasing crop yields using sustainable practices could reduce poverty through higher incomes, improve health through better nutrition, and prevent or reverse environmental degradation (Pretty et al, 2005). By sustaining the natural capital necessary for crop production, there is greater potential for agricultural productivity to become sustainable into the future.

Agricultural development projects have sought sustainability in different ways depending on the purpose of the intended outcomes. Some agricultural initiatives have aimed to improve the sustainability of crop production during periods of change, often with climate change as a rationale for enhancing sustainability. This form of initiative is intended to most benefit farmers through stable yields, and subsequently, more reliable income and food source (e.g. Burayidi, 1996). Other agricultural initiatives have sought to increase the sustainability of the natural environment, such as soil, water, and vegetation, which had previously been degraded by agricultural practices. The rationale behind the sustainability of environmental features often reaches beyond that of individual farmers to the broader community and frequently is identified as climate change mitigation (e.g. Boyd et al, 2013; Owusu and Ekpe, 2011). The following section discusses some of the components of sustainability which are most commonly identified as objectives within agricultural development and the broader sustainable development discourse.

### 2.3.2 Components of Sustainability

There are two dominant bodies of literature under review here, that of complex adaptive systems originating at the Santa Fe Institute (Holland, 1995), and the Pathways

to Sustainability literature from the STEPS Centre (Scoones et al, 2007). The theory of complex adaptive systems (Section 2.1.5) originated in ecological literature (Holling, 1973) and consequently, within the sustainability discourse it continues to be applied to discussion regarding sustainability of ecosystems and natural resources (e.g. Levin, 1998; Rammel et al, 2007). Concepts of sustainability have been brought into development theory, policy and practice through the recognition of the importance of social equality and justice concerns (see Section 2.3 for further discussion; Conway and Barbier, 1988; Chambers and Conway, 1992; Scoones et al, 2007).

Both bodies of literature identify non-linearity as a dynamic property of complex systems and the STEPS Centre has proposed that this results in multiple possible pathways to sustainability (e.g. Scoones, 2009). Also common to both bodies of literature are the concepts of resilience and adaptability as components of sustainability. The term resilience has in some cases been used synonymously with sustainability (Berkes et al, 2003), and in other cases has been used in discussion of adaptability (Carpenter et al, 2001). Drawing on both bodies of literature, the differences in the definition of these central terms are outlined below.

The STEPS Centre's pivotal publication, *Dynamic Sustainableities*, defined sustainability as:

“a normatively explicit form of the general term, referring to the capability of maintaining over indefinite periods of time specified qualities of human well-being, social equity and environmental integrity.” (Leach et al, 2010, p xiv)

To be sustainable, the system under consideration must maintain the specified function over time and despite shocks or stresses.

Within the context of this research, ‘sustainability’ will be used to refer to the need to maintain livelihoods within agricultural systems in Northern Ghana during periods of climatic, environmental, social, political and/or economic change. This requires reliable annual crop production regardless of the type, rate, length or degree of change to the system. For rural farming communities in Northern Ghana, an agricultural system which is sustainable during shocks and stresses helps to ensure survival through the provision of essential food and income to pay for supplementary food items and basic healthcare.

Walker et al (2004) suggested that resilience and adaptability are both attributes of a system which contribute to establishing the sustainability of function. In his influential paper, Holling uses the following definition:

“Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist. In this definition resilience is the property of the system and persistence or probability of extinction is the result.” (Holling, 1973, p17).

The STEPS Centre considered resilience to be an attribute which maintains the system’s structure or function during short-term shocks, identifying robustness as the attribute which ensures sustainability in response to long-term stresses (e.g. Dawson et al, 2010; Leach et al, 2010).

Walker and Salt (2006) considered re-organisation to be an important feature of resilience as it allows the system to continue functioning despite changes to structure. Folke et al (2003) identify four features, or stages, of resilience: accepting life with change and uncertainty; encouraging diversity to allow reorganisation and regeneration; developing learning through use of different forms of knowledge; and, building opportunities for self-organisation. Folke (2006) sees resilience as not merely withstanding negative impacts of disturbance but combining the capacity systems have to find beneficial opportunities from change.

Scoones (2007) perceived sustainability within a resilience framework as the ability of a system to maintain a stable state and recover to that state following shocks. A notable difference between understandings of resilience and adaptability is the requirement for resilience to maintain the system within its present conditions rather than change through adaptation.

As a component of sustainability, adaptability requires capacity within the system to be adaptive. The term comes from the Latin word adapt, meaning ‘to fit’ (Holland, 1995). Following this, Walker and Salt (2006) suggested that adaptability is the system’s ability to fit its structure and function within the current state or surrounding environment. Holling and Gunderson (2002) argued that in circumstances where the system functions within conditions that are changing, or have changed to a different state, the system must adapt to fit within this altered state and continue functioning effectively. Within agricultural systems, such a change of state may occur on a short-term basis resulting from extreme weather events such as drought or

flooding. In such cases, the state that the agricultural system functions within may change between states on an annual to inter-annual basis. Additionally, Holland (1995) suggested that a change of state may occur over a longer-term, caused by climatic or environmental stresses. In such circumstances, adaptive capacity may need to utilise innovation to learn from incremental adaptations (Ibid; Section 2.2.3).

Following this understanding of sustainability, resilience and adaptability, it may be useful for a system to develop resilience and adaptive capacity in order to sustain function when facing uncertainty, variability and change. To be a sustainable system is to maintain the primary function, whether through resilience to change within one state or adapting to function within a different or variable and unreliable state.

Walker et al (2004) suggested that resilience, adaptability and transformability will determine the pathway of a system. Within this interpretation of the properties of sustainability, transformability acts to change the state of a system, involving different structure and functions, when the present state becomes unable to function (ibid). Thus, it can be argued that transformability may not sustain a system as a whole but may result in the sustainability of individual components of a system in a new state. This adds an additional dimension to the components of sustainability to those described above through transformation beyond the boundaries of the perceived current system.

### 2.3.3 Sustainable Systems

As indicated above, systems may follow multiple possible pathways to sustainability. This is due to dynamic components of systems interacting in different ways and dynamic properties of these components, interactions and system functions (Leach et al, 2010). System structure and function may vary over different temporal and spatial scales, as could the degree and rate of change, and resulting impact from a shock or stress to the system.

Leach et al (2012) identified three aspects for consideration when hoping to understand pathways in relation to sustainability within innovation systems. The direction of change is important to ensure that policy and innovation move towards sustainable options. Secondly, they outlined the need for innovations which are diverse in nature and include social and technological innovation. They suggested that diversity allows for multiple options for responding to disturbance and change in the form of system shocks or stresses (ibid). The third principle they identified is the distribution of

innovation for sustainability. Leach et al (2012) recommended that sustainable initiatives developed through innovation must be accessible to different groups within societies, including those most marginalised.

Leach et al (2012) acknowledged the role of social capital and institutions in innovation for sustainability. They stressed that it is now necessary to connect policy-driven science and technology with local, community-led experiments and initiatives. Social institutions have a role to play in opening-up innovation pathways and bringing obscured directions into wider practice (STEPS Centre, 2010). Such actions taken by social institutions will also broaden the distribution of innovations and sustainable pathways (ibid). Furthermore, the heterogeneity of community-based organisations and local institutions will drive the development of diverse innovations (Norberg et al, 2008). The following section outlines social capital and its role in securing sustainability, followed by a discussion of how social capital contributes to different types and structures of diverse institutions and organisations.

Figure 2.1 indicated the way in which systems concepts associated with agricultural systems are related. Expanding on this, Figure 2.2 highlights the way in which components of sustainability are related to respective agricultural systems concepts. This indicates the Pathways to Sustainability discourse alongside that of complex adaptive systems, and that both bodies of literature are related to adaptive capacity. Figure 2.2 ties together the agricultural systems concepts and components of sustainability discussed above as both contributing towards sustainable agricultural livelihoods. Furthermore, Figure 2.2 indicates the links between social capital, adaptive capacity, and sustainable agricultural livelihoods. The concept of social capital will be discussed in the following section in relation to sustainable agricultural livelihoods.



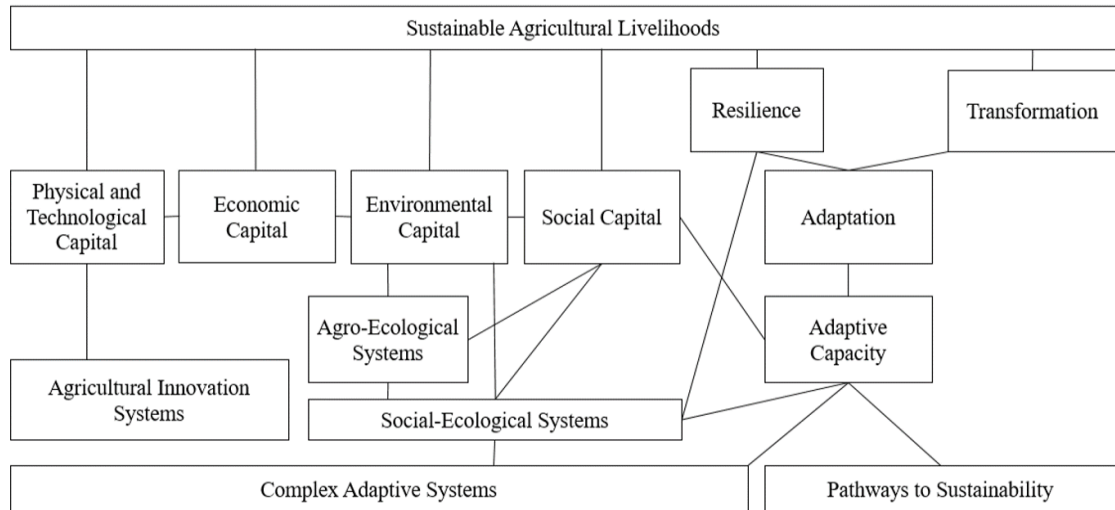


Figure 2.2 Framework indicating the relationships between relevant bodies of literature on agricultural systems and components of sustainability which may contribute to sustainable agricultural livelihoods

## 2.4. Social Capital

Social capital is a term that expresses how individuals interact with and contribute to others and the extent of their networks or relationships with other people, and what they derive from these interactions. Flora and Flora (2005) suggested that social capital can take many forms at a range of scales and hierarchies which may include family relationships, professional associations, friends and community acquaintances, among others. Walker and Salt (2006) took this further, suggesting that social capital combines features of networks, leadership, and trust as well as the ability to respond effectively together. Pretty (2002b) considers social capital to constitute only social interactions which can be beneficial for collective action.

Flora and Flora (2005) propose that to enhance or create social capital it is useful to identify certain traits and strengths about the local context. They suggest that supporting community development initiatives which are not solely focused on economic development can help to build social capital between individuals in the community. In the context of this research, social capital at the community level may play a role supporting agricultural activities and in the effectiveness of farmer participation in development interventions (see section 2.7). Furthermore, participatory development interventions may build social capital by extending social networks

beyond the community level through interactions with external agencies facilitating interventions.

#### 2.4.1 Social Capital and Sustainable Agriculture

There are a number of features of social capital which may be of particular importance in developing sustainable agriculture. Pretty (2002b) identified reciprocity and exchange as a component of social capital, which is formed from an innate predisposition to trust others and wish for collective wellbeing. Knowledge exchange and the potential for collective learning which accompanies this are features of social capital and may enhance adaptive capacity. The sharing of ideas and experiences may stimulate experimentation, innovation and learning as discussed as a feature of adaptive capacity (Section 2.2.3). In the context of agricultural livelihoods, innovation as a result of shared learning and problem solving may increase the uptake of innovations because the risks of doing so are shared collectively. Pretty (2002b) suggested that the development of sustainable agriculture depends on learning processes and shared experience which in turn depends on social capital at least at a local level of network.

A second feature of social capital is the presence of common traditions, norms and rules within a community structure (Pretty, 2002b). This may contribute to collective activities that have a common purpose (Pretty, 2005). Within the context of agricultural communities, common norms could be shared agricultural practices used throughout the community and collective activities may result in the sharing and division of agricultural labour.

These features of social capital may have greater influence on sustainable agricultural activities if a third feature is also active. Lin (1999) suggested that the role of networks and groups is considered to be central to social capital as a means for interactions and strengthening connectedness (Walker and Salt, 2006). Herbel et al (2012) proposed that identified and organised networks or groups, particularly at the community level, may utilise a common purpose to collectively manage natural resources. This may contribute to sustainable agriculture through enhancing environmental conditions as well as increasing components of adaptive capacity and sustainability as discussed above.

Although the concept of social capital had existed in undefined terms for some time (e.g. Portes, 1998), the concept as part of a suite of capitals or assets came to prominence in development theory and practice through the publication of the

Sustainable Livelihoods Approach. The following section discusses social capital in the context of this approach.

#### 2.4.2 Social Capital and Sustainable Livelihoods

The Sustainable Livelihoods Approach is one conceptualisation that received widespread attention in theory, practice and policy throughout the 1990s. The concept originated with Chambers and Conway (1992) which focused on processes, practices and relationships which are utilised by rural communities to secure their livelihoods. The concept was developed further in the Sustainable Livelihoods Framework (Scoones, 1998) which proposed four capitals that contribute to sustainable livelihoods for rural communities in developing countries: human, social, natural, and financial. This was expanded further by the UK Department for International Development which included physical capital (e.g. Scoones, 2009).

Within the Sustainable Livelihoods Framework, social capital is perceived as any social resources which individuals may draw on during the process of securing a livelihood. Social resources can include “networks, social claims, social relations, affiliations, [and] associations” (Scoones, 1998, p8). The social aspects of sustainability (see Section 2.3.1) are apparent in the context of sustainable livelihoods because this refers to the needs that people have to sustain human wellbeing. Social capital is considered to play an important role in rural livelihoods, and thus there is scope for it to also play a role in sustaining such livelihoods (Chambers and Conway, 1992).

Pretty (2005) suggested that the term ‘social capital’ implies that social interaction is necessary for sustainability. The Sustainable Livelihoods Framework suggests that it is one of five capitals which can contribute to sustainability, but in varying degrees. For example, if an individual has low social capital but high human, natural, physical and financial capitals, they may still be able to develop sustainable livelihoods. This suggests that social capital can contribute to sustainability rather than being essential as other capitals may enhance resilience or adaptive capacity. Conversely, it is possible that increasing social capital may not necessarily reduce an individual’s vulnerability to some shocks and stresses if they have low human, natural, physical, and financial capitals. The diversity of components of adaptive capacity discussed in Section 2.2.4 is also reflected in this framing of sustainable livelihoods, whereby multiple potential capitals may support sustainability in different configurations. The diversity of types of social interactions as well as a diversity of

physical and technological capital are discussed as a potential component of adaptive capacity in Section 2.7.5.

The Sustainable Livelihoods Framework provides a theoretical basis for considering sustainability which has also been interpreted into planning for development interventions. The capitals it presents are not easily quantified for practical assessment of sustainability (e.g. Ashley, 2000) although some have taken the concept and applied it to different indicators (e.g. Ellis and Freeman, 2004).

The Sustainable Livelihoods Framework has been criticised for not considering political capital as a feature of rural livelihoods and overlooking the importance of empowerment, security and choice (Scoones, 2009; Ashley, 2000). Scoones (2009) suggested that there has been broad discussion of power, politics and social structures as central to social capital and, thus, are incorporated in the Framework. Scoones (1998) proposed that power relations are identified as embedded within social relationships and institutions and the complexities of power within social capital should be considered in a situated context. However, Newing (2009) argued that the situated consideration of rural livelihoods often overlooks the dynamic nature of community and temporality of community structure (e.g. Portes, 1998). Agrawal and Gibson (1999) discussed political dynamics within the concept of community. They suggested that the consideration of institutions may be a more effective approach than communities because institutions shape and define social interactions. The next section outlines differences in formal and informal institutions and organisations and how social capital features in these.

## 2.5 Institutions and Organisations

Institutions and organisations take various forms globally at a range of scales. Institutions and organisations may be formalised, internationally-recognised agencies of thousands of people with numerable functions, activities and outcomes, such as the United Nations. At the opposite end of the scale, an institution may be a network of family or informal relationships at the community level. A common feature of institutions and organisations is the facilitation of governance, whether this is a recognised attribute of formal institutions or an unintentional feature of informal institutions (e.g. Dietz et al, 2003; Herbel et al, 2012). The following sections outline

the differences in formation, structure and functioning of formal and informal institutions.

### 2.5.1 Formal Institutions

Formal institutions are registered, publicly recognised institutes or organisations which have a legislation and policy, and employ staff to conduct activities within the mandate of the policy (The World Bank, 2012a). Formal institutions can be public or privately owned and include government ministries, universities and academic institutes, private research organisations, commercial businesses, financial institutes, non-governmental organisations (NGOs), trade unions, and other similar organisations or institutions.

Formal agricultural research and development institutes have policy mandates which typically stipulates a focus on agricultural science and technology for the development of seeds, products and technologies. Through research and development, formal agricultural institutes often try to support the intensification or extensification of agricultural production for the purposes of increased crop yields (and thus income), improved crop quality (and subsequently higher sale price), or for maintaining crop production during periods of climatic or environmental shocks or stresses (The World Bank, 2012a; Özgediz, 2012).

Formal agricultural research and development institutes have been recognised for at least six decades. The international system for agricultural research for development is dominated by the Consultative Group on International Agricultural Research (CGIAR) which is formed of 15 research institutes globally (Özgediz, 2012). The CGIAR was formed in 1971 in part to support the coordination of national agricultural research systems (NARS; Alston et al, 2006). NARS typically consist of a national research institute which may be wholly or partly agricultural-based and with links to national universities (Taylor, 1991).

The CGIAR initially considered centre autonomy, consensus-led decision-making, and independent scientific advice to be important features of agricultural research for development (Özgediz, 2012). Donors were also able to select which projects they funded and the sums they donated. The network of CGIAR centres experienced a decline in funding throughout the 1990s. Along with a global shift in research focus towards interdisciplinary research, this resulted in system-wide reform and restructuring of the CGIAR starting in 2008 (ibid). Under the current structure,

there are 15 CGIAR Research Programmes (CRPs) which are facilitated through multi-centre collaboration and encompass all research carried out within the 15 centres.

Özgeditz (2012) stated that there are now four strategic outcomes across the CGIAR system: to reduce rural poverty, increase food security, improve nutrition and health, and support the sustainable management of natural resources.

This form of agricultural research and innovation presupposes the top-down transfer of technology from research institutes (Sumberg et al, 2003). In many developing countries, the research and development outputs from formal agricultural research institutes are disseminated to farmers through extension officers, most commonly working for the government ministry responsible for agriculture (Herbel et al, 2012). National or local NGOs may also provide extension services in conjunction with socio-economic development and welfare initiatives (ibid; Michael, 2004). Increasingly, the private sector is playing a role in agricultural research and development and extension services. This may be in the form of businesses selling agricultural services or providing products which facilitate knowledge sharing and learning (e.g. Crossley et al, 2015).

### 2.5.2 Informal Institutions

Ostrom (1990) defined informal institutions as networks developed by community groups or locally organised individuals which often have a social component to the formation of the network (Osbaahr et al, 2010). Osbaahr et al (2010) found informal institutions in southern Africa to be exclusive and predominantly consist of kin, neighbours and friends with variable composition and structure. Many informal institutions may have developed over generations as community-based social networks which those engaged in the institution may not recognise as having a role to play with formal institutions (Ostrom, 1990).

Informal institutions can take several forms, some more organised than others. Community-based organisations or farmer-based organisations are groups of individuals which have a common purpose for governance of a locally-important issue (Herbel et al, 2012). For example, Ostrom (1990) investigates the structure, or design, of institutions where individuals have organised to collectively govern and manage common pool resources. Other informal institutions may follow structures of traditional community governance and family networks, such as village chiefs, and cultural norms and practices. Additional informal structures within communities may provide forums or

networks for stakeholders or cooperation between public and private actors (Herbel et al, 2012).

Formal institutions are increasingly expecting informal and community-based institutions to engage with them, be they local NGOs or governmental ministry officers, or national and international development initiatives. Furthermore, interventions from external, formal institutions are in many areas facilitating the formation and organisation of informal institutions to assist in the provision of development interventions and dissemination of policy and research outputs. Agricultural innovation systems consider the interactions and networks between formal and informal institutions for agricultural research and development (Brooks and Loevinsohn, 2011).

### 2.5.3 Challenges to Integrating Formal and Informal Innovation

McKeon (2015) suggested that there continues to be a divide in literature regarding the future development of sustainable agricultural systems, increasing crop yields to ensure food security, and stimulating socio-economic development. Practical interventions including biotechnology and information and communication technology continue to be developed primarily by scientists working in Western academic institutions, although with some exceptions (e.g. Juma, 2011). Such interventions are recommended by scientists to policy makers for governments, international agencies such as the United Nations, and NGOs. McKeon (2015) argued that this continues to take a top-down perspective to developing sustainable and increased agricultural yields. On the other hand, development academics, such as Leach et al (2012), often suggest approaches to agricultural interventions and innovation focus on the need to integrate farmer-based innovation as a core element of ensuring a sustainable system within context-specific circumstances.

There are increasingly partnerships for research and development projects between academic and scientific institutions of the Global North and South, for example Monsanto collaborating with the African Agricultural Technology Foundation in 2008 (Gilbert, 2010), and between academic and private sector research and development within developing countries (Juma, 2011). However, there continues to be a divide between top-down science and policy interventions and bottom-up innovations and adaptations. Brooks and Loevinsohn (2011) have argued that:

“How to create constructive alliances between the informal systems and formal systems operating at different scales has over the years been a major challenge

to researchers in areas like varietal breeding and selection and natural resource management” (Brooks and Loevinsohn, 2011, p187).

A key point here is the difference in scale at which formal and informal agricultural innovation systems function. Formal research and development is increasingly in the private sector and thus is focused on profit-making technologies (Alston and Pardey, 2006). To reach the largest market, formal innovation systems develop technologies for a homogenous landscape and society, whereas informal, grassroots innovation is context-specific and often autochthonous, thus highly heterogeneous. Leach et al (2012) suggested the use of dialogues between multiple actors including farmers, scientists and policymakers, to identify priorities at national and local levels. This approach may cross the divide between formal and informal agricultural innovation systems but it is still unknown whether an adapted combination of innovations is effective and sustainable in any given context.

The challenges of integrating formal research and development innovations with farmer-based informal innovation are particularly prevalent in dryland agricultural systems because of multiple dynamics and vulnerabilities of the natural resource base. Dryland environments are highly variable spatially and temporally because seasonal and unreliable rainfall influences vegetation growth and subsequently the livelihood practices of rural communities (e.g. Mortimore et al, 2009). Furthermore, rural communities are often remote and there may be minimal road infrastructure linking distant communities. This adds additional challenges and complexities to implementation of interventions in dryland contexts as well as governance over social, economic, and natural resources. Consequently, as Nyantakyi-Frimpong (2013) argued, heterogeneity exists within and between communities so broad-spectrum research outputs and development interventions may not be appropriate for all communities or individuals. Furthermore, where interventions are appropriate in one season they may not be in another season or year because of fluctuations in environmental characteristics and livelihood practices (Ibid).

## 2.6 Farmer Participation

In recent decades there has been a widespread shift in the nature of agricultural research and development in the developing world, with a new focus on farmer



participation and grassroots innovation (Sumberg et al, 2013). Escobar (2001) and Addo et al (1985) have suggested that as globalisation spread, within development literature there was a call to recognise that regions are not homogenous: decentralisation of government and governance was proposed as a response to globalisation. Jupp et al (2010) have suggested that greater civil participation in community activities would provide opportunities for empowerment for marginalised rural poor. This relates participation to the social justice and equality aspects of sustainability discussed in Sections 2.3 and 2.4.

Much recent literature regarding sustainable agriculture in developing countries, and particularly in dryland areas, acknowledges a need to integrate farmer participation and bottom-up innovation and adaptation with top-down scientific, technological, and policy interventions (e.g. Bakker, 2011; Mortimore et al, 2009; Altieri, 2002b). Bakker (2011) suggested that a top-down command structure of change is not suitable for supporting a sustainable agricultural system in rural areas of developing countries.

The Commission on Sustainable Agriculture and Climate Change recommended that sustainable and adaptive agricultural systems require collective action, governance that accommodates participation, and empowerment of vulnerable populations (CGIAR, 2011). In acknowledging the need to involve farmers in marginal areas, the Commission suggests that knowledge and technology can be transferred from the Global North to the Global South, or through South-to-South and farmer-to-farmer relationships (CGIAR, 2011, p10). This overlooked the possibility that the Global North could gain insight, learning and development from South-to-North relationships and knowledge transfer. Despite a long history of adaptive agriculture in many regions of the Global South, the Commission presented a view that the South can learn from the North but not the other way around.

While top-down education and training for rural farmers may increase capacity for innovation, there is evidence that farmer-to-farmer learning through farmer demonstrations and observation are effective in engaging farmers with new ideas and practices (e.g. Reij and Waters-Bayer, 2001a). Mortimore et al (2009) have argued that in rural drylands of developing countries, “research has shown that success can be attributed to social mechanisms embedded within communities for the transfer of knowledge and responses to environmental cues” (p27). De Vente et al (2016) suggested that knowledge exchange among farmers engaging in a participatory process can provide opportunities to evaluate practices used by others, which may in turn lead to

experimentation and innovation for some farmers. Akpo et al (2015) concurred with this suggestion, and argued that the co-production of knowledge during participatory processes resulted in beneficial outcomes for the participating farmers. Further, Bakker (2011) suggested that subsistence farmers are integral in the learning process for developing adaptive and sustainable agricultural systems.

The expansion of farmer participation within agricultural research systems was initially advocated based on the assumption that “a greater degree of farmer involvement would make agricultural research in the developing world more effective” (Okali et al, 1994, p1). The move towards integrated participatory approaches to agricultural systems began in the mid-1970s with the inclusion of farmers within farming systems research. This emphasis progressed throughout the 1980s, with influence coming from the methodological development of participatory rural appraisal (PRA). Robert Chambers’ *Rural Development: Putting the Last First* led the call to include farmers and the rural poor in agricultural systems and policy decisions (Chambers, 1983).

“It took organised agricultural research decades to realise that what appeared primitive and unprogressive was complex and sophisticated. Small farmers are, after all, professionals.” (Chambers, 1983, p87)

Chambers suggested that rural people’s knowledge is complementary to that of professional outsiders. While calling for ‘outsiders’ to consider what the rural poor want first, Chambers cautioned that even within participatory research and a bottom-up approach, this focus is still formed from an outsider wanting to change the circumstances for those perceived as worse-off than themselves (Chambers, 1983, p141).

### 2.6.1 Typologies of Participation

This research is investigating whether different understandings of adaptive capacity exist within two participatory agricultural development interventions. In order to then assess whether participatory features influence project outcomes, it is useful to have an understanding of the dominant types of farmer participation and how literature interprets the relationship between farmers and external agencies in development interventions identified as participatory. This section considers the differences and similarities between different typologies of participation.

At a crude level, typologies of participation identify two forms of participation: ‘top-down’ and ‘bottom-up’. Top-down and bottom-up participation form the two opposing ends of the typical linear typologies of participation but most of the types, or levels, of participation discussed above would be considered as top-down participation and only those nearest the grassroots and autochthonous end of the continuum would be identified as bottom-up.

Other terms have also been used to describe top-down and bottom-up participation. ‘Grassroots participation’ or action is commonly used to describe initiatives that originate at the community level (e.g. IIED, 2011). ‘Farmer-led’ has also been used as an alternative for bottom-up development initiatives, with formal-led providing the opposing term for top-down development (Sperling et al, 2001). Notably, however, the terms organic and induced have been used to describe bottom-up and top-down participation respectively.

The terms ‘organic’ and ‘induced participation’ are used by The World Bank in its broad-ranging analysis of participatory development (Mansuri and Rao, 2013). Mansuri and Rao (2013) provide the following definitions:

“Organic participation is organized by civic groups outside government, sometimes in opposition to it; induced participation attempts to promote civic action through bureaucratically managed development interventions.” (p ix)

The central concept in this understanding of participation is the role of civic action and how it may come about. Mansuri and Rao (2013) proposed that a top-down form of initiative is intended to induce participation within civil society. Their definition of organic, bottom-up participatory development being that of civic groups organising action suggests that the role of social capital in forming civic groups is a necessary feature of organic participation.

This understanding of participatory development emphasises the role of politics in socio-economic development. The role of politics and power is often an underlying influence in development initiatives but in many local-scale initiatives, politics and power are not the drivers of participation (e.g. Michael, 2004). Furthermore, in many agricultural development projects and initiatives which employ bottom-up or organic participation, the initiative originates with a desire to increase crop productivity or create livelihood security rather than a political motive (ibid).

Mansuri and Rao (2013) applied the terms ‘organic’ and ‘induced participation’ to a broad range of development initiatives, not only agricultural. Their analysis of participatory development focused entirely on initiatives which have employed induced participation because, as they argued, 80 percent of The World Bank funding for participatory development was spent on induced participation (Mansuri and Rao, 2013). The influence of politics, and any power dynamics this may create within development initiatives, is a common feature of induced participation (Michael, 2004), and thus a definition of participation that has politics at the centre may be more helpful for analysis.

Most typologies of farmer participation within agricultural research and development consider participation on a linear continuum between activities conducted by formal research institutes and those undertaken independently by farmers (e.g. Okali et al, 1994; Sperling et al, 2001; Neef and Neubert, 2010). This perception of a spectrum of participation originated with Arnstein’s (1969) ‘ladder of participation’ which identifies eight types of citizen participation comprising three degrees of citizen power, three degrees of tokenism, and two levels of non-participation. Other typologies have focused specifically on farmer participation and have identified four, five or seven types or levels of participation, for example, Okali et al, 1994, Neef and Neubert, 2010, and Sperling et al, 2001. The names given to the types of participation in Table 2.1 give an indication of the forms or reasons for participation in each category (Chatty and Colchester, 2002). Although this typology is not focused solely on farmer participation and agricultural development, the definitions provided for each type of participation incorporate features of a number of other typologies. The comparative terms used in other typologies of participation are given in the right-hand column. This indicates that not all typologies provide comparative types, there is some crossover between typologies, and categories and definitions of participation are complicated.

Table 2.1. A typology of participation with seven categories or types. Adapted from Chatty and Colchester, 2002, p11, Table 1.1.

Sources: <sup>1</sup>-Terms used by Mansuri and Rao, 2013. <sup>2</sup>-Terms used by Ashby, 1996, cited in Neef and Neubert, 2010, p181. <sup>3</sup>-Terms used by Sperling et al, 2001.

<b>Typology</b>	<b>Components of each type</b>	<b>Comparative terms given in other typologies</b>
Passive participation	People participate by being told what is going to happen or what has already happened. It is a unilateral announcement by project management; people's responses are not taken into account.	Induced <sup>1</sup> Nominal <sup>2</sup> Formal-led <sup>3</sup>
Participation in information giving	People participate by answering questions posed by extractive researchers. People do not have the opportunity to influence proceedings.	Induced <sup>1</sup> Consultative <sup>2</sup> Formal-led <sup>3</sup>
Participation by consultation	People participate by being consulted, and external agents listen to views. Professionals are under no obligation to take on board people's views.	Induced <sup>1</sup> Consultative <sup>2</sup> Formal-led <sup>3</sup>
Participation for material incentives	People participate by providing resources, for example labour, in return for food, cash or other material incentives. It is very common to see this called participation, yet people have no stake in prolonging activities when incentives end.	Induced <sup>1</sup> Formal-led <sup>3</sup>
Functional participation	People participate by forming groups to meet predetermined objectives. Such involvement tends to be after major decisions have been made. These institutions tend to be dependent on external initiators and facilitators.	Induced <sup>1</sup> Action-oriented <sup>2</sup> Formal-led <sup>3</sup>
Interactive participation	People participate in joint analysis, which leads to action plans. It intends to involve interdisciplinary methodologies that seeks multiple perspectives. These groups take control over local decisions, and so people have a stake in maintaining structures or practices.	Decision-making <sup>2</sup>

<b>Typology</b>	<b>Components of each type</b>	<b>Comparative terms given in other typologies</b>
Self-mobilization	People participate by taking initiatives independent of external institutions to change systems.	Organic <sup>1</sup> Collegial <sup>2</sup> Farmer-led <sup>3</sup>

Farmer participation in development initiatives has at least three variables. Firstly, the type of participation, for example, whether the farmers are decision-makers or are engaged as labour. Secondly, the point(s) at which participation occurs from project initiation to planning, implementation and evaluation. Thirdly, farmer participation can be a feature of initiatives at varying amounts, for example, cases where a community spokesperson engages with a group of external facilitators, or cases where a representative facilitator engages with a community group. None of the typologies of participation tabulated above incorporate the differences in how people participate, at what point and to what extent. This has consequences for the potential for representativeness, accountability, and legitimacy of participatory intervention and activities which draw on these typologies to inform practice or related research.

Participation in agricultural development initiatives is diverse and dynamic and the diversity of types of participation increases when also considering participation within agricultural research projects and other socio-economic development initiatives. Additionally, participation can be found in a wide range of geographical, cultural and political settings. A description or definition of types of participation cannot account for the variability within and between different participatory development initiatives (Neef and Neubert, 2010). Although typologies of participation may be useful for theoretical discussion, policy-making and practical implementation, a typology cannot fully capture the diversity of types of participation because of intrinsic heterogeneity of social contexts.

The type, degree, and phase of the project when participation is active varies between projects. Additionally, the participation of different stakeholders may vary within a development intervention. Furthermore, an individual's understanding of how and why they are participating in a project and their interpretation of what participation means may differ within and between development interventions. The interpretations and understandings of types of participation varies and is context specific. Therefore, a

typology of participation cannot include the nuances of different understandings but must group similar interpretations together.

## 2.7 Theoretical Framework

The discussion in Section 1.1 and 2.2 highlight the diverse understandings of adaptive capacity used within theoretical and practice discourses. Within development interventions seeking to enhance adaptive capacity, it is important for all engaged stakeholders to have a common understanding of what this means in the context of the intervention in order to ensure that they are all working towards the same objective. The existing diversity of understandings is often unrecognised which causes a lack of clarity and may result in ineffective or inefficient interventions. This research aims to investigate diverse understanding of adaptive capacity and provide a framework for identifying different understandings within single interventions. In addition, this research seeks to identify a series of indicators of enhanced adaptive capacity, drawing on empirical case studies, and the potential implications of this on sustainable agricultural livelihoods. This section outlines the theoretical framework which draws on the literature examined in the preceding sections and informs the research questions and hypotheses for this study.

This framework outlines the theoretical concepts and discourse which informs and supports the analysis undertaken in this research. In introducing the theoretical framework, the background assumptions and ongoing discourse surrounding understandings of adaptive capacity are outlined in the context of different framings of sustainable agricultural livelihoods and development goals associated with them. The framework brings together two existing frameworks from theoretical discourses in order to place adaptive capacity as a central feature within a concept of sustainability that seeks to enhance the livelihoods of smallholder farmers by bringing together economic, environmental and social concerns. In this context the framework highlights some key components that are conceived as contributing to adaptive capacity which are specifically under investigation in this research. It then identifies key indicators for enhanced adaptive capacity linked to social capital which will be incorporated into the analytical framework outlined in Section 4.6.

In doing this, the framework outlined here provides a basis for a series of research questions and hypotheses (see Section 2.8) to be tested through empirical data analysis. By responding to this theoretical framework, the research questions aim to fill a gap in existing literature in theory, policy, and practice sectors. This research will contribute to the existing discourse regarding adaptive capacity by unpacking the diverse understandings of this term and identifying useful indicators of adaptive capacity. The following discussion outlines why this is necessary in the context of agricultural development interventions and where this research is located within contemporary discourse.

### 2.7.1 Contextual Assumptions Underlying this Research

The underlying assumption which provides a background to this research is that there is a common concern to enhance food and income security for poor communities in developing countries. This refers to a relatively simple definition of food and income security, being that security exists when there is access to sufficient food and income to enable a healthy and active life. As food and income security are not the focus of this research, rather the underlying assumption, a more nuanced definition is not required but discussion of this can be found elsewhere (e.g. Ericksen, 2008). In the context of this research, this assumed concern to achieve food and income security relates to poor communities in Northern Ghana.

Rural communities in Northern Ghana are predominantly farming communities because agriculture provides the primary livelihood source for up to 80 percent of the population (Ghana Statistical Service, 2012). Therefore, food and income security in poor rural communities in Northern Ghana relies upon the security of agricultural production for the provision of both food, through predominantly subsistence farming, and income, through the sale of surplus crops. Consequently, the overarching concern of this research is with the sustainability of agricultural livelihoods in farming communities of Northern Ghana.

It is important to acknowledge that in the context of rural communities in Northern Ghana, agricultural livelihoods exist among a suite of livelihood options which include non-agricultural livelihoods. The engagement with different livelihood sources may vary between individuals, households, and communities and may differ temporally, both seasonally and inter-annually. Thus, agriculture interacts with other



social and livelihood activities as part of a complex and dynamic agricultural livelihood system.

In order to enhance the sustainability of agricultural production and associated livelihoods, agricultural development interventions frequently assume that increased sustainability is an effective means to increase human development indicators and maintain or improve environmental conditions (see Section 2.3.1). Within a complex agricultural livelihood system, sustainability needs to encompass social, economic and environmental considerations. Section 2.4.2 introduced the Sustainable Livelihoods Approach which recognises social capital as one of five capitals that can support the sustainability of livelihoods. Chapman (2016) suggests “[m]ost of the barriers to improving the adaptive capacity of institutions are related to social processes operating both within and outside of these human systems” (Chapman, 2016, p4). In the context of this research, adaptive capacity is an attribute of social processes, in that the capacity is possessed by humans either individually or collectively. Equally, social capital is here considered to contribute to enhanced adaptive capacity. Adaptive capacity in this understanding is considered to contribute to the sustainability of social, economic and environmental features of an agricultural system.

### 2.7.2 Agricultural Development Interventions and Adaptive Capacity

Agricultural development interventions are increasingly attempting to incorporate the building of local adaptive capacity and/or resilience into project activities. For example, Turnbull et al (2013) examined the incorporation of resilience building in development interventions as a means to reduce risk of disasters. As discussed in Section 2.3.2, resilience is often considered to be a component of sustainability in a range of theoretical, policy, and practice-based discourses. However, the focus of this research is on adaptive capacity, how agricultural development interventions understand and try to enhance adaptive capacity, and how this contributes to the overall sustainability of agricultural livelihood systems. Thus, it is necessary to have an understanding of how adaptive capacity is understood within and beyond agricultural development interventions and how multiple understandings interact and influence one another.

While it is often acknowledged that there are multiple understandings of what the terms ‘sustainability’ and ‘resilience’ mean (e.g. Scoones, 2007; Folke, 2006), to date a consideration of multiple understandings of ‘adaptive capacity’ is lacking. This

research seeks to address this by examining the multiple and diverse understandings of adaptive capacity within two case study agricultural development interventions. This analysis will contribute to existing knowledge which informs the rationale behind the inclusion of goals to enhance adaptive capacity within agricultural development interventions and associated policy.

Different understandings and uses of multiple terms are prolific in policies and practices, both written documentation and oral discussions. Within policy and practice, multiple interpretations and uses of terms can create conflicting understandings of, and judgements about, the goals, objectives, purposes for specific activities, successes and failures, and outcomes of interventions intended to enhance adaptive capacity. Furthermore, differing conceptions of what constitutes adaptive capacity are likely to influence the processes, methods and practices chosen to try to enhance adaptive capacity. The use of multiple terms and understandings of adaptive capacity can be seen in relevant discourses during recent decades and earlier.

Adaptive capacity has been discussed in the context of agricultural systems for several decades. Adams (1981) stated that farmers "...had organised on their own, and had shown themselves capable of adapting to new crops and new techniques" (Adams, 1981, p341, cited in Richards, 1985, p153). Folke et al (2005) have conceived adaptive capacity as playing a role in the local-level management and governance of agricultural systems. This recognition of adaptive capacity in the context of development practice has influenced policy development at an international scale which will be examined in Section 3.1. Further, discussion of adaptive capacity and associated concepts within policy and practice has influenced academic and theoretical study.

Brooks (2003) highlighted multiple terms within vulnerability and adaptation literature: "The relationships between these terms are often unclear, and the same term may have different meanings when used in different contexts and by different authors" (p2). The concept of adaptive management and governance is also present in the *Farmer First* discourse regarding farmer participation (see Section 2.6; e.g. Chambers et al, 1989; Scoones and Thompson, 2009). This is closely linked with informing development practice, thus creating an iterative process between practice, policy and theoretical discourse.

While more recent discussions of adaptive capacity relate the concept to resilience and a framework of sustainability, the concept has frequently been narrowed to focus only on climate change rather than change more broadly within agricultural systems. For the purposes of this research, however, a broader understanding of adaptive capacity is adopted, which incorporates a wider range of existing and potential types of changes, rather than solely climate change. Additionally, this broader understanding considers that adaptive capacity may not only be a response to reducing risks from hazards but also enable communities to optimise benefits from changes, and increase their sustainability (social, economic and environmental), and/or ensure livelihoods. While it is assumed that systems, institutions, and any living organisms may have the capacity to adapt, for the purpose of this research, the discussion of adaptive capacity is focused on the capacity of individuals and communities situated within agricultural systems to adapt to diverse types of shocks, stresses and opportunities.

A conceptually narrow understanding of adaptive capacity, or conversely, a conceptually broad understanding applied to a local context, could result in adaptive capacity which supports ineffective or unhelpful adaptations. Further, maladaptation could result in a negative impact for individuals or communities and present a hindrance to the sustainability or survival. Reid et al (2013) suggested that interventions seeking to implement adaptation strategies which do not consider the local context which the intervention targets, maladaptation could occur due to conflicting interests between introduced and existing adaptations. As this study is seeking to investigate diverse understandings of adaptive capacity and indicators of enhanced adaptive capacity, it is important to note that these may be context specific and could result in maladaptation in other contexts.

### 2.7.3 Sustainable Agricultural Livelihoods

Conceptualising sustainability as requiring social, economic and environmental sustainability in both time and space is particularly appropriate in the context of agricultural livelihoods framed within social-ecological systems. Agricultural livelihoods epitomise the concept of social-ecological systems, being a direct interaction between social, human needs and ecological processes (see Section 2.1.4). The social requirements of a livelihood also need economic activity in terms of income, expenditure, exchange and market interactions. An agricultural livelihood must interact

with each of the three domains and thus if one of the three is unsustainable the sustainability of the other two domains becomes vulnerable.

A three-domain construction of sustainability is also appropriate for an analysis applying a sustainable livelihoods approach (Section 2.4.2). The five capitals described in the Sustainable Livelihoods Framework (Scoones, 1998) can be identified within the three domains of sustainability discussed here: social and human capital fall into social sustainability; financial capital falls into economic sustainability; natural capital is evident in environmental sustainability; and features of physical capital can be identified in all three.

Within a social, economic, and environmental framing of sustainability, Leach et al (2010) characterised the types of action (control or response) necessary to maintain sustainability in the face of different speeds of change (shock or stress) within a system. In a complex system it may not be possible to control processes of change due to multiple variable dynamics. Thus a complex system must respond to change in order to maintain or achieve sustainability. Adaptive capacity will support response actions at a range of temporal and spatial scales within a complex system. The following section outlines the role of adaptive capacity at the intersection of complex adaptive systems and pathways to sustainability discourses.

#### 2.7.4 Complex Adaptive Systems and Pathways to Sustainability

Conceptually, smallholder agricultural systems can be considered to be complex adaptive systems (Section 2.1.5). This is in part due to the importance of agricultural livelihoods interacting with other informal livelihood sources which largely depend on natural resources and economic market fluctuations. Agricultural livelihoods must interact with a large number of dynamic social, economic, political, ecological and environmental factors, making sustainable crop production a complex and dynamic process. Furthermore, the concept of complex adaptive systems stems from social-ecological systems literature (Levin, 1998).

The complex adaptive systems discourse acknowledges the importance of dynamic non-linearity in developing sustainability within a system. However, in relevant theoretical literature, the contribution of adaptability within complex systems is often implied rather than explicitly stated. Multiple dynamic, non-linear pathways to sustainability are also a dominant theme in the *Pathways to Sustainability* discourse originating from the STEPS Centre. This discourse identifies the role of resilience,

robustness, durability, and stability in achieving dynamic sustainability. The role that adaptive capacity can play in contributing to these characteristics of dynamic sustainability is not explicitly discussed in the framework proposed by Leach et al (2010), although a recognition of the role of adaptive governance is discussed in relation to managing sustainability.

Although the two bodies of literature make use of different frameworks, there are common themes which run through both. The complex adaptive systems concept considers maintaining sustainability to be a continual process of change through adaptive response to experienced or anticipated change. The dynamic feature of pathways to sustainability also suggests a continual process, an interactive flow or movement which results in multiple possible pathways to achieving sustainability. For the purposes of this research, some elements of each of these two theoretical discourses will be combined to form the framework.

In bringing these two concepts together, this research considers adaptive processes within complex systems to support the sustainability of system functions through providing multiple pathways. This will bring the concept of adaptive capacity to the discussion of pathways to sustainability, while linking the role of adaptive capacity to outcomes of sustainability within the complex adaptive systems discourse. Through examination of the association between adaptive capacity and sustainable agricultural livelihoods in policy discourse and agricultural development interventions, this research intends to contribute to policy, practice, and theoretical understandings of adaptive capacity.

#### 2.7.5 Components of Adaptive Capacity

As discussed in Section 2.2, there are multiple possible components of adaptive capacity and the attributes of adaptive capacity may vary temporally and spatially. In the context of this research, adaptation refers to: ‘human responses to experienced or anticipated change’; it is therefore conceptualised as a human, social process. Social capital is necessary for several of the components of adaptive capacity discussed in Section 2.2. For example, social networks, collaborative governance and collective learning all require interactions between people. Social capital is therefore a feature of social-ecological systems and informal institutions, as discussed in Sections 2.1.4 and 2.5.2 respectively.

Figures 2.1 and 2.2 (Sections 2.1.1 and 2.3.3) indicated the links between different bodies of literature and conceptualisations of agricultural systems. Figure 2.2 highlighted adaptive capacity as being directly linked to social capital and contributing towards sustainable agricultural livelihoods. Following this, the framework of adaptive capacity proposed here considers social capital to contribute to enhancing adaptive capacity, as indicated in Figure 2.3. In this framework, attributes of social capital can contribute to adaptive capacity, including collaborative governance, collective learning, social networks, anticipation, and diversity. This framework also considers experimentation and innovation to contribute to diversity and adaptive capacity.

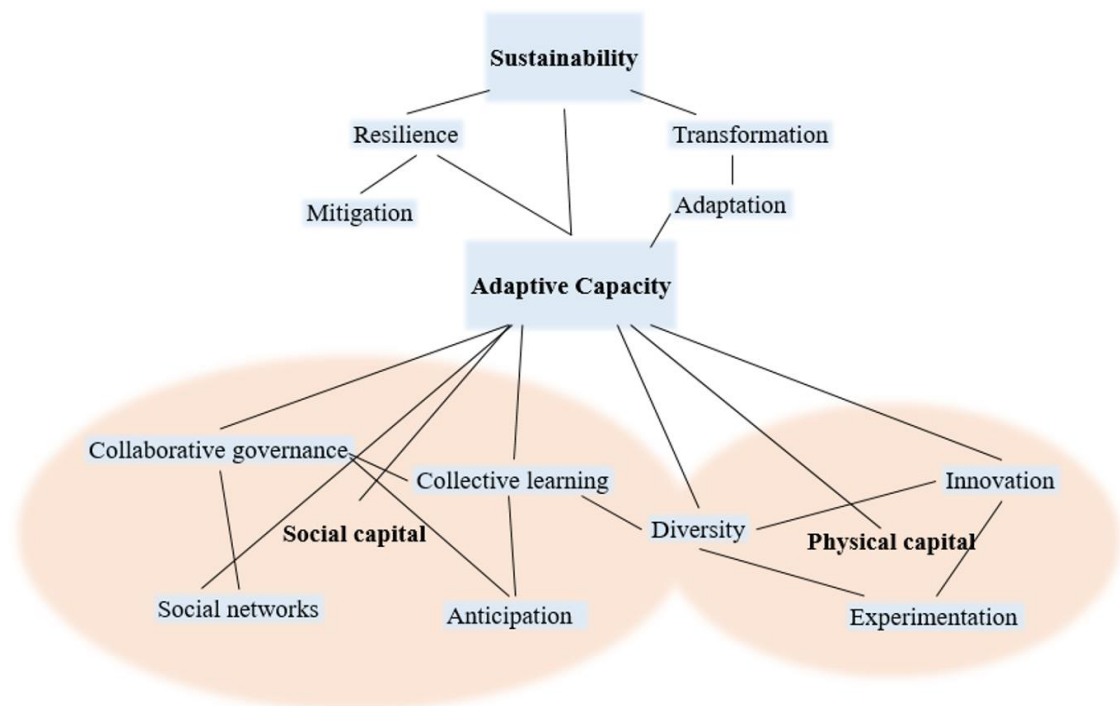


Figure 2.3 Diagrammatic representation of the proposed theoretical framework indicating the ways the identified characteristics of adaptive capacity ultimately contribute to system sustainability.

Although this research is concerned with adaptive capacity and how this contributes to sustainability, the framework presented in Figure 2.3 acknowledges that in some cases mitigation can contribute to resilience and sustainability. While often discussed alongside adaptation, mitigation will not be examined further here. However, it is necessary to note that factors beyond those of adaptive capacity and adaptation may

enhance and/or limit the resilience and sustainability of a system, in this case an agricultural livelihood.

As a component of the sustainable livelihoods approach, social capital is considered to be one of five attributes that can contribute toward ensuring a sustainable livelihood in rural areas (see Section 2.4.2). It is worth noting that an individual may not be able to utilise available social capital without at least some degree of human capital, particularly in terms of physical and psychological health.

The framework being tested in this research views social capital as incorporating the social processes that function as attributes of adaptive capacity. In the context of rural agricultural livelihood systems it is possible that social capital may stimulate processes such as reflexive governance and collective learning, as well as innovative processes, behaviours and outcomes. As a component of adaptive capacity, innovation may allow for sustainable functioning and outputs of a system within changing or new conditions. Within agricultural livelihood systems, innovations result from processes or behaviours enacted by humans, and thus social capital may support or stimulate innovation, and may even be indispensable.

Social capital may increase the diversity of social processes, behaviours, interactions, or networks. Additionally, through increased networks, social capital may enhance the diversity of available options. Within this research, diversity is also assumed to be a component of adaptive capacity in several ways, particularly through providing multiple options and spreading potential risks. This is especially important in relation to diversification of agricultural livelihoods. Thus, diversity may not only refer to social processes and behaviours but can include tangible activities or products, which may constitute physical and technological capital.

Figure 2.4 reframes the framework of adaptive capacity proposed in Figure 2.3 by placing these attributes in relation to sustainable agricultural livelihoods. This framework of adaptive capacity within sustainable agricultural livelihoods acknowledges the different role of diversity within the often referred to diversification of livelihoods and the potential for diverse forms of interactions and relationships within a social network to contribute to social capital. The revised framework presented in Figure 2.4 also recognises that, in some cases, adaptation can result in a transformation of rural livelihoods away from agriculture and towards other constructions of livelihood systems.

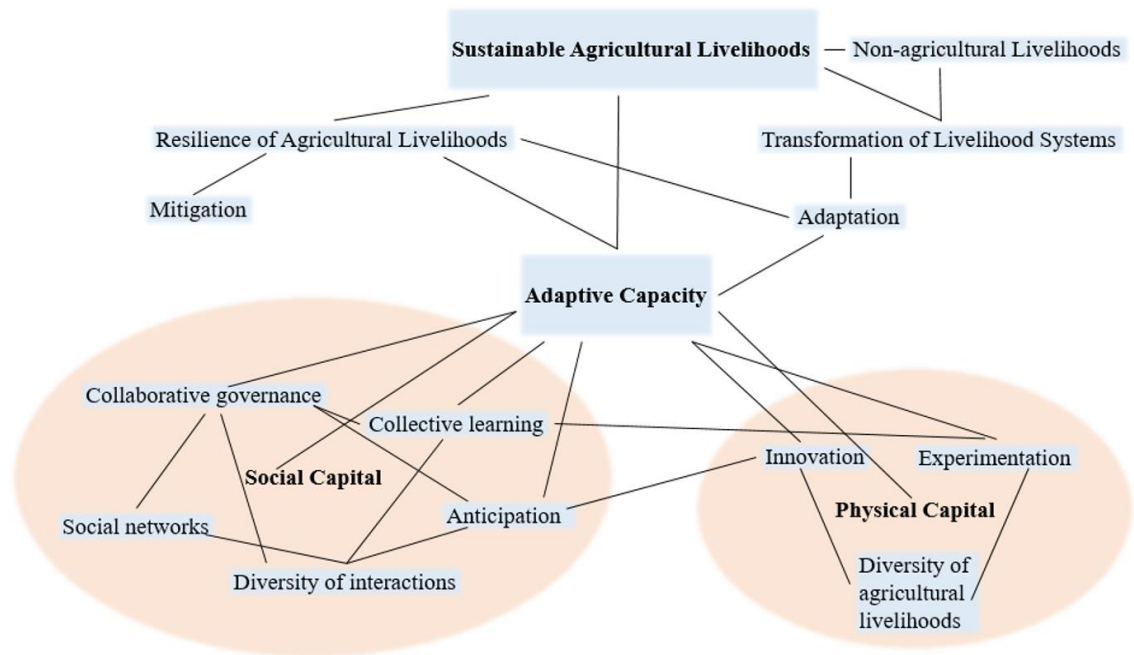


Figure 2.4 Framework of adaptive capacity within the context of sustainable agricultural livelihoods

While diversity is a potential component of adaptive capacity, there is also a diversity of influences on interpretations of adaptive capacity as well as diverse understandings of the term. Thus, in relation to adaptive capacity it is important to consider diversity in multiple ways, to include diverse social processes, diversity within physical and natural capital, and a diversity of influences and interpretations both of the term adaptive capacity and, in the context of this research, of the influence that understandings of adaptive capacity have on outcomes of agricultural development interventions. The features of diversity with both social and physical capital reflects the role of diversity of capitals in supporting sustainability discussed in Section 2.4.2.

This research will examine two agricultural development interventions in Northern Ghana as case studies to investigate whether the components of adaptive capacity outlined here are incorporated into diverse understandings of adaptive capacity. Section 4.6 will outline an analytical framework which presents these components of adaptive capacity as proposed indicators of adaptive capacity. Through the framing of adaptive capacity postulated here, an analysis of these indicators will examine how particular sustainability objectives and understandings of adaptive capacity within agricultural development interventions actually enhance adaptive capacity in practice.



This will further contribute to a detailed theoretical understanding of connections between social capital, enhanced adaptive capacity, and sustainability, as discussed in the preceding sections. The following section introduces the research questions and hypotheses posed in this study. Chapter 3 will then examine the policy context of agriculture and adaptive capacity in Northern Ghana and provide a background to the two case studies.

## 2.8 Research Questions

The discussion throughout Section 2.7 identifies a lack of clarity surrounding understandings of the term ‘adaptive capacity’ and how this capacity relates to enhancing the sustainability of agricultural livelihoods for smallholders. In the context of the increasing adoption of ‘enhanced adaptive capacity’ as an objective of agricultural development interventions, it is pertinent to investigate how different understandings of adaptive capacity form, and how outcomes of enhanced adaptive capacity occur in practice. In order to do this, the components of social capital and physical features of adaptive capacity discussed in Section 2.7.5 will be used to examine the concept of adaptive capacity within two agricultural development interventions in Northern Ghana.

Following this, the primary research question at the centre of this investigation is: **What influences the understandings, indicators, and implications of enhanced adaptive capacity within agricultural development interventions?**

There are three dominant strands to this research question: the understandings of adaptive capacity within agricultural development interventions, indicators of enhanced adaptive capacity within agricultural development interventions, and its implications for sustainable agricultural livelihoods. In order to fully respond to these strands it is necessary to examine understandings of adaptive capacity in relation to the objectives of the associated agricultural development interventions and their respective aims to enhance the sustainability of agricultural livelihoods. Additionally, to investigate the outcomes of adaptive capacity within the identified case studies in this research, it is necessary to examine potential indicators for adaptive capacity and evidence of these in the relevant farming communities. The potential components of adaptive capacity

discussed in Section 2.7.5 will form the basis of indicators for analysis of outcomes of enhanced adaptive capacity and will be discussed in the analytical framework in Section 4.6.

The three strands of the primary research question will be investigated through a series of five sub-questions. These sub-questions focus on the strands of the understandings and indicators of enhanced adaptive capacity, and the lessons for agricultural development interventions which intend to support sustainable agricultural livelihoods.

1. What are the understandings of adaptive capacity that are identified within agricultural development interventions in Northern Ghana and how have they formed?
2. What indicators of adaptive capacity exist within agricultural development interventions in Northern Ghana?
3. How do participatory project activities of agricultural development interventions contribute to outcomes of enhanced adaptive capacity in Northern Ghana?
4. What implications does enhanced adaptive capacity have for sustainable agricultural livelihoods?
5. What lessons are there for informing policy and planning of ongoing and future agricultural development interventions which seek to enhance adaptive capacity?

### 2.8.1 Hypotheses

Section 2.7 introduced the assumptions which form the background of this research. The research questions outlined do not explicitly acknowledge these assumptions as they form the context in which this research is located rather than the core focus of the investigation. However, the research questions do create a series of hypotheses which incorporate the contextual assumptions and assumptions in the research questions.

1. There are multiple understandings of ‘adaptive capacity’ being applied within and among different agricultural development interventions.
2. The influences on how ‘adaptive capacity’ is understood within agricultural development interventions are multiple, vary between interventions, and are variable in time and space.

3. The way adaptive capacity is understood within an agricultural development intervention influences the nature of formal intervention activities and the potential for impact on associated sustainable agricultural livelihoods.
4. If agricultural development interventions focus on enhancing features of social capital there are opportunities for outcomes to adaptive capacity to support the sustainability of agricultural livelihoods.

### Chapter 3 – Agricultural Policy Discourse in Ghana and Background to Case Studies

Policy is central to many governance processes and institutional functioning at a range of scales. Some policies may ensure welfare of stakeholders, while other forms of policy might ensure accountability or enforce rights and participation. Pinstrup-Andersen and Watson II (2011) identified governance at a range of scales in the food system, from international globalisation, to national governments, organisations and institutions, to communities and households. Pinstrup-Andersen and Watson II (2011) suggested that the construction of policy is subjected to diverse influences at a range of scales, involving power and institutional dynamics. They suggested that “policies that emerge from this system rarely resemble the idealized versions considered in more policy analysis. This can lead to significant departures from expected policy results” (Pinstrup-Anderson and Watson II, 2011, page 27).

This chapter reviews the relevant policy discourses and the context of agricultural development in Ghana. First, relevant international policy and discourse documents are introduced to frame the development of associated Ghanaian policy and the understandings of terminology pertinent to this research. Relevant policies were identified as those which have shaped the agricultural or adaptation policies of Ghana. This included historical policies which have influenced the development of recent and contemporary policies. A number of international policies were identified because they mandate the Government of Ghana to produce policy or documentation to meet purposes on international agreements. These international policies are introduced in Section 3.1 and Ghanaian policy documents are discussed in Section 3.2. National-level policy documents which are examined in this chapter include those which inform the principle activities of the Ministry of Food and Agriculture and national objectives to support adaptation. Table 3.1 provides details of the relevant policy and discourse documents at both international and national level.

The final section of this chapter introduces the two case studies under investigation in this research. Both case studies are agricultural development interventions in Northern Ghana. Thus, it is necessary to consider this in the context of governmental policies which support agriculture and/or adaptation in Ghana. Current Ghanaian discourse on agricultural development and adaptation are discussed alongside

the historical development of agricultural research and intervention and associated government policies. This frames the context in which both case studies seek to enhance adaptive capacity within agricultural development interventions.

The policies examined in this chapter are analysed using a discourse analysis approach which sought to identify links between documents and occasions when one policy mandated the production of another (see Section 4.5 for discussion of discourse analysis). The policy documents analysed here are treated as secondary data. The discussion of policy discourse in this chapter sets the background for examination of empirical data in Chapters 5, 6 and 7. International and national level policy which refer to adaptation and adaptive capacity provide some of the diverse understandings of adaptive capacity being investigated through research question 1. Outlining this policy discourse frames the context in which empirical data were collected, discussed in Chapter 4, and examination of empirical data in subsequent chapters.

Table 3.1 Relevant formal institutions and associated policy and discourse documents

<b>Level</b>	<b>Institution</b>	<b>Policy or Discourse Document</b>	<b>Year Policy was First Implemented</b>	<b>Relevant to Agriculture or Adaptation Discourse?</b>
International	United Nations Framework Convention on Climate Change (UNFCCC) and Conference of the Parties	United Nations Framework Convention on Climate Change and Kyoto Protocol	1992 – ratified by Ghana in 1995	Adaptation
International	African Union (AU)	Comprehensive African Agricultural Development Programme	2003	Agriculture / Adaptation

<b>Level</b>	<b>Institution</b>	<b>Policy or Discourse Document</b>	<b>Year Policy was First Implemented</b>	<b>Relevant to Agriculture or Adaptation Discourse?</b>
International	Economic Community Of West African States (ECOWAS)	Economic Community Of West African States Agricultural Policy (ECOWAP)	2005	Agriculture
National	Ministry of Food and Agriculture (MOFA)	Food and Agriculture Sector Development Policy II (FASDEP II)	2007	Agriculture
National	Ministry of Food and Agriculture (MOFA)	Medium-Term Agricultural Sector Investment Plan (METASIP)	2009	Agriculture
National	National Development Planning Commission	Medium-term National Development Policy Framework: Ghana Shared Growth and Development Agenda 2010-2013	2010	Agriculture / Adaptation

<b>Level</b>	<b>Institution</b>	<b>Policy or Discourse Document</b>	<b>Year Policy was First Implemented</b>	<b>Relevant to Agriculture or Adaptation Discourse?</b>
National	Ministry of Environment, Science, Technology and Innovation (MEST)	National Science, Technology and Innovation Policy	2010	Adaptation / Agriculture
National	Ministry of Environment, Science, Technology and Innovation (MEST) and Environmental Protection Agency (EPA)	National Technological Needs Assessment	2012	Adaptation / Agriculture
National	Ministry of Environment, Science, Technology and Innovation (MEST)	Ghana Goes for Green Growth	2010	Adaptation
National	Environmental Protection Agency (EPA) and United Nations Development Programme (UNDP)	National Climate Change Adaptation Strategy	2010	Adaptation

<b>Level</b>	<b>Institution</b>	<b>Policy or Discourse Document</b>	<b>Year Policy was First Implemented</b>	<b>Relevant to Agriculture or Adaptation Discourse?</b>
National	Ministry of Environment, Science, Technology and Innovation (MEST)	National Climate Change Policy	2013	Adaptation
National	United States Agency for International Development (USAID)	Ghana Climate Change Vulnerability and Adaptation Assessment	2011	Adaptation

### 3.1 International Agricultural and Adaptation Policy

#### 3.1.1 Global Agricultural Discourse

The dominant body for international agricultural research and development is the Consultative Group on International Agricultural Research (CGIAR; see Section 2.5.1 for further discussion of the CGIAR). The focus of CGIAR Research Programs (CRPs) drive much of the global rhetoric surrounding the needs of agricultural research and the subsequent practice of agricultural research for development. Through collaborative research outputs, the CGIAR and associated research centres aim to achieve reduced poverty, increase food security, improve nutrition and health, and sustainable natural resource management (CGIAR, undated a). The understandings of adaptive capacity used within the CRPs and CGIAR research centres are particularly pertinent to this research because both case studies are partly or wholly associated with one of the research centres. Thus, it is reasonable to expect that the understandings of adaptive capacity used within these research centres may influence the understandings adopted within the case study projects.



Although sustainable natural resource management is one of the overarching aims of the CGIAR system, a consistent understanding of sustainability is not evident throughout the 16 CRPs. Instead, a number of the CRPs explain the need for developing agricultural sustainability within the domain of the CRP under discussion. For example, the CRP on Forests, Trees and Agroforestry includes a research theme specifically focused on the role of trees and forests in Climate Change Adaptation and Mitigation (CRP on Forests, Trees and Agroforestry, 2014). In the description of the rationale for this research theme within the Forests, Trees and Agroforestry CRP, the online documentation states:

“In addition to their contribution to climate change mitigation, forests, trees and their genetic diversity are also relevant to adaptation, i.e., the reduction of the impacts of climate change on ecosystems and societies.” (CRP on Forests, Trees and Agroforestry, 2014, online: <http://foreststreesagroforestry.org/forests-trees-agroforestry-research-portfolio/theme-4-climate-change-adaptation-and-mitigation/2-4-1-introduction/>)

This definition of adaptation is unclear and although the text goes on to discuss adaptive capacity of developing countries, it does not suggest how adaptive capacity may support adaptation to reduce the impacts of climate change on ecosystems and societies. Online documentation from other CRPs, for example the CRP on Water, Land and Ecosystems research program titled ‘Resilience’, refer to adaptation only in relation to resilience but do not provide a definition of either term (CRP on Water, Land and Ecosystems, undated).

CGIAR has widespread and wide ranging research activities in Ghana which include projects coordinated by CGIAR Centres and projects which are jointly run by CGIAR Centres and the Council for Scientific and Industrial Research in Ghana (CGIAR, undated b). The Ghanaian national agricultural research system (NARS; see Section 3.3.2 for details of the Ghanaian NARS) has been engaging with CGIAR research, due to the need acknowledged by the Government of Ghana for focused agricultural research nationally. This has involved research for cash crops, food crops in southern areas with higher productivity potential, and food crops in semi-arid northern areas (Taylor, 1991; Stads and Gogo, 2004). There are numerous ongoing and past research projects conducted through the CGIAR Centres which involve research in Ghana (CGIAR, undated b). These include research programmes that are large-scale international and inter-continental, and programmes which are regional or national in scope.

Other international formal institutions which are engaged with discourse surrounding adaptation and sustainability in agricultural development include The World Bank and UN bodies such as the Food and Agriculture Organization (FAO). As with CGIAR research, these institutions do not clarify their working understandings of adaptive capacity but, rather, they use the terms adaptive capacity, adaptation, and sustainability within the details of specific projects or programmes they are facilitating (e.g. FAO, 2014). Furthermore, the understandings or definitions of adaptive capacity used within these institutions are not explicitly stated. This means the understandings are assumed to be understood by the reader and are implied through the context within a sentence or paragraph.

One UN body which discusses adaptation and adaptive capacity in greater detail is the United Nations Framework Convention on Climate Change, discussed in the following section.

### 3.1.2 Global Adaptation Policy

As discussed in Section 2.7, in recent years discourses surrounding adaptation and adaptive capacity have referred to these concepts only in relation to climate change. The global policy and discourse on adaptation to climate change was largely initiated by the United Nations Framework Convention on Climate Change (UNFCCC) which was prepared for the 1992 United Nations Conference on Environment and Development (commonly referred to as the Rio Earth Summit) and by 2016 had been ratified by 195 countries (UNFCCC, 2014a). The Convention functions alongside the Kyoto Protocol, prepared in 1997, which cites legally-binding reductions in greenhouse gas emissions for developed countries. From 2020, the Paris Agreement will supersede the Kyoto Protocol as the legally-binding agreement which sits alongside the UNFCCC. The Paris Agreement cites supporting and enabling adaptation, particularly in developing countries, as a key feature (European Commission, 2016).

The UNFCCC originally gave more attention to climate change mitigation than adaptation, although recognising the need to fund adaptation activities (Schipper, 2006). The need to support adaptation increased in the UNFCCC discourse and at the 2001 Conference of Parties (COP) there was agreement for developing countries to prepare and submit National Adaptation Programmes of Action (NAPA). During the 2010 COP the Cancun Adaptation Framework was adopted following three years of negotiation.

Within the UNFCCC, the overarching aim of adaptation is “reducing vulnerability and building resilience in developing country Parties” (UNFCCC, 2011, p4).

The UNFCCC is significant to this research because, alongside the supporting documentation and the Cancun Adaptation Framework, it mandates developing countries to prepare and submit reports on their national needs for adaptation. Consequently, in preparing their national adaptation plans, developing countries may refer to the understanding of adaptation and adaptive capacity provided in the UNFCCC documentation. Thus, the UNFCCC influences the use of adaptive capacity at a national level which may in turn influence the understanding of adaptive capacity within associated government institutions and other national policy and discourse documents.

Beyond the UNFCCC, other global bodies that may have an influence on understandings of adaptive capacity and its links to sustainability include the World Bank and the Food and Agriculture Organization of the United Nations (FAO). In online documentation both bodies refer broadly to climate change adaptation but do not give any further details on the institution’s understanding of what constitutes adaptive capacity: the audience’s understanding of adaptive capacity is assumed (FAO, 2014; The World Bank, 2012b). While both the World Bank and FAO do not provide institutional-wide understandings of adaptive capacity or sustainability, both institutions provided significant support in the preparation of the dominant Africa-wide agricultural plan, discussed in the following section.

### 3.1.3 African Agricultural Development Policy

The Comprehensive Africa Agriculture Development Programme (CAADP) was finalised by the New Partnership for Africa’s Development (NEPAD) in 2003. The CAADP was prepared to direct the common focus on agricultural development throughout the continent following the suggestion that the agricultural sector in Africa was facing a “crisis situation” (NEPAD, 2003, p5). The CAADP outlines three areas that it suggests require action across the continent: extending the area under sustainable land management and reliable water control systems; improving rural infrastructure and trade-related capacities for market access; and increasing food supply and reducing hunger (NEPAD, 2003). As a long-term pillar to support each of these action areas, a fourth over-arching action is outlined: agricultural research, technology dissemination and adoption (ibid).

As the CAADP process and discourse developed, the focus shifted to regional and national-level policy and planning for agricultural development and a new strategy to this effect was formalised in 2006 (Poulton et al, 2014). Under the CAADP, regional centres were mandated with the task of overseeing implementation of the Programme at the regional and national-levels (ECOWAS, 2008). Furthering the focus for regional and national-level policy and planning, the Economic Community of West African States (ECOWAS), to which Ghana belongs, adopted a region-wide policy for agricultural development in 2005. The Economic Community of West African States Agricultural Policy (ECOWAP) was prepared as a means of enacting the CAADP requirements in West Africa while ensuring effective regional integration of trade and markets.

As in the CAADP, the ECOWAP identifies the modernisation of agriculture through the dissemination of technologies to farmers as key to increased crop production (ECOWAS, 2005). The Policy also seeks to enhance the activity of agricultural value chains within the West Africa sub-region. As a third axis for implementation, ECOWAP identifies the need for sustainable management of shared natural resources (ibid). The ECOWAP recognises the need for sustainable development within the agricultural sector and outlines the needs for sustainability within both social and environmental components of agricultural production (ECOWAS, 2005).

Both the CAADP and ECOWAP have a mandate to support national governments in establishing appropriate policy and institutions for the implementation of the policies to effectively increase agricultural production. The following section discusses agricultural policies in Ghana as well as the relevant documentation that supports national-level adaptation.

### 3.2 Agriculture and Adaptation in Ghanaian Policy

The Ghanaian Statistical Service has estimated that agriculture and livestock rearing provide livelihoods for 45.8% of Ghanaian households, rising to over 78% of households in Northern Ghana (Ghana Statistical Service, 2012). Agricultural production, processing, packaging and marketing constitute over 40% of Ghana's Gross Domestic Product (GDP; MEST, 2010a). The significant contribution that agriculture provides to livelihoods and the national economy echoes that throughout much of Sub-

Saharan Africa (ATPS, 2010). In Ghana, agricultural and food systems are supported by a range of national government policies, formal research institutes and informal indigenous knowledge systems. The following sections provide a background to the formal and informal features of the Ghanaian agricultural system.

### 3.2.1 Agricultural Policy in Ghana

The Food and Agriculture Sector Development Policy (FASDEP II) is the principal policy document for the Ministry of Food and Agriculture (MOFA) and sets out the government's intentions for the development of the agricultural sector in Ghana. The policy document states:

“The national vision for the food and agriculture sector is a modernised agriculture culminating in a structurally transformed economy and evident in food security, employment opportunities and reduced poverty.” (MOFA, 2007, p20)

A vision for modernised agriculture to increase food security echoes the objectives of the CAADP and ECOWAP (Section 3.1.3). FASDEP II references the vision and framework pillars in the CAADP and the ECOWAP, citing them as drivers for the national policy. Reduced poverty and increased food security are also aims for the CGIAR centres and the underlying purpose for CRPs, as discussed in Section 3.1.1. Thus, the Ghanaian vision for the national agricultural sector is in line with much of the rhetoric from core agricultural development institutions globally.

FASDEP II was finalised in 2007 following a review process of FASDEP I which had been approved in 2002 (MOFA, 2007). A poverty and social impact analysis of FASDEP I had concluded that the policy would not achieve the desired reduction in poverty (ibid). The revised policy states a number of challenges to meeting the objectives of the original policy:

“The expectation of modernising poor smallholder agriculture was unachievable because of improper targeting of the poor within an environment where the drivers of modernisation, access to credit and technology, good infrastructure, and markets are very limited. Problem analysis was weak and did not sufficiently reflect client perspectives on their needs and priorities” (MOFA, 2007, p1)

Therefore, FASDEP II set out to overcome these challenges and make agricultural modernisation, and an increase in production in Ghana, realistically achievable. Unlike the first Sector Development Policy, FASDEP II identifies five categories of farmers

throughout Ghana and acknowledges that smallholder farmers are a heterogeneous category (MOFA, 2007). The policy states that different approaches will be used according to the needs of the different categories of farmers. In reviewing agricultural policy trends in Ghana, the Food and Agriculture Organization of the United Nations stated that policy decisions have become producer-oriented (FAO, 2015). Despite acknowledging in the introduction that FASDEP I had not considered the needs and priorities of the farmers, FASDEP II continues to lay out a procedure for the modernisation of agriculture through a top-down, transfer-of-technology format of dissemination and training through extension. This approach does not provide scope for discourse with farmers about their priorities or addressing such priorities.

However, the procedures outlined in the FASDEP II includes a section on the role of Civil Society Organisations which states that they are expected to “participate in policy dialogue to ensure that their interests are reflected” (MOFA, 2007, p49). This expectation was included in the 2007 policy document following a review process, rather than as a result of civil society engaging with the review of the previous policy so that their interests could be reflected in the current policy, FASDEP II. Additionally, this policy procedure provided scope for engagement with organised, recognised Civil Society Organisations but with no provision for engaging with farmers external to organised groups. Furthermore, Civil Society Organisations in developing countries are typically formed of the more active and educated members of society, thus again limiting the input of the poorest smallholder subsistence farmers who are most in need (e.g. Mansuri and Rao, 2013).

Furthermore, many of the strategies for the agricultural sector refer to increasing the productivity of cash crops, mostly grown in the south, and improved quality of crops for export (MOFA, 2007). A focus on increasing national productivity and income through export of crops does not reach smallholder subsistence farmers, many of whom are located in the north. Therefore, it may be possible for FASDEP II to achieve the national goals of increased productivity and aggregate income from agricultural production and reduce poverty, but this will be the outcome for only some of the five categories of farmers in some regions of the country. Darko and Atazone (2013) have argued that the productivity of smallholder subsistence farmers will not be directly targeted by many of the modernisation strategies outlined in the policy document (see Section 3.3).

The Ghanaian Medium-term Agricultural Sector Investment Plan 2009-2015 (METASIP) outlined planned expenditure of more than 12.7 billion cedis (over £3.4 billion) over six years to increase production, processing and income from agricultural activities (MOFA, 2009). This expenditure was largely allocated to research and development of agricultural technologies and processing mechanisms, and on dissemination of technology packages, knowledge, and information regarding seed and food standard laws to farmers through extension (ibid). Only one activity allocated funding in that METASIP referred to learning from existing or past processes and this related to stakeholders engaged in the small agricultural sub-sector of bee keeping, and mushroom and snail harvesting (MOFA, 2009, p14). The planned expenditure and investment in agricultural systems through Ghana for the six-year period covered by the METASIP did not discuss the role of indigenous knowledge systems in innovation and developing agricultural systems, which will be discussed further in Section 3.3.1.

The planned expenditure acknowledged the need to increase agricultural production throughout all ecological zones of Ghana. Despite this, there are many plans which are only applicable to Southern Ghana with less focus on the Northern regions even though agricultural livelihoods form a higher proportion of income in the north of the country (Ghana Statistical Service, 2012). The METASIP focused on increasing production of cash crops for the export market (MOFA, 2009). Cash crops such as coffee and cocoa are almost exclusively grown in the southern regions of Ghana, with the exception of some cotton plantations in northern areas. There is limited potential for increasing cash crop production in Northern Ghana because the climatic and soil conditions do not readily permit the cultivation of cash crops.

Further to the Agricultural Sector Investment Plan, the Medium-term National Development Policy Framework on growth and development for 2010 to 2013 contained a chapter dedicated to Accelerated Agricultural Modernisation and Sustainable Natural Resource Management (NDPC, 2010). This National Development Policy Framework stated that:

“The main focus of agricultural development policy, over the medium-term, will be to accelerate the modernisation of agriculture and ensure its linkage with industry through the application of science, technology and innovation... This will be complemented by an effective natural resource management and environmental governance regime.” (NDPC, 2010, p38)

The chapter presents agricultural modernisation as a blanket objective for all agricultural sectors throughout Ghana and suggests this is a comprehensive solution for the main national development objectives (NDPC, 2010). As with the METASIP, the National Development Policy Framework did not consider the role of farmers other than as the receivers of technology and participants in modernisation. There was no recognition of the potential for farmers to innovate and develop agricultural systems or for policy processes to learn from farmers.

Agricultural systems were cited as a key area requiring innovation in Ghana with the expectation that advancement in science and technology development would increase agricultural production and processing (MEST, 2010a). The Ghanaian government has viewed science, technology and innovation (STI) as a means to achieving national socio-economic development, sustainable environmental management and increased industrial activity since independence from the United Kingdom in 1957 (MEST, 2010a). A number of political and economic factors meant there was not a formal government policy to support the development of STI capacity until 2010 when the National Science, Technology and Innovation Policy was enacted by the Ministry of Environment, Science, Technology and Innovation (MEST; *ibid*). However, it was an early recognition of the need for STI which led to the formation of the national Council for Scientific and Industrial Research (CSIR) and subsequent National Agricultural Research System (NARS; see Section 3.3.2 below).

Keynes suggested that economists and political philosophers have significant power and influence in decision-making (1936, p383). In Ghana, the role of political discourse and economic incentive drives the focus and practice of agricultural extension officers within MOFA as well as the funding environment for local NGOs. Thus, Keynes' suggestion that economic and political ideas have much power and influence is evident in the Ghanaian agricultural system.

The focus on increasing national income has resulted in an emphasis on development and investment in large-scale commercial agriculture in Southern Ghana taking priority over increasing the incomes of smallholder farmers living in extreme poverty predominantly located in the North. National-level economics and politics also exert influence over the input of international policies, agencies, private organisations and NGOs working in Ghana, further driving the emphasis of agricultural development away from smallholder farmers, farmer participation, and local-level adaptive capacity. Due to the influence of particular perspectives in economics and politics, national



priorities are placed above the needs of the communities who are most vulnerable to change and have the lowest adaptive capacity to support social-ecological sustainability.

The Ghanaian National Technology Needs Assessment completed in 2012 considered some of the needs of the agriculture and water sectors. That assessment considered the needs for the development, growth, adaptation and sustainability of these sectors as requiring more than physical technologies but also referred to processes through which community-based extension and governance might support the facilitation of technologies or practices (Essegby et al, 2012). Within the agricultural sector, a stakeholder-led workshop was used to prioritise identified technologies or methods based on the potential costs and benefits of each technology for enhancing adaptation and sustainability. The Assessment documentation does not define the term ‘technology’ and the technologies assessed are not typical machine or equipment-based technologies (Section 3.2.2).

Of 19 technologies that were assessed by the stakeholder group, the five which were identified as highest priorities for agricultural development in Ghana were: 1) Community Based Extension Model; 2) Water User Associations; 3) Integrated Soil Nutrient Management; 4) Ecological Pest Management; and 5) Farmer Field Schools (Essegby et al, 2012, p41). Independently of the agriculture and water sectors, an Integrated Climate Monitoring and Early Warning System was considered to be crucial for all sectors and thus would also be a priority (ibid).

These priorities identified for an adaptive and sustainable agricultural sector throughout Ghana show an emphasis on community-based management and governance, farmer and field-level processes, and the enhancement of social networks for learning processes. These concepts correlate with the understanding of adaptive capacity within rural agricultural systems that will be used for this research. Some of the characteristics of the technologies identified as priorities in the National Technology Needs Assessment process also feature in the two case study agricultural development projects for this research, discussed in Section 3.5.

The technologies identified as priorities in the National Technology Needs Assessment are not found in other relevant policy documents from the Ghanaian government. Relevant policy documents were completed prior to the Technology Needs Assessment and have not been reviewed since that was published in 2012 (Essegby et al, 2012). The Technology Needs Assessment was designed to inform policy processes

and decision-making so the priorities for technology which were identified could be brought into future revisions of government policy. However, revisions of the agricultural sector policy (FASDEP II), agricultural investment plan (METASIP), or relevant sections of the National Development Policy Framework and STI Policy have not been published.

This analysis of a range of policy documents from several Ministries in the Ghanaian government indicates that national agricultural objectives are ostensibly focused on investing in STI to modernise agriculture through technological advancement. This set of policy documents is, in places, contradictory to the National Engagement on Climate Change Discussion Document, '*Ghana Goes for Green Growth*', which recognises agriculture as a contributor to climate change through the release of 24% of national greenhouse gas emissions and as a driver of deforestation (MEST, 2010b). While acknowledging the need for sustainable natural resource management throughout these policy documents, a blanket policy of 'modernisation' and mechanisation of agriculture in some or all of Ghana may not result in a reduction of deforestation and could lead to increased soil erosion because of poor soil structure in many areas (see Section 3.4.1; e.g. Mortimore et al, 2009). The National Engagement on Climate Change Discussion Document is discussed further in the following section on adaptation policy discourse in Ghana.

### 3.2.2 Adaptation in Ghanaian Policy and Discourse

The Ghanaian National Development Policy Framework suggested that adaptation is the primary way to respond to the impacts of climate change (NDPC, 2010). The discussion of adaptation only refers to climate change and reducing vulnerability to the risks of climate change (e.g. Sarpong and Anyidoho, 2012). This echoes the dominant discourse surrounding adaptation globally and the recent emergence of adaptation and mitigation as international climate change priorities (see Sections 2.7 and 3.1.2). In a study of adaptation to climate change in Ghana, Yaro (2010) interpreted adaptation as being an adjustment of natural or human systems specifically in relation to climate change. However, the emphasis on climate change within national and international adaptation discourse overlooks other forms of environmental change and social, political, and economic changes which can influence

adaptation needs, development of adaptive capacity, and adaptation outcomes (e.g. Yaro, 2010; Thomas and Twyman, 2006).

The Ghanaian National Climate Change Adaptation Strategy (NCCAS), adopted in 2011, is the central governmental document regarding adaptation (EPA/UNDP, 2010). Other related documentation refers to the Strategy as the ‘blueprint’ for successful adaptation nationally (e.g. Essegby et al, 2012). The overarching goal of the NCCAS is: “To enhance Ghana’s current and future development to climate change impacts by strengthening its adaptive capacity and building resilience of the society and ecosystems” (EPA/UNDP, 2010, p17). The Strategy then cites five objectives for achieving this goal:

- “1. Improve societal awareness and preparedness for future climate change;
2. Enhance the mainstreaming of climate change into national development to reduce climate change risks;
3. Increase the robustness of infrastructure development and long-term investments;
4. Enhance the adaptability of vulnerable ecological and social systems by increasing the flexibility and resilience of these systems;
5. Foster competitiveness and promote technological innovation.” (EPA/UNDP, 2010, p17)

Within the agriculture sector, the NCCAS identifies the need to enhance the capacity of farmers and extension agents through education and a transfer-of-technology model (EPA/UNDP, 2010). The Strategy also identified the need to document indigenous knowledge in agriculture (ibid) although it does not state why this would be helpful to adapt to climate change or how this information will be used once documented.

The National Climate Change Adaptation Strategy was completed in 2011, following the National Engagement on Climate Change Discussion Document, ‘*Ghana Goes for Green Growth*’, which addressed mitigation and adaptation (MEST, 2010b). This Discussion Document identified four key areas for development to support adaptation: infrastructure, natural resources, agriculture and food security, and disaster preparedness and response (ibid, p24-27). The National Climate Change Policy was finalised in 2013, building on that Discussion Document.

In 2011, Ghana submitted its Second National Communication to the UNFCCC (Section 3.1.2), as mandated by the Convention. The Second Communication stated that within the agricultural sector, significant investment of funds is required to facilitate adaptation to climate change. The areas outlined as needing investment included the development of drought-tolerant crop varieties, moisture and irrigation management,

education and training, and fire prevention in crop management. The development of technologies and expansion of infrastructure were strategies identified in other national policies such as the National Development Policy Framework (NDPC, 2010) and the Science, Technology and Innovation Policy (MEST, 2010b).

As part of the preparation of the National Adaptation Programme of Action for the UNFCCC, a National Technology Needs Assessment was completed in 2012 to identify and prioritise adaptation needs for the agriculture and water sectors in the face of climate change (Essegby et al, 2012). Although it was an assessment of technological needs, the document did not define its use of the term ‘technology’ and the assessment process identified knowledge and practice-based priorities. Identified priorities for the agriculture sector were farmer-level practices, such as integrated soil nutrient management and ecological pest management, and communal governance and learning, including community-based extension and water user associations (ibid).

These conclusions are further reflected in an Africa Portal policy brief which suggested that high-resource options for adaptation, such as machinery, synthetic fertilisers and hybrid seeds, were not relevant or suitable for smallholder farmers (Nyantakni-Frimpong, 2013). Nyantakni-Frimpong (2013) argued that smallholder farmers have built adaptation measures into their farming systems because of climatic variability, such as intercropping practices which respond to the duration of rainfall. They suggested that indigenous knowledge systems currently support local-level adaptability for farmers in Northern Ghana and thus should be built into policy-making. As discussed above, the National Climate Change Adaptation Strategy suggested the need to document existing indigenous knowledge but with no indication of how this may be accomplished or used (EPA/UNDP, 2010). Indigenous knowledge in Ghanaian agricultural systems is discussed further in Section 3.3.1. In an analysis of climate change and agriculture policy processes in Ghana, Sarpong and Anyidoho (2012) suggest that there has been a governmental focus on climate change mitigation rather than adaptation. They outlined evidence which suggested that bias toward mitigation activities was driven by external donors and the Ghanaian government was following opportunities for funding. Sarpong and Anyidoho (2012) also cited a study of adaptation and mitigation funds spent in Ghana between 2004 and 2011 which identified mitigation spending as almost double that on adaptation.

Sarpong and Anyidoho (2012) suggest that adaptation should be the most important concern for Ghanaian agriculture in relation to climate change. They caution

that influence from external donors may distract from national priorities. However, taken with the findings of the Technology Needs Assessment (Essegby et al, 2012) and the study by Nyantakni-Frimpong (2013) discussed above, more funding for adaptation may be most effective if directed towards supporting community-based governance, farmer-to-farmer learning, and sharing of indigenous knowledge. This research aims to contribute to this discussion by identifying whether farmer and community-based features of adaptive capacity are enhanced by participation in agricultural development interventions.

To further this discussion of local-level processes in adaptation, Yaro (2010) analyses social aspects of adaptation to climate change within Ghana. He identifies socio-economic features as not only drivers for vulnerability to climate change but also influencing adaptation responses through social relations. Yaro suggests that local-level adaptability, such as that identified by Nyantakni-Frimpong (2013), is important for short-term adaptation processes. However, he posits that medium to long-term adaptation responses will require greater institutional capacities and inputs from infrastructure and technology development, thus requiring regional to national-level resources (Yaro, 2010).

Throughout the documents which refer to adaptation in Ghana, agriculture is consistently identified as the sector which is most vulnerable to climate change and is most in need of adaptation measures. A national assessment of climate change vulnerability and adaptation, completed by the United States Agency for International Development in 2011, concurred with this. The assessment suggests that farmers are particularly vulnerable to long-term climatic stresses and there is some existing adaptation to short-term climatic variability (Stanturf et al, 2011). Water and natural resource sectors are also identified as priorities for adaptation, both of which agriculture draws upon. The following section discusses the development of the national agricultural research system in Ghana, the formal institutions which are charged with the innovation and technology development which is hoped to enhance agricultural adaptation and meet the objectives of increased food security and reduced poverty.

### 3.2.3 Formal Agricultural Research Systems

The Ghanaian National Agricultural Research System (NARS) has had formal research centres since the 1930s and expanded significantly in the late-1950s (MEST,

2010a; Taylor, 1991). The evolution of the Ghanaian NARS was driven by the establishment of a number of regional agricultural research institutes throughout West Africa from the 1950s to early-1960s. These regional institutes included: the West African Cocoa Research Institute, Ghana; the West African Institute for Oil Palm Research, Nigeria; the West African Maize Rust Research Institute, Nigeria; the West African Rice Research Institute, Sierra Leone; and others (ibid). The disbanding of these research institutes in the 1960s triggered the formation of formalised NARS throughout West Africa, including in Ghana (ibid).

Ghana was among the first Anglophone countries in Africa to develop a formal agricultural research system (Taylor, 1991) which was also stimulated by gaining independence in 1957 and, later, the overthrow of Nkrumah's government in 1966 (MEST, 2010a). This formalisation came in the form of the establishment of the National Research Council in 1958 and the Ghana Academy of Sciences in 1961 which oversaw the activities of a range of research institutes, including agricultural. The Council was merged into the Academy of Sciences in 1963 and became the Academy of Arts and Sciences in 1966 which also saw the creation of the Council for Scientific and Industrial Research (CSIR; ibid). Some of the agricultural research institutes established or renamed during this period include: the Cocoa Research Institute of Ghana; the Crops Research Institute, Kwadaso; the Soils Research Institute, Kwadaso; the Aquatic Resources Research Institute; and the Food Research Institute, Accra (Taylor, 1991). Taylor (1991) suggests that semi-autonomous structured NARS such as the Ghanaian one are more successful in conducting and completing research projects.

The Council for Scientific and Industrial Research currently oversees 12 research institutes, of which eight are directly related to agricultural research: the Crops Research Institute; the Forestry Research Institute of Ghana; the Food Research Institute; the Oil Palm Research Institute; the Plant Genetics Research Institute; the Savanna Agricultural Research Institute; the Soil Research Institute; and the Water Research Institute (CSIR, 2010-2012).

Due to links with European markets resulting from colonial activity and an amenable environment, Ghana has been engaged in production of cash crops for export including cocoa, coffee, cotton and rubber. The importance given to cash crops in the 1950s resulted in the formation of research institutes exclusively for export crops (Taylor, 1991). These research institutes are typically privately funded and closely tied

to industrial production and export markets. Therefore, Taylor (1991) proposed that they are not part of the formal NARS despite researching agricultural crops.

In acknowledgement of the importance of the agricultural sector, the Ghanaian National Science, Technology and Innovation Policy identified agriculture as a key area to which outputs from STI research should be targeted (MEST, 2010a). The STI Policy highlighted the Savanna [sic] Agricultural Research Institute (SARI) as one of three national research institutes which require a specific focus on agricultural productivity (ibid). SARI has a mandate to conduct research in the semi-arid savannahs of Northern Ghana, so is of particular interest to this research (CSIR, 2010-2012).

Public and private universities form an important feature of the Ghanaian NARS. Ghana has seven public universities, 25 private universities, ten polytechnics, and 23 technical institutes (MEST, 2010a). Agricultural research has formed an integral aspect of research throughout this system. Within the formal NARS, agricultural research expenditure in Ghana from 1980 to 1985 was 3.3 million US\$ (at 1980 value) and there were 138 research scientists engaged in national agricultural research (Taylor, 1991). By 2008 annual agricultural research expenditure had risen to 94.6 million US\$ (at 2005 value) with 537 researchers employed (ASTI, undated).

The Ghana Agricultural Information Network System (GAINS) was established in 1991 to link the libraries of all the relevant governmental, academic and research institutions in Ghana with an aim of making research more accessible to researchers, policy makers and extension agents (CIARD, 2011). This has been supported by the Ghana AGRIS Pilot Project (GAPP), funded by the FAO and UK Department for International Development (DFID). The goal of GAPP was to function within the Ghanaian national agricultural science and technology information system to facilitate information sharing (CIARD, 2012). In 1992, the institutions, universities, and organisations of the Ghanaian agricultural research system were formally brought together with GAINS to form a cooperative research initiative, the National Agricultural Research Project (CIARD, 2012).

In recent years Ghana has increased investment in agricultural research, following a period of stagnation in the 1990s. Between 2002 and 2008, investment in the public agricultural research institutes in Ghana more than doubled, spending 352 billion cedis in 2008 compared with 151 billion cedis in 2002 (95 million US\$ in 2008 and 41 million US\$ in 2002; Flaherty et al, 2010). The increased investment in agriculture followed agreement under the CAADP (Section 3.1.3) and associated

Maputo Declaration for governments to spend 10% of the national budget on the agriculture sector. However, in Ghana much of this increased input of funds went towards increasing the salaries of staff and only 17% of the funds that went to agricultural research were spent on the research itself rather than staff salaries (ibid). The expenditure on operational costs increased during the period of 2002 to 2008, but the percentage of total expenditure decreased due to the large increase spent on salaries, a trend continuing since the 1990s (ibid).

This section has outlined the governmental policy discourse surrounding agricultural development as a priority area for Ghana. It has indicated that the Government of Ghana considers the agriculture sector to be a focus area for adaptation strategies. The above discussion provides the context for the two agricultural development interventions which are the case studies for this research, introduced in Section 3.5. This context is pertinent to the research questions posed in Section 2.8 because it provides the political rationale and governmental support for development interventions in Ghana to seek to enhance adaptive capacity through agricultural livelihoods. Furthermore, both case studies engage fully or partially with governmental ministries and thus must adhere to the objectives of associated government policy. The following section outlines sources of alternative priorities for agriculture in Ghana which sit alongside Government of Ghana policy discourse.

### 3.3 Alternative Priorities for Agricultural Development in Ghana

As mentioned in Section 3.2.1, the Ghanaian agricultural policy (FASDEP II) and investment plan (METASIP) gave little attention to smallholder farmers in the semi-arid north. This lack of attention on agriculture in Northern Ghana partly came from a heavy focus on cash crops, such as cocoa which can only be grown in the wetter south, due to the potential to increase exports and gross national income from these crops. The majority of farmers in Northern Ghana are illiterate and speak only local languages (see Section 3.4) so they have limited access to extension services or public information from the Ministry of Food and Agriculture (MOFA). In the north an alternative approach to that of investment in cash crops is required to achieve the national goals of increased food security and reduced poverty. The following section



discusses the role of indigenous knowledge and alternative priorities for agriculture in Northern Ghana.

### 3.3.1 Indigenous Knowledge in Informal Agricultural Systems

Informal institutions (see Section 2.5.2) are constructed of organised networks with shared norms, rules and values. Osei-Tutu et al (2015) suggested that informal institutions may influence local dynamics in natural resource management even in circumstances where they are overlooked as influential. Their study of forest management in Ghana found undocumented, localised informal institutions to play a key role in forest management when interacting with formal institutions (Osei-Tutu et al, 2015).

Interactions between formal and informal institutions and the potential for beneficial outcomes from collaboration have been identified in a number of contexts. Osei-Tutu et al (2015) identified four possible types of interactions between formal and informal interactions in Ghana. They suggested that when formal and informal institutions engage for forest management, interactions could be complimentary, substitutive, competing, or could create an institutional void.

As discussed in Section 2.6, farmer participation in formal interventions has been adopted as a key approach in development practice in recent decades. Part of the rationale for farmer participation in agricultural development interventions is their local knowledge (e.g. Scoones and Thompson, 2009). However, Arora (2012) found the knowledge exchange and learning between formal and informal institutions was restricted by power dynamics and dominance of the formal institutions involved. Conversely, De Vente et al (2016) identified different ways in which informal institutions participating in formal interventions may create beneficial outcomes. They found that well designed decision-making in participatory processes could lead to strengthened benefits for both environmental and social outcomes. One route they identified was through knowledge exchange between stakeholders from formal and informal institutions, resulting in opportunities to build on local knowledge (ibid). Assessment of relationships and participation between formal and informal institutions will be discussed further in Section 4.2.

Derbile (2013) suggested that indigenous knowledge in Northern Ghana helped informal institutions to become embedded within communities. He identified water user groups as informal institutions and suggested that indigenous roles embedded within

local ethnic groups influence community development. Derbile (2013) defined indigenous knowledge as “embedded in the community and is unique to a given culture, location or society.” He went further to explain that indigenous knowledge is dynamic and consists of “accumulated knowledge, skill and technology of the local people derived from systems of production and consumption” (p75).

Studies by Fairhead and Leach (1998) and Richards (1985), among others, have suggested that indigenous knowledge has been active in West African agricultural systems since at least the colonial period. A number of colonial governors and agricultural officers identified indigenous agricultural practices to be more appropriate for local environmental conditions than methods used elsewhere in the world (Richards, 1985). Richards (1985) suggested that farmers have historically adapted farming practices according to local climate, vegetation and soil dynamics and that this has required innovation. Reij and Waters-Bayer (2001b) also identified farmer innovation to adjust agricultural practices to local conditions throughout Africa. They suggested that additionally to local environmental conditions, changes in population and demand for land have driven more recent innovation. Derbile (2013) suggested that indigenous knowledge systems are closely tied with farmer innovation and adaptation within agricultural systems.

Malongza Bukari (2013) suggested that indigenous knowledge systems were responding to soil erosion in Northern Ghana. Other studies, such as Derbile (2013) and Robinson and Sasu (2013), among others, identified indigenous knowledge as playing a role in responding to climatic variability, drought, and forest and natural resource management (e.g. Richards, 1985; Aalangdong et al, 2010). Derbile (2013) suggested that indigenous knowledge is integrated with the evolution of agricultural practices in Northern Ghana. He proposed that accumulated indigenous knowledge and continual learning as climatic conditions change have enabled community-wide adaptive processes.

Many of the agricultural processes that Richards (1985) referred to, which were developed in line with historical indigenous knowledge, have been replaced by methods disseminated by agricultural development initiatives (Ngeleza et al, 2011). The subtle understanding previously used in shifting cultivation and intercropping for managing soil fertility and minimise erosion (Richards, 1985) is no longer practiced in many regions of Northern Ghana and soil fertility is widely controlled through the addition of fertilisers (Diao, 2010).

The argument for the incorporation of indigenous knowledge in agricultural development projects suggests that farming communities understand better the dynamics of local environmental conditions than those from external agencies. Recent evidence from Derbile (2013) and Malongza Bukari (2013) suggested that indigenous knowledge continues to be widely applied in agricultural systems in Northern Ghana. It may be important for practitioners and policy-makers to ensure indigenous knowledge has a role to play in agricultural development initiatives for the purposes of enhancing adaptive capacity.

### 3.3.2 Ghanaian Agricultural Systems in Relation to Research Case Studies

The two case studies for this research are agricultural development projects implemented in rural farming communities in Northern Ghana (see Section 3.5). The formulation of project activities within participatory agricultural development initiatives can depend upon the interactions and dominance of local conditions and demands, indigenous knowledge through farmer participation, interactions between formal and informal institutions, local and national agricultural policy discourses, local, national and international investments in agricultural development, and national and international rhetoric surrounding needs within agricultural development (e.g. De Vente et al, 2016; Osei-Tutu et al, 2015; Casson et al, 2010). Consequently, an understanding of each of these factors and an interpretation of how they interact within defined agricultural development projects is important.

Farmer participation in agricultural development initiatives may provide opportunities for informal institutions and indigenous knowledge to be incorporated into planning, problem-solving, and decision-making activities. Different types of farmer participation at different phases of a formal agricultural project may allow for different levels and types of indigenous knowledge to be incorporated into the initiative. As discussed, indigenous knowledge systems have recently been identified as functioning within Ghanaian agricultural systems in response to dynamic conditions (e.g. Malongza Bukari, 2013; Derbile, 2013). It is therefore important to examine how informal institutions can play a role in defining the understandings of adaptive capacity within a participatory agricultural development projects and under what conditions this is the case.

National policy and agricultural discourses can also have a bearing on agricultural development initiatives, particularly those which engage with the Ministry

of Food and Agriculture (MOFA) and the national agricultural research system. One of the case studies for this research is such a project, being facilitated in Ghana by a national research institute and MOFA (see Section 3.5.1). The national-level goals for agricultural development will influence the objectives of initiatives facilitated by government Ministries and institutions. Furthermore, national investment, whether public or private, in agricultural systems will influence the development of infrastructure, technologies and governance within agriculture. This can be expected to have bearing on the implementation of project activities and thus the construction of agricultural initiatives. Therefore, knowledge of the local and national policy and investment discourses may be necessary in investigating how understandings of adaptive capacity are defined and formed within agricultural development initiatives. Thus, the preceding discussion is useful for forming a background understanding of the political economy context within which the case studies for this research function.

The following section provides further context for the two case study project by outlining bio-physical and socio-economic characteristics in Northern Ghana which may have a bearing on agriculture and farmers' engagement with related development interventions and policy discourse.

### 3.4 Bio-Physical and Socio-Economic Context in Northern Ghana

The environment, demographics, and socio-economics of Northern Ghana differ to that of Southern Ghana. Recent national statistics indicating economic growth and improvement in generic development indices do not reflect circumstances in the three northern regions (Table 3.2). Ghana has met the Millennium Development Goal 1 of halving poverty by 2015 on 1990 levels. However, this poverty reduction is largely in the southern regions of Ghana; poverty rates remain high in the north (The World Bank, 2011). This section outlines the current conditions of Northern Ghana rather than the context of Ghana as a whole.

Table 3.2 Socio-economic statistics for Ghana, Northern Ghana and Southern Ghana.  
Sources: <sup>a</sup> The World Bank, 2011; <sup>b</sup> Ghana Statistical Service, 2012; <sup>c</sup> Ghana Nsem, 2009

	<b>Ghana</b>	<b>Northern Ghana (3 Regions)</b>	<b>Southern Ghana (7 Regions)</b>
Poverty in 2006 (% of population) <sup>a</sup>	28.5	62.7	19.8
Literacy in 2010 (% of population aged over 15) <sup>b</sup>	71.5	36.1	78.1
Under 5 mortality in 2006 (deaths per 1000 live births) <sup>c</sup>	111	143	100
Under 5 malnutrition in 2006 (% children underweight or severely underweight based on weight for age) <sup>c</sup>	21.4	29.8	17.8

Ghana has ten Regions, three of which are considered to form Northern Ghana (Figure 3.1). The Upper West, Upper East and Northern Regions constitute over a third of the land area of Ghana and, as of the 2010 Population and Housing Census, have a combined population of 4,228,116 which is 17.1% of the national population (Table 3.3; Ghana Statistical Service, 2012).



Figure 3.1 Map of the Regions of Ghana – the three most northerly regions are commonly identified as Northern Ghana

Upper East Region has a population density higher than the national average at 118.4 people per square kilometre (Table 3.3). Relatively high population density in this region has put pressure on land for cultivation and other natural resources. Deforestation and land degradation is widespread in Upper East Region due to overgrazing and as people have cleared trees for farmland (Yiran et al, 2012). However, Upper West and Northern Regions have the two lowest population densities of all regions in Ghana.

Table 3.3 Population of Northern, Upper East and Upper West Regions of Ghana as of the 2010 national census. Source: Ghana Statistical Service, 2012

	<b>Total population</b>	<b>Share of national population (%)</b>	<b>Proportion urban (%)</b>	<b>Percentage increase 2000 - 2010</b>	<b>Population density (people per sq.km)</b>
<b>All Regions</b>	24,658,823	100.00	50.9	30.4	103.4
<b>Northern Region</b>	2,479,461	10.1	30.3	36.2	35.2
<b>Upper East Region</b>	1,046,545	4.2	21.0	13.7	118.4
<b>Upper West Region</b>	702,110	2.8	16.3	21.8	38.0

#### 3.4.1 Environment and Climate

The ecosystem of Northern Ghana is open-wooded and grassland Guinea savannah, open grassland interspersed with short trees and shrubs, although the most north-eastern area is classified as Sudan savannah. The dominant tree species are acacia varieties and teak, while shea, cola nut, cashew nut, mango, dawadawa, and baobab tress also grow well. Thus, a number of non-timber forest products are available from native trees for informal livelihoods. Savannah soils are typically well drained which results in leaching of nutrients and only have a thin layer of organic matter due to dry conditions (Jones et al, 2013). The African Savannah soils such as those of Northern Ghana have a high sand content due to wind-blown sand and dust from drier Saharan areas to the north (ibid). Soils of this type present challenges for agricultural production due to low water retention, nutrient leaching, and high soil erosion due to poor soil structure, limiting options for cultivation.

The soils of Northern Ghana are predominantly Plinthosols, varying between Petric and Pisoplinthic Plinthosols. There are areas of Lithic Leptosols and Haplic Lixisols (Jones et al, 2013). Plinthosols are characterised by an accumulation of iron

and manganese (called plinthite) beneath the surface which hardens permanently once exposed to air and sunlight. If the water table drops below the level of the plinthite layer it can harden without erosion of the overlying soil (ibid). These soils present even greater challenges for cultivation, particularly in a semi-arid environment where the water table will drop during drought years. Once plinthite has hardened it can be too hard to plough for planting and plant roots cannot reach through the layer to soils below.

Northern Ghana has a semi-arid climate with bi-modal seasons, a wet season from May to October and a dry season from October to April (Antwi-Agyei, 2012). The single wet season influences agricultural activity in the region, allowing for only one cropping season per year, where two crops can be harvested annually in the south because of two shorter wet seasons. The average annual precipitation in the northern regions is between 1000 and 1200mm. The average temperature ranges from 30°C to 40°C in the dry season and 14°C to 30°C in the wet season.

In the years from 1961 to 2000, rainfall in the Guinea savannah area of Northern Ghana decreased by 120mm (Stanturf et al, 2011). Niang et al (2014) projected that climate change will lead to increased temperatures in West Africa. The occurrence of extreme weather events such as droughts, flooding and storms is projected to increase with climate change (ibid). There is uncertainty in the projected trends of rainfall between different climate models. Collective averages project that rainfall in the wet season will decrease by between 1.46% and 10.35% by 2050, becoming less reliable and more variable (Stanturf et al, 2011; EPA/UNDP, 2010).

### 3.4.2 Culture and Livelihoods

Ghana is ethnically diverse, which has a bearing on traditional culture, livelihoods and social interactions. Multiple ethnic groups stem from historical lineages and sub-groups have developed localised languages and traditions (Government of Ghana, 2013). Some ethnic groups dominate each region but no regions are ethnically homogenous (Awedoba, 2006). This section provides details of the dominant ethnic groups in the case study areas of Upper East and Upper West Regions.

The dominant ethnic group in Upper East Region is Frafra, a subsection of the Gurunsi ethnic group of Northern Ghana and Southern Burkina Faso. Frafra itself has different sub-groups according to the locality in Upper East Region, including Nabdam, Nankani, and Gurense (Government of Ghana, 2013). Other ethnic groups in the Region



include Kusasi, Kassena, Busanga and Bimoba, although in total there are over 30 ethnic groups or sub-groups in Upper East Region (ibid).

There is no caste system within ethnic groups in Upper East Region, and villages are governed by a council of elders. Frafra are predominantly farmers, growing cereals and legumes, and they rear livestock (Awedoba, 2006). A traditional landowner, the *Tindana*, advises communities on the agricultural cycle and land use (Yaro, 2010). The youth are known to migrate to Southern Ghana for employment on a temporary or permanent basis and this has been the case since the colonial period (Awedoba, 2006). Frafra are also known for art and crafts, particularly external decoration of houses and making craft produce with straw (ibid).

The dominant ethnic group in Upper West Region is Dagaba, speaking the language Dagaari. However, the ethnic group which dominates in the area where one of the case studies for this research is located is Wala, also spelled Wale (Awedoba, 2006). The Wala clan founded the city of Wa, the capital of Upper West Region, and the clan dominate in the three districts around the city: Wa Municipality, Wa East, and Wa West (see Figure 3.2). Wala are predominantly Muslim while other ethnicities in the region are mostly of Christian or Traditional religions (ibid). Thus, religious affiliation forms a significant feature of ethnic identity in the region.

Like Frafra, Wala are also primarily farmers growing cereals, legumes and tubers. Other rural livelihood sources come from natural resources such as shea butter production for trading further south in Brong Ahafo Region. The *Tindana* is again a feature of cultural tradition, although within the Wala clan they play a different role to that in Frafra. Within the Wala clan the *Tindana* is responsible for allocating land to individuals or households according to the boundaries of what is considered to be land belonging to the village. The *Tindana* also states what the land can be used for when it is allocated, specifying whether it is for cultivation, residential building, other buildings, or tree planting.

Wala communities are governed by a group of elders, of which the local *Tindana* is one. The role of the village chief is hereditary through male lineage and this family are considered as the royalty of the village (Awedoba, 2006). Wala have a tradition of building palaces for their royalty. It is the village chief's responsibility to select other village elders and designate the roles of *Tindana* and Imam (Islamic leader).

Throughout Northern Ghana, rural livelihoods have historically adapted to the bi-modal seasons and climatic variability. It is common practice for rural communities to invest time in farming during the wet season and focus on other sources of production and income during the dry period (e.g. Yaro. 2002). Such diversified livelihoods allow for flexibility in selection of livelihood activities according to personal needs, and social, environmental and economic conditions during any period. Non-agricultural livelihood activities common in rural Northern Ghana include livestock rearing, the production of shea butter, producing charcoal, and petty trading.

Livestock are an important part of rural livelihoods, particularly goats, sheep, and chickens. In some areas of Northern Ghana pigs, guinea fowl, and cattle are also found with preferences varying according to the locality. Often, any financial revenue will be invested in livestock with the hope that the livestock will have offspring and that investment increases (Yaro, 2002). Livestock are frequently sold during the lean season in the months when food stocks from the previous year's harvest are low and the current season's harvest is not yet ready. The sale of livestock provides essential income to buy supplementary food items to feed the farming household until the next harvest.

The following section provides details of the two case study projects for this research. The framing of the case studies highlights the different influences of government policy discourse and indigenous knowledge within the two participatory agricultural development projects.

### 3.5 Background to Case Studies

Two agricultural development interventions in Northern Ghana were identified as case studies for this research. Both interventions stated the objective of enhancing adaptive capacity of farming communities and adopted the use of participatory features of project implementation. Although there are some similarities between the two case studies, they were implemented by very different formal institutions and through different project activities. Both case studies function at a local scale with direct and indirect links to formal institutions at national and international levels, notably, governance and funding agencies. Table 3.4 introduces the formal institutions associated with each of the case studies, and whether those institutions function at a local, national, or international scale.

Table 3.4. Project partners of both case study projects at international, national and local levels

	<b>CODE-WA</b>	<b>Trax Ghana</b>
<b>International Funding</b>	BMZ (Germany)	DfID (UK)
<b>International</b>	ICRISAT – International Crops Research Institute for the Semi-Arid Tropics	Self Help Africa (UK)
	University of Hohenheim (Germany)	
<b>National</b>	SARI – Savanna Agricultural Research Institute (Ghana)	Trax Ghana
	MOFA – Ministry of Food and Agriculture (Ghana)	
<b>Local</b>	Kamwinsomte Women’s Group – in the Upper West Region	Three Project Zones in the Upper East Region

Despite several similarities between the two case studies, they differed in location, time scale and the number of beneficiaries. Table 3.5 outlines the locations of the two interventions, indicated in Figures 3.2 and 3.3. Although the years of the project implementation reflected in Table 3.5 have some overlap between the two case studies, the Trax project has been facilitated in other communities of Upper East Region for 27 years while the CODE-WA Project was a three-year project in two communities.

Table 3.5. Location of the communities within each case study and the years of project implementation

<b>Case Study</b>	<b>Community or Project Zone</b>	<b>District</b>	<b>Region</b>	<b>Years of Project</b>
Trax	Kabusgo	Bongo	Upper East	2013 – 2017
Trax	Pelungu	Nabdam	Upper East	2009 – 2014

CODE-WA	Doodiyiri	Wa Municipality	Upper West	2008 – 2011
CODE-WA	Jonga	Wa Municipality	Upper West	2008 - 2011

The case studies for this research were selected due to their focus on agricultural development in the dryland area of Northern Ghana. In addition, both case studies had a stated objective of enhancing adaptive capacity of the participating farming communities. This was a requirement for this research in order to be able to sufficiently investigate understandings and indicators of enhanced adaptive capacity and potential implications of this for the sustainability of agricultural livelihoods. The two case studies provide scope for similarities to emerge through data analysis while also representing some diversity of type of agricultural development intervention seeking to enhance adaptive capacity. A final consideration in selecting case studies for this research was the capacity of the implementing formal institutions to host the researcher during fieldwork for data collection and the willingness of the associated farmers to engage in the research process.

The following sections introduce the case studies by outlining the objectives of the interventions, the framing of relevant concepts within the project documentation, the project activities identified as being able to meet the objectives, and the structure of the projects. This introduction to the case studies provides the context in which empirical data was collected, discussed in the following chapter.

### 3.5.1 Community Management of Crop Diversity to Enhance Resilience, Yield Stability and Income Generation in Changing West African Climates (CODE-WA) – ICRISAT

This project aimed to target environmental variability as an opportunity for crop production through intensification and stabilisation in West Africa (CGIAR, undated c). This project ran from 2008 to 2011 and was implemented in four countries: Mali, Burkina Faso, Niger and Ghana, chosen to provide a north-south gradient for study. In Ghana, the project was informally extended by the implementing Ministry of Food and Agriculture (MOFA) staff to 2012 at the request of farmers.

The aim of the CODE-WA project was to improve the adaptability of farming communities in West Africa by developing agro-biodiversity. Project activities focused on introducing improved varieties of certain crops which had been bred by SARI and ICRISAT, and identifying suitable crop varieties and combinations for local needs (climatic, environmental and social or cultural). The project aimed to facilitate participatory activities with farming communities, extension services and scientists to support crop diversity and natural resource management. Outcomes of the project were intended to identify suitable crop diversity management practices under different climate change scenarios throughout West Africa (CGIAR, undated c). Therefore, the understanding of adaptive capacity within this project focused solely on physical practices rather than the role of institutions in adaptive governance. Thus, the interpretation of adaptive capacity was narrower than other possible understandings.

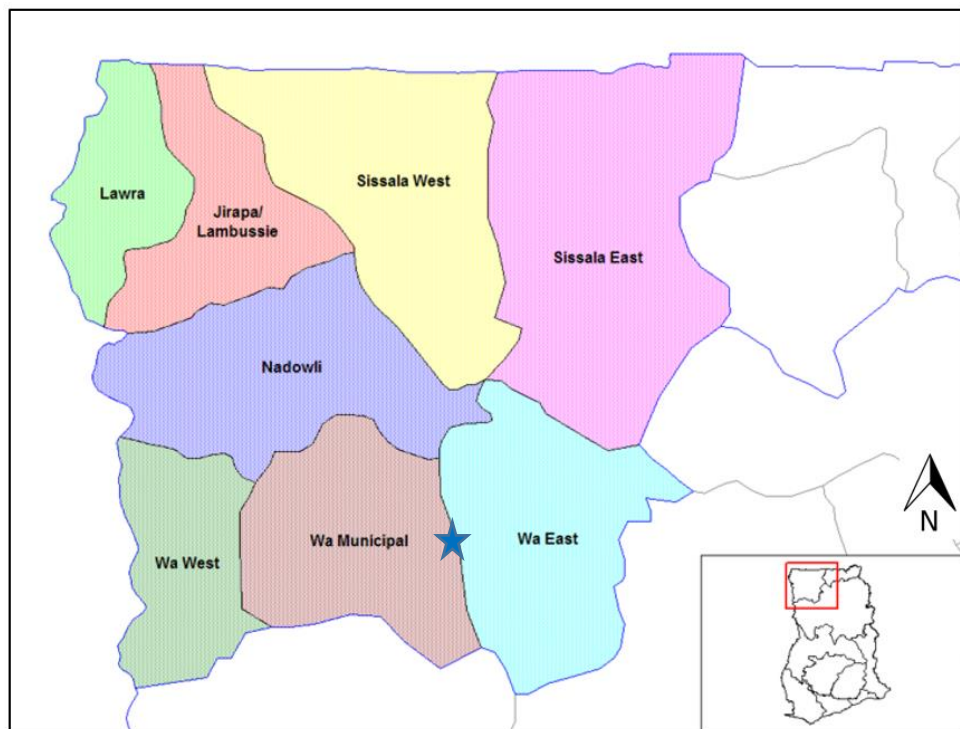


Figure 3.2 Map of the administrative Districts of Upper West Region. Location of the case study CODE-WA project villages is indicated with a blue star.

The project identified a pre-existing farmer group in each of the countries in order to implement the project. In Ghana the Kamwinsomte Women's Group participated in the project (CODE-WA, undated a). The Kamwinsomte Women's Group is located near Wa, the provincial capital of the Upper West Region (see Figure 3.2),

and they were identified as suitable participants for the CODE-WA project by SARI which is working in the region around Wa (L.Herrmann, 2013, pers.comm).

Kamwinsomte Women's Group originally formed in 1995 as part of a project being implemented by the World Food Programme. They have continued to work with other non-governmental organisations and the MOFA on agricultural projects since. Due to this SARI knew they were well organised as a group and they were well known to the MOFA staff who were working on the CODE-WA Project. The size of the group was suitable for the CODE-WA Project so all women in the group participated in the project, and they were located only 10 kilometres from the SARI station in Wa. Therefore, the Kamwinsomte Women's Group were identified as a suitable group for the CODE-WA Project because it was convenient due to the previous working relationship with both SARI and MOFA, and their proximity to SARI.

The CODE-WA Project focused on research into conditions for sustainable agriculture rather than directly targeting development goals. Therefore, the purpose of project activities was to identify generalisable results which could be disseminated across West Africa and built into future research projects and agricultural development interventions. Although the CODE-WA Project implemented development activities within farmer groups, this was with the aim of establishing research findings. Any beneficial socio-economic development impacts of these activities within the participating farmer groups were a by-product of the research activities rather than the project's targeted development outcomes. The results and recommendations of the project did not reflect on outcomes within the four farmer groups and there was no comment regarding whether project activities had any impact on agricultural productivity or adaptability to climate change (CODE-WA, 2012). Although the results stated that crop diversity increased at all four sites during the project, there was no information given regarding the impact that increased crop diversity had on the productivity and livelihoods of the farmers concerned.

### 3.5.2 Structure of the CODE-WA Project in Ghana

The CODE-WA Project combined on-station and on-field trials of improved crop varieties. During the first year of the project a range of crop varieties that had been bred by SARI and ICRISAT to be high-yielding and short-duration were grown at the SARI station in Wa. Although the on-field trials involved farmers selecting the crop varieties to grow, the varieties bred by SARI for the purposes of the project was not

selected by the farmers and had been bred by SARI scientists prior to the project. The farmers who were members of the Kamwinsomte Women's Group visited the SARI station repeatedly in order to observe the crops growing and assess them against one another. Thus, the participation at this stage of the project planning and implementation was passive as farmers observed crops which had been previously selected and had no say in project planning (see Table 2.1, Section 2.6.1 for a discussion of typologies of participation).

At the end of the cropping season at the time of the harvest the farmers gathered at the SARI station and engaged in a participatory evaluation of the crops which was facilitated by SARI staff. The farmers used participatory methods to identify which of the crop varieties they had been observing were the best in terms of crop yield and growth characteristics, as well as those which were most desirable according to social and cultural preferences locally. They then selected which of the improved crop varieties they wanted to continue to trial on-farm for the rest of the project duration. This stage of the project involved features of function and interactive participation (see Table 2.1, Section 2.6.1), whereby the farmers made decisions but within pre-determined limits of the format the project activities would follow.

During the remaining three years of the CODE-WA Project the farmers grew the selected crop varieties on their farms alongside their native varieties of the same crop types. During the first year of on-farm trials MOFA and SARI staff trained the farmers on farming techniques that were termed 'modern'. This included row planting, as well as appropriate application of pesticides, herbicides and fertilisers. Throughout the remaining three years of the project the farmers were provided with fertilisers to apply to their crops. The farmers also began growing their native crop varieties using row planting instead of a haphazard method they had used previously.

A significant feature of the CODE-WA Project was the use of farmer exchange visits where representative farmers from each of the four countries where the project was being implemented visited the other countries. Farmer exchange visits took place once per year, with one country site being visited in each of the four years of the project. During the farmer exchange visits the representative farmers and project staff visited the farmers' fields, exchanged ideas and knowledge, and taught others how to produce a local dish using one of the introduced crop varieties. Farmers were able to take seed samples back to their own community to trial.

As part of the CODE-WA Project the farmer group was provided with a budget which they were able to manage and spend as they wished. The Kamwinsomte Women's Group chose to buy refreshments for their meetings when they were working in the field as well as supplement the fertiliser they were given. The funds were paid into the Kamwinsomte Women's Group collective bank account annually and the group received training on book keeping and providing receipts for SARI. The decisions regarding the use of the budget were made collectively during group meetings.

### 3.5.3 Trax Sustainable Agriculture Project

Trax Program Support is an NGO working in the Upper East and Northern Regions of Ghana with the headquarters located in Bolgatanga. It was founded in 1989 and is an independent section of what was previously an international network of Trax organisations (Trax, undated a). It received funding support from a number of international organisations according to specific projects. Self Help Africa, an NGO based in the UK, funded a project from 2007 to 2015 to enhance climate adaptation in Northern Ghana which was facilitated through Trax (Self Help Africa, undated). Self Help Africa in turn received funding from UK Aid, the EU, Irish Aid, and US Aid.

However, there is some contradiction in the description and framing of this project between documentation from Trax and Self Help Africa. The Self Help Africa online documentation stated that the project was targeting Climate Change Adaptation, while the internal documentation from Trax titles the project Poverty Reduction in Northern Ghana through Sustainable Agriculture Interventions and Enterprise Development. The different titles suggest very different intentions for the project outcomes, even though the same project activities are described by both organisations. This research hopes to identify how the discrepancy in the titles of the project occurred through investigation of how understandings of adaptive capacity formed between the two organisations and other influences.

Trax initiates agricultural and livelihood development by implementing participatory methods with rural farming communities. Through participatory methods farmers are asked to identify the needs, issues or challenges they consider to be important in their community, and thus a participatory rural appraisal (PRA) is completed (Trax, undated b). Following farmer-led initiation of projects facilitated by Trax, the decision-making, organisation, management and evaluation of any implemented project activities is fully participatory with farmers. Trax state that they



will only initiate projects in communities at the request of the communities themselves (Trax, undated a).

Trax state that they turn to farmer-led initiatives and innovation rather than drawing on external technologies (Trax, undated b). Trax Ghana cite innovation as one of the key values in their work (Trax, undated a). Project activities facilitated by Trax apply principles of organic low external input sustainable agriculture (LEISA). Additionally, Trax provide training to support the development of community-based organisations and lead farmers, termed Community Trainers (Trax, undated c). Training, participatory exercises and practical project activities are all aimed to increase capacity, skills and empowerment.

The support provided by Trax draws on the concept of bottom-up participation because the process is instigated by farming communities requesting the support of Trax. Following this initial step the farmer participation in Trax projects requires organic participation, such as farmer problem priority rankings, as it is driven by decisions, facilitation and management by the farmers. There is a big emphasis on farmer participation within the work of Trax and grassroots facilitation of agricultural development projects is a key element of this. Trax state that “We respond to community needs rather than imposing ideas from the outside” and only provide the support in facilitation which the participating farmers decide is required (Trax, undated a).

#### 3.5.4 Structure of the Trax project

The Trax Program Support project is currently facilitated in a community, or project zone, for a five year cycle (previously it was seven years). After the five year project cycle has completed, the facilitation will move to a different project zone. There have consistently been two active projects zones in each of the Upper East Region and Northern Region. For the purposes of this research current and past project zones within Upper East Region (see Figure 3.3) will serve as the case study due to time limitations on fieldwork restricting ability to collect data in a wider area and with a greater number of communities.

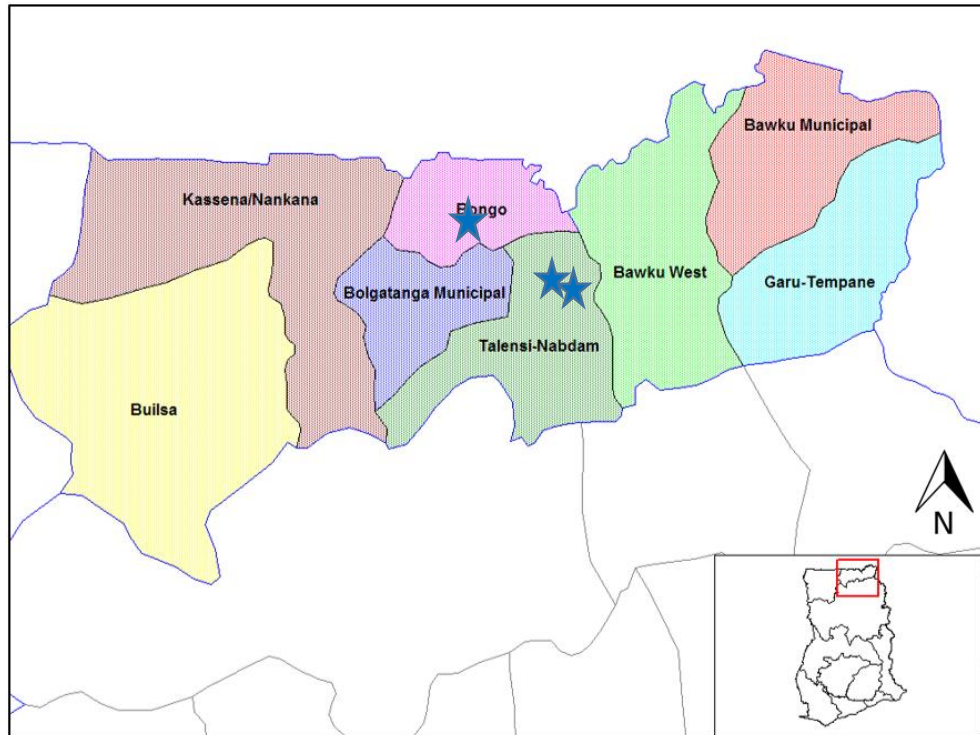


Figure 3.3 Map of the administrative Districts of Upper East Region. Location of the case study Trax project villages are indicated with blue stars

At the start of each five year project cycle, Trax staff will meet with the whole community in the project zone to complete a Needs Assessment using a participatory rural appraisal. This includes problem identification and ranking, as well as community resource mapping, creating a history profile and a seasonal calendar. The Needs Assessment acts as a baseline survey. It is also during the first year that farmer groups are formed within the community. Farmer groups are formed by the farmers through consensus around composition of the groups. All farmers who wish to participate in the project are able to form part of one of the farmer groups. If a group becomes too big then an additional group will be formed.

There are additional project activities in the first year which are designed to build social networks by creating linkages with other institutions and communities. The processes adopted by Trax staff allow for bottom-up participation, with Trax supporting the farmers' requirements through activities that are managed by the farmers. See Appendix D for full details of Trax project cycle and activities.

At the point of formation of the farmer group, Trax ensure that the groups develop a written constitution which is agreed on by all farmers in the group. This is formed through consensus among the farmers and provides a set of rules the group must

adhere to, such as the timing and frequency of group meetings and the roles of chair and secretary. Although the farmer group constitution is written by the farmers through facilitation from Trax staff, there is much similarity in the constitutions of different farmer groups. Through this participatory process of constitution development, the farmer group are encouraged to establish their own processes for consensus, collective governance, and shared responsibilities.

Beginning in the first year and continuing throughout the five year project cycle, a range of activities are facilitated under the project. Each farmer group or project zone will engage in the project activities that they have identified as something which will help to resolve the problems they identified during the Needs Assessment. For example, some project zones may receive a donkey and cart, some might receive a bullock and plough, while some might be given a machine for making soap or a shea nut grinding machine. Some farmer groups are trained on controlling bush fires by the Fire Service, while some are trained in making milk and kebabs from soya beans to improve nutrition. There are other project activities which most farmer groups engage with but vary according to the group.

However, there are some project activities which are standard for all the farmer groups and project zones. These include training on identifying contours and constructing stone bunds or grass strips to reduce soil erosion. Compost making using farm yard manure and crop stalks is a common project activity throughout project zones because soil fertility is naturally low and has become depleted by repeated cultivation. Farmer groups are also trained on the benefits of tree planting and are provided with seedlings and grafts to practice agro-forestry. Women farmer groups also receive a demonstration of how to construct fuel-saving mud stoves. Women groups are also supported to organise a Village Savings and Loans Association which each member contributes to every week and collects their savings once per year.

During the second year the farmer groups will collectively identify individuals who act as Community Trainers. Community Trainers are chosen by a majority vote within the farmer group. Once identified, Community Trainers receive training from Trax additional to that which the whole group receives. In training some members as Community Trainers it is intended that they will then be able to support the farmer group during and after completion of formal project facilitation from Trax, assist in the formation of a community-based organisation (CBO), as well as provide training to additional community members and those beyond the community. This structure of the

project is intended to support bottom-up participation and self-mobilisation of the group during and beyond the five-year project.

In the third year of the project a participatory monitoring and impact assessment is completed by the farmers, with Trax staff facilitating participatory methods with farmers. In the fifth year of the project cycle, Trax staff again meet with the whole community to complete an end of project participatory monitoring and impact assessment. The final report is prepared by Trax staff based on the outcomes of the participatory monitoring and a comparison of this with the Needs Assessment completed in the first year.

The five year project cycle begins working with six farmer groups within the project zone in the first year. An additional six farmer groups will be added to the project zone in each of the second, third and fourth years, totalling 24 farmer groups in each project zone. Each farmer group typically has between 25 and 30 members, sometimes more. In the 25 years that Trax have been operating in Northern Ghana, the NGO has to date worked with 321 farmer groups in 19 project zones. This totals over 7000 individual farmers who have engaged with Trax, reaching over 50,000 indirect beneficiaries who are members of the farmers' households.

This chapter has reviewed the context of agricultural development interventions and objectives to support adaptation and adaptive capacity in Ghana. The international and national policies which influence agricultural and/or adaptation interventions have been discussed in order to understand the policy context in which the two case studies for this research are situated. This discussion has introduced some of the diverse understandings of adaptive capacity which play a role within agricultural development interventions in Northern Ghana. The CODE-WA and Trax projects were introduced as the case studies and the context in which empirical data was collected has been outlined. In light of the context of the case studies introduced here, the following chapter discusses the research design and methods used for data collection and analysis.

## Chapter 4 – Methodology: Research Design and Data Collection

In order to examine empirical data, it is first necessary to understand the approach and process used to collect and analyse the data. This chapter presents the methodology used in this research. It first outlines the ontological and epistemological framing underlying the research and why this is an appropriate approach for this study. The process and methods used for data collection will then be outlined. Sections 4.5 and 4.6 present the methods used for data analysis and the associated analytical framework. Finally, this chapter will discuss some of the ethical considerations and potential limitations of this research.

### 4.1 Research Ontology and Epistemology

The ontology and epistemology of the researcher informs decision-making throughout the research process and is particularly important during the research design process. Ontology refers to the researcher's assumptions about the nature of those aspects of reality that are being studied, while epistemology refers to assumptions about the nature of the kinds of knowledge being sought. It is useful to outline the underlying ontology and epistemology that inform this research and consider how they apply to the research topic, research questions, and selected research methods.

#### 4.1.1 Subjectivism and Constructivism

The ontology underlying this research considers that social perceptions and interpretations influence actions and subsequent perceptions, interpretations and interactions within a system. In the context of this research, this refers to the perceptions and interpretation of, and within, agricultural development interventions. The focus is particularly on the diverse ways that adaptive capacities are understood and interpreted. Thus, viewing this research from an underlying assumption of the influence of social perceptions and interpretations on understandings of adaptive capacity supports the focus of this research. This perspective is in line with a subjectivist ontology:

“Subjectivism asserts that social phenomena are created from the perceptions and consequent actions of social actors. As social interactions between actors are a continual process, social phenomena are in a constant state of revision” (Saunders et al, 2012, p132).

This perspective is in line with the hypothesis, proposed in Section 2.8.1, that there are multiple understandings of adaptive capacity amongst stakeholders involved in agricultural development interventions in Northern Ghana and that these diverse understandings may differ over time and space. In order to examine subjective perceptions and interpretations this study adopts a realist constructivist epistemology.

Participatory development interventions, such as those featured in the case studies for this research (Section 3.5), highlight the multiple actors and institutions within one system and the many others that are interacting at nested scales. The challenge for practitioners and facilitators of participatory development interventions is to engage with and bring together the different issues, needs and solutions raised by diverse actors at, for example, an individual, institution, or system-level. As Leach has argued:

“System boundaries, dynamics, functions and outcomes are open to multiple *framings* - particular, contextual, positioned and subjective assumptions, methods, forms of interpretation, values and goals.” (Leach, 2008, p7, emphasis in original)

Within this research, the first research question (Section 2.8) is investigating the multiple framings and understandings of adaptive capacity used within selected participatory agricultural development interventions. This perspective of multiple voices and understandings of systems, interests and realities lends itself to a constructivist epistemological paradigm through which learning, knowledge and truth are created and understood by combined exploration of those who are engaged in it (Denzin and Lincoln, 2008; Sluka and Robben, 2007). Within the context of this research, the multiple actors and institutions interacting within agricultural development interventions can be considered as multiple voices interacting to co-create diverse understandings of adaptive capacity. Charmaz has argued that:

“Constructivism assumes the relativism of multiple social realities, recognizes the mutual creation of knowledge by the viewer and the viewed, and aims toward interpretive understanding of subjects’ meanings” (Charmaz, 2003, p250).

A constructivist approach enables multiple knowledges to be identified, thus it is useful in the context of this research because it allows for diverse understandings of

adaptive capacity to emerge through data collection and analysis. Constructivism goes beyond identifying the presumed knowledge or understanding to investigating the meaning of these knowledges and examining the views, values and contextual influences that influence the creation of these knowledges. Thus, a constructivist approach may also assist in responding to the first research question to investigate what diverse understandings of adaptive capacity existed within the case studies and how they developed.

Van Zwanenberg and Millstone (2000) propose a realist constructivist approach which acknowledges social factors in examining and explaining processes. As they suggest:

“Realist analysts can acknowledge that social factors affect all facets of scientific activity but are not compelled to explain scientific development purely in terms of social factors. Rather, a realist explanation of scientific development must make reference to complex interactions between social and natural factors, and these interactions will vary between different parts of science and at different stages of development of particular parts of science” (Van Zwanenberg and Millstone, 2000, page 261).

As such, a realist constructivist approach allows for complex relationships to be explored while also acknowledging that diverse elements of a system function at different spatial and temporal scales. A realist constructivist approach is appropriate for investigating the influences on understandings of adaptive capacity and the role of social capital within indicators of enhanced adaptive capacity. A realist constructivist epistemology is adopted in this study.

The focus on discourse in the process of constructivist knowledge creation implies a need to gather qualitative discursive data. Therefore, the research methods identified for this research will be mainly qualitative rather than quantitative. Thus, a research epistemology of constructivism informs the selection of research methods for data collection. Charmaz (2003) proposes that when applying a constructivist paradigm it is most appropriate to study people and the co-creation of knowledge *in situ*. This suggests that an ethnographic approach to data collection is appropriate (see Section 4.4.1). An ethnographic approach to data collection includes participant observation of the researcher in the communities, activities, or institutions being investigated (Hammett et al, 2015). Ethnography incorporates reflections and observations of the researcher as qualitative data alongside data from focus groups, interviews and secondary data (see Sections 4.4.3, 4.4.4, and 4.4.5). Furthermore, the constructivist

paradigm draws attention to local processes, interactions and interpretations, rather than global meanings. Therefore, it is suitable to investigate diverse understandings of adaptive capacity within participatory agricultural development interventions through the use of case studies.

## 4.2 Case Study Approach

As Eisenhardt (1989) suggests, case study research is an appropriate method for investigating complex systems: “The case study is a research strategy which focuses on understanding the dynamics present within single settings” (p534). Within the context of this research, the use of case study research allows for in depth investigation into the specific situations, processes and interactions relevant to the identified case studies.

A case study must be bounded and Stake (2003) suggests that, within social science research, a case must be an integrated system with a pattern of interactions or functions. As part of the study of the case it is useful to gain insight into the physical context and other socially or politically defined conditions that the case exists within, as well as the background history and evolution of the case being studied (ibid). Stake (2003) proposes that case studies are intrinsically complex because they must interact with a number of other potential cases (see discussion of panarchy in Sections 2.1.5) and function within dynamic conditions.

Within the restrictions of doctoral research, it is not possible to investigate all the causes and consequences of diverse understandings of adaptive capacity within all agricultural development interventions, or even within all such interventions in Northern Ghana. Therefore, it was necessary to identify a sample of agricultural development interventions to act as case studies for this research.

For the purpose of this research the case studies are identified as agricultural development interventions, within which the diverse understandings, indicators, and implications of enhanced adaptive capacity were investigated. In this research, investigation of the case studies was used to identify and characterise interactions between farming communities, project facilitators and national or international-level influences in defining the understandings of adaptive capacity that are identified. The



use of case studies for this research is to facilitate understandings and investigation of the causes of diverse interpretations of adaptive capacity within agricultural development interventions and its implications for sustainable agricultural livelihoods. Thus, using the terminology of Stake (2003), the case studies being used in this research are instrumental to understanding the processes and outcomes of defining adaptive capacity rather than an explicit interest in the case studies themselves.

In order to investigate the diverse understandings of adaptive capacity adopted within the case studies, it is necessary to identify the different stakeholders and their perspectives on the respective interventions. As introduced in Section 3.5, both case studies in this research involve a number of formal institutions functioning at different scales. The communities and farmer groups they engage with function as informal institutions, as outlined in Section 2.5.2. The case studies therefore allow for analysis of interactions and relationships between formal and informal institutions. Reed et al (2009) analysed methods to assess relationships between stakeholders collaborating in natural resource management. They suggested that different methodological approaches are suitable for analysis of interactions between institutions according to the rationale and purpose of the investigation. Reed et al (2009) proposed a typology of methods for analysis of interactions between stakeholders. The case studies in this research allow for analysis of interactions between formal and informal institutions and the role those interactions have on outcomes. This particularly relates to the participatory nature of the two interventions, responding to research question 3.

Although there are differences and similarities between them, the use of the two case studies selected for this research, described in Section 3.5, is not for a direct comparison between the two. The two case studies selected for scrutiny provide scope for investigation of a range of interactions with different types of actors and institutions as well as different processes, despite being implemented in a similar context and with similar stated aims. Furthermore, one of the projects had a base in Ghana but was also implemented in other countries in West Africa, therefore providing scope for generalisation of research findings to the other West Africa bases.

It is important to note, however, that the two case studies under investigation in this research are examples of agricultural development interventions and should not be considered as typical of all such interventions. The case studies are being used to

identify and examine complex processes of influences and interactions in determining understandings and indicators of enhanced adaptive capacity, and the implications of project outcomes for sustainable agricultural livelihoods, rather than reflecting the full scope of possible agricultural development interventions. Thus, there may be limits to generalisability of the research findings to other development interventions in different contexts or using different approaches. Furthermore, the qualitative nature of this study may restrict scope for generalisation because it is not statistically representative (e.g. Garbarino and Holland, 2009) Section 4.8 provides further reflections on some of the limitations of this research.

An additional potential limitation of the use of these two case studies is the lack of triangulation of data and findings. The two case studies provide rich data on enhanced adaptive capacity within agricultural development interventions but this was not triangulated with empirical data from a third case study. As such, it is possible that these two case studies present anomalies in the findings so any subsequent generalisation must be tentative. Section 8.8 reflects on this and the need for additional case studies to be investigated to strengthen findings. However, Burns (2014) suggests that triangulation of data is possible between different institutions involved in case studies, for example institutions functioning at different scales. Thus, although the data is not triangulated across case studies it is triangulated within the case studies through analysis of multiple individuals and institutions involved in the interventions.

### 4.3 Policy and Programme Evaluation

According to Weiss, evaluation research “assesses the extent to which goals are realized and looks at the factors associated with successful or unsuccessful outcomes” (Weiss, 1983, p31). Evaluation research within social programmes assesses an impact hypotheses (House and Howe, 1999), in this case that there are direct and indirect impacts resulting from diverse understandings, and different indicators, of adaptive capacity within agricultural development interventions.

Both case studies used for this research have the overarching objective to increase the sustainability of agricultural livelihoods of smallholder farming communities. Likewise, both case studies identify enhanced adaptive capacity as a trait which may help to achieve increased sustainability. As such, in order to establish

whether the interventions have been successful in achieving their objectives, it is necessary to consider how sustainability is understood. Section 2.3 examined differing understandings and uses of the term ‘sustainability’ and its relationship with adaptive capacity. The theoretical sustainability discourse was explored in the theoretical framework in Section 2.7 which identified sustainability as requiring social, environmental, economic, and political elements of a system to be sustainable. These multiple features of sustainability function over differing temporal and spatial scales, adding complexity to sustainability issues (Espinosa and Walker, 2011). The temporal dynamics of sustainability may result in feedbacks and emergent behaviours as seen in complex adaptive systems (see Sections 2.1.5 and 2.7.4). In addition to the criteria set by the interventions, outcomes of the two case studies will be evaluated against this framework through indicators identified in empirical data. Potential indicators of sustainability within the Trax and CODE-WA Projects will be examined in Section 7.2.

Coote et al (2004) suggested that evaluating complex systems is difficult because of challenges in determining boundaries of nested systems and due to continual evolution and change within adaptive systems. Therefore this research employed elements of participatory and developmental evaluation, which is interpreted as evaluation which is done during the course of a project or initiative and is conducted by project participants rather than by facilitators. As the developmental evaluation process is adaptive and responsive to change within the project or initiative, it is an appropriate approach to use in this study for the evaluation of interventions which sought to enhance adaptive capacity of farming communities. This reflexive and adaptive approach enables the intervention to respond to current conditions compared to the specified objectives and adjust either the project or the objectives accordingly throughout the process.

Participatory and developmental evaluations are used in order to identify how project stakeholders perceive the network and boundaries of the system within which the projects are implemented. House and Howe (1999) suggested that the constructivist perspective of evaluation research requires that research participants are engaged in dialogue at an early stage. From this, participatory evaluation follows, with the research participants directing the requirements of the evaluation process. Needham (2008) suggested that within participatory evaluation collective processes of co-production are most likely to be beneficial to participants and facilitators.

Patton (2011) suggested that developmental evaluation is particularly appropriate as a research method for evaluating features of complex adaptive systems because it allows for the process of evaluation to adapt and change with the policy or project that is being evaluated. “Informed by systems thinking and sensitive to complex nonlinear dynamics, developmental evaluation supports social innovation and adaptive management” (Patton, 2011, p1). A key feature of developmental evaluation is that the process is informed by the individuals and institutions engaged with the policy, project or initiative being evaluated. Further, the process of evaluation evolves throughout the relevant time period, and thus developmental evaluation is co-created with the features that are being evaluated. As a process and approach to applying research methods, developmental evaluation is suitable within a constructivist epistemology of co-created knowledge and understanding because it can incorporate the perspectives of many. Within this research the approach was used to incorporate the perspectives of numerous farmers as well as field staff, managers, and project funders. Where existing evaluations of the two case studies assessed quantitative values of numbers of farmers engaged and activities undertaken, the developmental evaluation used for this research sought the farmers’ views on the outcomes, and which of those were most significant in achieving sustainable agricultural livelihoods rather than those pre-assumed.

Developmental evaluation allows for the inclusion of a range of methods for data collection. This is particularly useful in researching complex adaptive systems because it may be necessary for different research methods to be used to investigate different elements or functions of the system and it allows for different methods to be used as systems changes over time.

One drawback of using developmental evaluation as a process for this research is that, by nature, developmental evaluation is an ongoing process throughout the lifetime of a programme, project or initiative (Patton, 2011). Through necessity, the research period and time available for data collection and fieldwork was limited for this research and thus a full process of developmental evaluation could not be completed. Furthermore, one of the projects investigated in this research had already been completed so the evaluation was of the development of outcomes over time rather than the development of the project activities. However, some of the key features of developmental evaluation are highly appropriate for this research and thus the principles of developmental evaluation were applied to the evaluative context of this research.

Evaluation of agricultural development interventions not only provided the necessary data for responding to the research questions outlined in Section 2.8, but may also provide information which may be useful for the management of the case study projects and development of future activities or similar projects by highlighting the farmers' perspectives on achievement of sustainable agricultural livelihoods (Greene, 2003). The principal investigator of the CODE-WA Project, one of the case studies identified for this research (Section 3.5.1), intended to complete a post-project evaluation at each of the four sites where it was implemented. The fieldwork for this research was conducted as the qualitative impact evaluation of the CODE-WA Project site in Ghana, thus providing data for the management of the project and informing similar future projects.

#### 4.4 Data Collection Methods

Primary data collection was completed during two fieldwork periods in Northern Ghana in 2014, totalling 28 weeks. Table 4.1 provides a summary of the data collection methods used and Appendix B provides a full list of research participants and dates of data collection.

Table 4.1 Summary of the data collection methods used and research participants

<b>Method</b>	<b>Number of times method was used</b>	<b>Male participants</b>	<b>Female participants</b>
Ethnography	NA	NA	NA
Visual ethnography	10 cameras	26	66
Participatory methods	14	63	134
Focus groups	19	65	152
Semi- structured interviews	149 (individuals interviewed 1, 2, or 3 times each)	34	60

<b>Method</b>	<b>Number of times method was used</b>	<b>Male participants</b>	<b>Female participants</b>
Key informant interviews	10	8	2

This research used a qualitative approach to data collection methods and data analysis. This was deemed appropriate because of the subjective nature of diverse understandings of adaptive capacity held by different individuals and the qualitative nature of the potential components of adaptive capacity identified in the theoretical framework (Section 2.7). Alternative approaches to assessing adaptive capacity within agricultural development interventions were considered but deemed to be insufficient for responding to the research questions set out in Section 2.8. Quantitative methods such as developing metrics for measuring adaptive capacity were evaluated. For example, a set of quantitative metrics for assessing agricultural interventions was proposed by Masters et al (2014) but these provided no scope for identifying understandings adaptive capacity or potential indicators of enhanced adaptive capacity.

The qualitative methods used for data collection were discussed with the facilitating institutions associated with both case studies prior to the fieldwork period. As both interventions used features of participatory activities, the field staff and directors of the projects believed that farmers would respond well to participatory methods and participant observation within an ethnographic approach. The use of these methods is outlined in the following sections.

Due to the locality of the two case studies (Section 3.5) and the diversity of ethnic groups in Ghana, the use of local translators was required when talking with farmers. It would have been preferable to work with one translator throughout fieldwork to ensure consistency in terminology used and strengthen a common understanding of the purpose of the research and required data. However, due to the nature of diverse rural communities in Northern Ghana it was not possible to work with a single translator throughout. Hammett et al (2015) discussed some of the contextual considerations when working with translators, including their positionality within the research context. Positionality will be discussed further in Sections 4.4.1 and 4.7.

The dominant ethnic groups for the Trax and CODE-WA projects are Frafra and Wala, respectively. Additionally, the Trax project covers quite a large geographical area and owing to the nature of locating the correct communities on narrow dirt tracks through fields, it was also necessary for the translator to have sufficient knowledge of the local area and to also act as a guide. Consequently, two translators were used during fieldwork with farmers engaging with the Trax case study in Upper East Region, one translator for communities in Nabdam District and one for communities in Bongo District. One translator was used when engaging with farmers participating in the CODE-WA Project in Wa Municipality, Upper West Region.

Translators were selected according to their ability to speak the respective local languages, their familiarity with the local communities involved with the case studies, their availability throughout the fieldwork period, and their knowledge of research methods and the subject matter. As suggested by Temple and Edwards (2002), prior to beginning data collection the researcher spent time with the translators in order to explain the topic of the research and elicit an understanding of the translators' perception of issues surrounding agricultural development interventions and adaptive capacity.

Temple and Edwards (2002) suggested that the role of translators in data production be explicitly acknowledged. This perspective of translators contributing to research through data production sits in line with the constructivist epistemology adopted in this research (see Section 4.1.1). Kiraly (2001) discussed the role of translators as co-creators of knowledge within a constructivist epistemology and this framing of the relationship between the translators, researcher, research participants, and data was used in this study. During preparatory discussions prior to data collection, this framing and the constructivist approach to data collection and knowledge co-creation was explained to the translators. This initiated a process of discussion about the research approach between the researcher and translators and how this related to the research topic in the local context. The translators then gave their suggestions regarding how best to proceed with introductions to the communities and farmer groups associated with the two case studies.

Access to the farming communities who participated in the two case study projects was obtained through the field staff of the two projects acting as gate keepers. The field staff acted as gate keepers by arranging meetings with the associated farmer groups to introduce the researcher and the purpose of the research to the farmers.

Following these introductory meetings the researcher met with the farmers in groups and individually, with the support of the appropriate translator as described above. As field staff from the respective interventions acted as gate keepers, it is possible that this will have influenced the positionality of the researcher as viewed by the farmers groups. If the farmers associated the researcher with the respective organisations, this could have influenced the nature of responses from research participants. Although it was explained to research participants that the researcher was independent of the associated institutions during explanation of the research and informed consent process, this may not have prevented all possible influence of the gate keepers on responses. Ethnographic records (discussed in the following section) included reflection on this during the two fieldwork periods. Positionality of the researcher and translator is discussed in Sections 4.4.1 and 4.7.

Purposive sampling was used to identify potential research participants. Purposive sampling was necessary because the research required participants who had engaged, or were engaging, with the case study projects, so intentionally identifying these individuals was necessary. All of the farmers who were members of the farmer groups which had engaged with the two case studies were approached for interviews and participation in focus groups during the data collection period. Individuals were given the option to not participate in the research but all of those approached opted to participate in the research process and gave informed consent to participate, discussed further in Section 4.7. The same research participants were invited to take part in each of the activities used for data collection, including focus groups, interviews, and participatory methods, discussed below.

#### 4.4.1 Ethnography

The investigation and collection of empirical data for analysis and evaluation was completed through observation, participation, discussions and interviews, drawing on an ethnographic approach throughout. Ethnographic research methods can be applied in any setting and can be highly reflexive, meaning the researcher can systematically reflect on their position in the research and how they influence the research design, framing, data collection and analysis (Chambers, 2003). A reflexive ethnographic approach is able to respond to changing circumstances or needs by adjusting the types and extent of interactions the researcher has with participants (ibid). Ethnography originated in the field of anthropology but the reflexive nature of the approach has



resulted in its application within a range of fields of study (Berg and Lune, 2014). The reflexive nature of ethnography makes it appropriate for use in investigating complex adaptive systems and participatory development projects because the personal and institutional situation of research participants may vary greatly, but ethnographic methods can be adapted to suit each situation.

Ethnography draws on a suite of predominantly qualitative research methods whereby the notes, comments and reflections of the researcher become data alongside those of research participants. Central to ethnography is the intention to gain an understanding of nuanced meanings within a group, culture or society (Hammet et al, 2015). Observation and participation, including the observation of research participants and the participation of the researcher within the lives or activities of the research participants, are essential components of ethnographic research methods.

The use of observation, interaction and involvement with project activities seeks to identify unspoken dynamics, relationships and rules within institutions and between project stakeholders (Angrosino and Mays de Pérez, 2003). In this context, it was difficult not to use ethnographic observation as a source of data because a great amount of information could be obtained from observing interactions between individuals. By spending time engaging with project activities and talking informally with project participants, it was envisaged that some information will be identified that is relevant to the research questions being addressed.

A constructivist paradigm can acknowledge that the researcher (or viewer) is a part of the co-creation of knowledge and understanding (Charmaz, 2003) because their perspective, in part, determines what they investigate. Additionally, the positionality of the researcher (see Section 4.7) can influence not only what they view, but what they consider to be of significance for investigation and how they interact with research participants and the co-creation of knowledge. Sultana (2007) suggested that the reflexivity and positionality of the researcher is contextual and both creates, and responds to, power dynamics. Hammett et al (2015) proposed that such positionality and reflexivity regarding power dynamics must be also applied to translators or research assistants. This was discussed with translators prior to beginning data collection. In addition, at the end of each day of data collection the researcher and translator met to reflect on the process and any positionality issues which had emerged. Review meetings were held with translators at regular intervals during the data collection period to review

progress with the data collected, reflect on the process and methods used for data collection, and respond to any positionality or ethical concerns which had arisen.

Within a constructivist paradigm, an ethnographic approach to fieldwork is particularly appropriate because it permits the researcher to become part of the data production process through participant observation and for notes, observations and reflections to become data. Sultana (2007) suggested that ethnographic fieldwork must incorporate reflexivity and self-critical reflection on power relations and positionality from the researcher. This was adopted in this research and ethnographic records noted reflections on relationships with research participants and translators, and two-way power and positionality dynamics between them.

#### 4.4.2 Visual Ethnography and Participatory Research Methods

Visual ethnography is one research method within an ethnographic approach. Visual ethnography considers the role of images, visual technologies, and ways of seeing, particularly within the context of understanding images associated with personal identity, culture and society of the research subject (Pink, 2013). Using images such as photographs, a researcher can continue to do empirical data collection and analysis while remote from the field. Pink (2013) argued that different epistemological and methodological approaches can complement one another to enable a thorough ethnographic examination of the research subject.

Historically, visual ethnography as a method was used for analysis of the researchers own photographs taken during fieldwork (Harper, 2003). As digital media have advanced and the presence of images has become commonplace within societies globally, visual ethnography as a research method has evolved to incorporate an analysis of the visual world within the research context (Pink, 2013).

“Contemporary visual ethnography uses photography not so much to claim ‘this is what is’, but to create a dialogue around the competing and complementary meanings of images.” (Harper, 2003, p244)

For the purposes of this research, visual ethnography was employed as a participatory method through analysis of photographs in order to complement other ethnographic and qualitative data. The use of this method was suggested by some of the research participants engaged in the Trax case study during the first fieldwork period. Participants suggested that this would allow them to show the researcher the things they considered to be important to changes which related to their agricultural livelihoods. In

response to this suggestion, visual ethnography was used during the second period of fieldwork. While not directly responding to the research questions, the content of the photographs taken by the farmer groups provided using contextual information which highlighted previously unidentified features of their agricultural livelihoods and how these interacted with adaptive capacity.

The researcher distributed celluloid film cameras to participants to enable them to determine the areas they considered important for the researcher to investigate within the agricultural development interventions they were engaged with. Participants were given the instruction to photograph things that indicated something of importance, change, or adaptation in any way they interpreted this. The cameras were left with the farming communities for between two and four weeks before being collected for processing. When collecting the cameras, focus groups were held with the farmer groups who had taken photos to discuss the process they had used and how they had engaged with the task. Once the photographs had been printed, the images were discussed with groups of farmers who were available in order for the researcher to gain some insight into why the farmers had selected the respective subject matter for the photos. This method gave research participants ownership and control of part of the research process while also providing an opportunity for the researcher to see through the eyes of participants using visual ethnography.

Within the context of the two case study projects as participatory agricultural development interventions, it was especially appropriate to adopt participatory research methods. These were applied within an ethnographic approach so observations of how research participants engaged with the process and with one another during the activities were also noted. Due to the participatory nature of the two case studies, research participants were familiar with a number of participatory research methods.

Participatory research methods were facilitated with groups of farmers, varying between five and 13 participants in each group. The groups of farmers developed seasonal calendars, completed problem ranking exercises, and prepared community resource maps. These were all facilitated during the first fieldwork period to provide background information on the socio-economic context of the agricultural development interventions under investigation. Although this contextual information did not directly respond to the research questions, it was necessary to gain an understanding of the

characteristics of the agricultural livelihood systems in which the two case studies were seeking to enhance adaptive capacity.

#### 4.4.3 Focus Groups

Focus groups are interview-style discussions held with small groups of research participants. Berg and Lune (2014) suggested that focus group discussions can help researchers to identify “conscious, semiconscious, and unconscious psychological and sociocultural characteristics and processes among various groups” (Berg and Lune, 2014, page 166). In the context of this, focus groups were used as a data collection method in this research in order to help identify the nature of interactions and relationships between members of the associated farmer groups. This provided evidence of some of the features of social capital identified as potential indicators of enhanced adaptive capacity among the groups, such as social networks, collaborative governance, and collective learning. As such, focus groups provided data which responded to research question 2. Along with semi-structured interviews (discussed below), focus groups provided the bulk of the data which responded to the research questions posed in Section 2.8.

Ethnographic focus groups were facilitated with research participants who were beneficiaries of the two case study projects. Table 4.1 provides a summary of the composition of the focus groups and Appendix B details the number of farmers which participated in each focus group. Both projects worked with organised farmer groups for the facilitation of the intervention activities. Therefore it was appropriate to talk to project beneficiaries in their farmer groups as they were familiar with group discussions and cooperation in this context. Focus groups, often referred to as ‘focus group discussions’, were employed as a research method with the intention of facilitating discussion among participants. The researcher initiated discussion on a topic through asking open questions for the group to discuss. An ethnographic approach to focus groups was used and the researcher noted any observations of interactions or behaviours which stood out. The researcher also recorded their comments on each focus group following each group meeting.

Focus groups during the earlier stage of fieldwork were used as a means to gain a thorough understanding of the context within which the agricultural development interventions were situated. This included the socio-cultural context, project beneficiaries’ opinions on their needs and priorities, and their recognition of changes

locally over different time-scales. During the main period of fieldwork, focus groups were used to develop an understanding of the ways different forms of social capital were interacting with the project activities, innovation, diversification, and adaptive capacity.

#### 4.4.4 Semi-Structured Interviews

Semi-structured interviews were employed as a primary research method for gathering detailed data on the understandings of adaptive capacity within the two case study interventions and investigating the consequences of this. Data from interviews responded to each of the research questions posed in Section 2.8. Semi-structured ethnographic interviews were conducted with each of the farmer beneficiaries who acted as research participants, as well as each of the individuals who facilitated the two interventions in the farming communities and relevant staff within associated organisations.

Berg and Lune (2014) suggested that interviews are a social interaction because they are a conversation with a purpose. Semi-structured interviews guide the conversation in order to meet the objective of the interview, but allow scope for the interviewee to influence the direction the conversation takes and for the interviewer to seek clarification or probe further should the discussion uncover pertinent issues (Sluka and Robben, 2007). In this research, semi-structured interviews gave individual research participants an opportunity to discuss the interventions, their interactions with the farmer group they were a member of, and their understanding of adaptive capacity without being influenced or biased by others.

Interviews sought to examine further the expectations of the projects, the existing understandings of adaptive capacity and which of those are utilised within the two projects, and how individuals, formal and informal organisations, and external influences interacted in the context of the two case studies. Discussion during interviews also investigated individual understandings of adaptive capacity, sustainability, and participation. Key informant interviews with individuals who facilitated the two projects also sought to gather detailed understanding of the process of project development and the interaction between external influences in order to investigate how diverse understandings of adaptive capacity have formed.

All direct quotes used from focus groups and semi-structured interviews which are quoted throughout this thesis are given in italics and are followed by the

anonymised interview or focus group identifier and date on which the interview or focus group took place.

#### 4.4.5 Secondary Data

As well as empirical data collected during fieldwork in Northern Ghana, this study also requires analysis of secondary data in order to respond to the research questions. In particular, secondary data provided some of the multiple understandings of adaptive capacity associated with the two case studies, responding to research question 1. Sources of secondary data include: internal and published project documentation from the facilitating formal institutions; published documentation from associated institutions; online and publicly-available documentation from associated institutions and relevant agencies; and policy documents from the Government of Ghana (see Section 3.2) and other relevant international bodies such as the African Union (see Section 3.1). Other relevant documents encountered during the research period also inform some commentary within the ethnographic data and discourse analysis. Information contained within secondary data also informed some of the questions asked during interviews with relevant key informants.

The following section outlines the methods used for data analysis of the visual, audio, and textual qualitative data collected through the above methods.

### 4.5 Data Analysis

Data analysis was based on the methodological process of grounded theory. Grounded theory is primarily concerned with identifying and explaining what is occurring within a specified human or social domain. This approach is particularly suitable for this research because the subject, data collection methods, and the research epistemology all concern the shared generation of knowledge and the potential for practical application of research theory and findings. This approach originated in the sociological sciences and, although conceived as applicable to multiple disciplines and interdisciplinary research, it has primarily remained a method utilised within qualitative social sciences.

As Gibson and Hartman (2014) explained, “[grounded theory] is problem-focused because it involves studying how people experience and resolve their everyday

problems” (p2). With this in mind, it is an appropriate method to inform data analysis for this study which has a research philosophy and methodology based on the concepts of the co-creation of knowledge and ethnographic investigation of everyday interactions, behaviours and relationships within the two case study projects (e.g. Charmaz, 2003).

Grounded theory applies a process of coding qualitative data whereby text is coded into themes, words, concepts or categories. Coding is intended to identify themes or categories from the data and then integrate these coherently into a theoretical framing of the data (Gibson and Hartman, 2014). Data analysis for this research drew on multiple iterations of coding throughout the data collection and data analysis periods. Each iteration of coding identified different levels of concepts and themes which emerged from the data (Yitshaki and Kropp, 2016). The first iteration identified patterns in the data and a second iteration coded concepts into categories across the data. A third iteration grouped these concepts into themes which related to the research questions (Section 2.8). Table 4.2 presents the concepts and themes generated during each iteration of the coding.

Table 4.2 Structure of data analysis indicating the concepts and themes generated during each iteration of data coding

First Coding Iteration	Second Coding Iteration	Third Coding Iteration
Documented understandings of adaptive capacity within project plans, reports, and evaluations	Formal understandings	Multiple understandings of adaptive capacity in existence
Understandings of adaptive capacity within external documents, reports and policies which are related to the projects		
Verbally reported understandings of adaptive capacity not given in project documentation	Informal understandings	
Understanding of adaptive capacity explained using visual aids		
Farmer groups governing own resources and decision-making processes	Social capital	Indicators of adaptive capacity

First Coding Iteration	Second Coding Iteration	Third Coding Iteration	
Social networks and diversity of types of relationships and interactions between different stakeholders			
Farmer groups identifying shared problems and potential solutions, common goals and opportunities			
Solidarity, unity, and togetherness of farmer groups			
Experimentation and innovation within farming and livelihood sources	Physical and technological capital		
Diversified agricultural biodiversity and diversified livelihood sources			
Adoption of introduced knowledge, technologies or practices			
Farmer groups governing own resources and decision-making processes	Intended outcomes		Outcomes of enhanced adaptive capacity
Experimentation and innovation within livelihood sources			
Adoption of introduced knowledge, technologies or farming practices			
Diversified agricultural biodiversity and diversified livelihood sources			
Empowerment, agency and autonomy of farmer groups	Unexpected outcomes		
Farmer groups identifying shared problems and potential solutions, common goals, and opportunities			
Diversity of types of interactions and governing processes			



First Coding Iteration	Second Coding Iteration	Third Coding Iteration
Farmer groups governing own decision-making processes resulting in increased empowerment and agency over time	Indicators of sustainability	Implications for sustainable agricultural livelihoods
Experimentation and innovation of relationships, farming methods and technologies, and combinations of livelihood sources		
Participatory project activities enhancing social capital which is increased over time	Processes and outcomes for sustainability	
Farmers sharing introduced processes, farming methods, and technologies with other farmers and communities		

Data from focus groups, interviews, and ethnographic records were all treated the same way during data analysis. The iterations of coding described above were applied to all focus groups, all interviews, and all ethnographic records separately in order to identify any potential patterns in the context in which similar issues emerged. In cases where there was a lack of clarity or contradictions within the data from individuals or farmer groups, follow-up interviews or focus groups were held to seek clarification.

The photographic data recorded by research participants were coded in a similar way to focus group and interview transcripts and researcher notes. The researcher systematically analysed each photo, noting key words for the content of the image, writing descriptions and recording notes and comments. This text was then coded as qualitative data, initially alongside the main body of qualitative data, and then with all data incorporated together for a second iteration of coding. Records of discussions with farmers about the photos they took, what the subject of the photos were, and why they had taken them were also coded.

In a grounded theory approach to data analysis, discourse analysis was also used as a method for interpreting qualitative data. Discourse analysis was particularly used for analysing secondary data and the rhetoric, linkages and influence within and

between policy and discourse documents from international, national and local-level formal institutions associated with the case studies.

To assist analysis of extensive qualitative data, computer software NVivo Version 10 (QSR International, 2014) was used for data management and analysis. NVivo software was used to assist the process of coding, identifying key concepts within qualitative data, identifying linkages within and between qualitative data at different levels of analysis (e.g. individual farmer, farmer group, community, and project case study), and identifying linkages with theoretical and conceptual discourse.

#### 4.6 Analytical Framework

The previous section outlined how data were analysed through a process of iterative coding through and across qualitative data. Table 4.2 provided an outline of the concepts, categories, and themes which emerged through data analysis. This analytical framework explains how those concepts, categories and themes relate to the theoretical framework (Section 2.7) and research questions (Section 2.8). As such, the analytical framework presents what the data analysis focused on, how it focused on those areas, and why. Figure 4.1 gives an overview of the analytical framework, indicating how the concepts, categories and themes are related to the theoretical framework and research questions. The following sections expand on this overview, providing detail to the analytical framework.

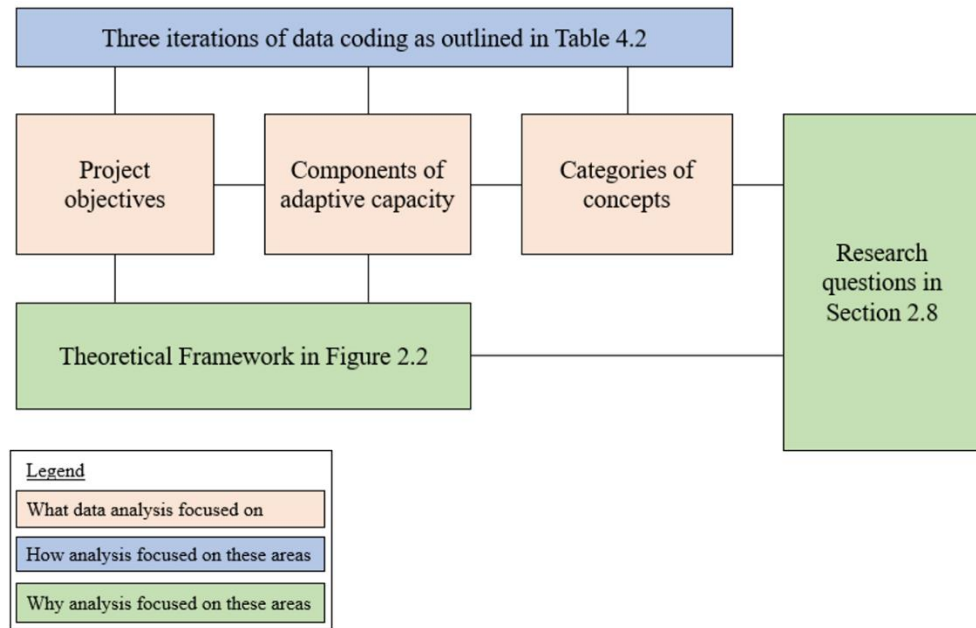


Figure 4.1 An overview of the analytical framework indicating what, how and why the data analysis focused on these concepts

#### 4.6.1 Research Framing and Theoretical Framework

This research is drawing on the concepts of social-ecological systems and complex adaptive systems (Sections 2.1.4 and 2.1.5). The role of these concepts in relation to agricultural systems provided the foundation of the literature review in Chapter 2, from which the theoretical framework was derived. Perceiving agricultural livelihoods as parts of systems is reflected in the complex pathways to sustainability discussion in Section 2.7.4 in the theoretical framework.

Within this research, adaptive capacity is considered to contribute towards sustainability of agricultural livelihoods. Adaptive capacity can support farmers to respond to experienced or anticipated change to social, economic, political, environmental, climatic, infrastructural, or institutional conditions. Thus, in this research, adaptive capacity is framed within a broad concept of change, and may support farmers to minimise risk or increase benefits resulting from change.

This underlying framing informed the theoretical framework, which outlined a series of potential components of adaptive capacity, which are being tested in this research. Figure 2.4 indicates how components of social capital and physical and technological capital may contribute towards enhancing adaptive capacity, which may in turn contribute towards the sustainability of agricultural livelihoods. This research framing and the theoretical framework provide the left-hand section of the analytical

framework as represented in Figure 4.2 and describes which concepts and themes data analysis focused on. The theoretical framework explains why it is appropriate to focus on these concepts and themes, following a review of relevant literature.

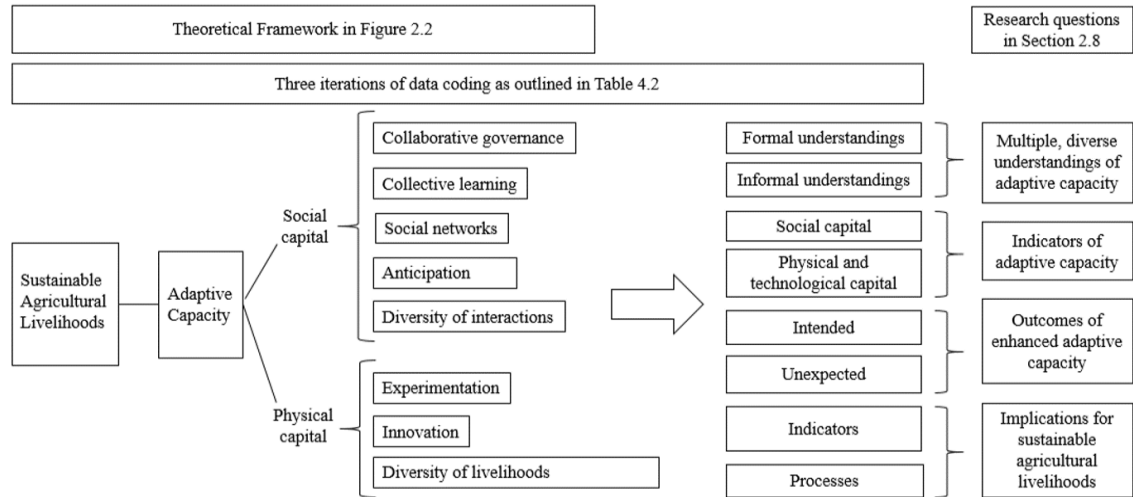


Figure 4.2 Analytical framework indicating relationships between the contributions of the research framing, the theoretical framework in Section 2.7, components of adaptive capacity being tested, categories generated through data coding, and the research questions

The theoretical framework also informed the development of five research questions and four hypotheses to be tested (Section 2.8). The research questions form the right-hand column of the analytical framework in Figure 4.2, indicating why analysis of the concepts in the theoretical framework are appropriate for responding to the research questions. The steps in the iterations of data coding, discussed in the following section, link the concepts of the theoretical framework with the research questions in hope of uncovering findings which can contribute to topical and pertinent discourse around adaptive capacity.

## 4.7 Research Ethics

Permission to engage with the two projects as case studies for this research was obtained from the directors of each project prior to submitting the research proposal for approval and ethical review. Prior to beginning fieldwork for data collection, ethical

approval for the research was obtained from the University of Sussex Social Science and Arts Cross-School Research Ethics Committee. The ethical review process addressed issues regarding the involvement of research participants and any possible impact the research could have on individuals, as well as the safety of the researcher during fieldwork. See Appendix A for certificate of ethical approval.

Formal consent was obtained from all research participants before beginning any data collection. All staff members of the case studies' facilitating formal institutions and associated organisations provided written consent. The majority of farmer participants were illiterate so were unable to provide written consent. Therefore, the research was clearly explained and verbal consent was obtained before beginning data collection. Ethnographic observation and participation of the researcher were overt.

The ethical procedures followed during this research ensured all primary data was anonymised at the point of data collection, providing confidentiality because participant responses could not be identified as belonging to any particular individual. Issues of confidentiality were explained to research participants from the facilitating formal institutions because it may be possible for individuals to be identified due to their job title through searching online documentation and profiles. This was acknowledged in the formal consent for the relevant participants.

A further ethical and methodological issue concerns the role and positionality of the researcher, as well as the positionality of the researcher as perceived by participants, and that of the translators. Within a constructivist paradigm researchers recognise that they are actors in the co-creation of knowledge; their research is situated and perspectival. Likewise, translators are co-creators of the research data and process (see Section 4.4.1) and the positionality of the translator must also be considered during fieldwork. Thus, there is the potential that the views and perspectives of the researcher and/or translators may be reflected within data collection processes. This is particularly pertinent to the determination of what is significant to investigate and what should be recorded as data from ethnographic observations. There is an element of this in any research and particularly so in social sciences and qualitative data collection. It is not possible to remove the subjectivity of the researcher but it is important to acknowledge the potential role this may play. As outlined in Section 4.4.1, during fieldwork the researcher met with translators frequently to review the research process and methods used and reflect on any emerging power or positionality dynamics.

#### 4.8 Limitations of the Research

The data collection processes, and therefore research findings, were limited by several factors. The data collection was particularly limited by the different nature of the two case study projects. Most significantly, participant observation within the facilitating formal institutions and project implementation activities was only possible with the Trax Sustainable Agriculture project (Section 3.5.3). Participant observation was not possible with the CODE-WA Project (Section 3.5.1) because this project formally ended in 2011 so was no longer being implemented by the associated institutions or through project activities. This resulted in a greater amount of ethnographic data being produced for the Trax project than for the CODE-WA Project.

Furthermore, the Trax project is a long-running cyclical project which works with hundreds of rural smallholder farmers in Upper East Region, providing hundreds of potential research participants. However, the CODE-WA Project was facilitated with a total of 25 rural smallholder farmers in two communities over a three year period. Therefore, the number of research participants for the two case studies differ greatly, further widening the difference in quantity of data between the two case studies.

The previous section referred to the role of positionality of the researcher and translators during fieldwork and the potential for this to raise ethical concerns. Marshall and Rossman (2006) suggested that despite acknowledging positionality issues from the outset, and seeking to be reflexive on the research process, positionality always creates a bias in research. As outlined in Section 4.4.1, the researcher discussed positionality and power dynamics with translators before beginning data collection and at frequent points throughout the fieldwork period. Although this approach to consideration of positionality allowed for reflexivity within the research process and reflection on emerging issues enabled scope for response, it is not possible to completely remove issues of positionality of the researcher in a fieldwork context, particularly in the case of cross-cultural research.

The influence of positionality and power dynamics on the research process, empirical data, and data analysis cannot be measured because it is subjective (Hammett et al, 2015). However, it is possible that the findings of this study are limited due to influences of positionality as research participants may have given biased responses or

may have responded in ways they believed the researcher or translator expected or wanted. Thus, although this research explicitly considered positionality issues during fieldwork, there may or may not be some limitations to data validity resulting from perceptions of positionality.

There is a temporal nature to both adaptation and the outcomes of development interventions. Thus, it would have been most desirable to conduct fieldwork and data collection throughout the lifetime of the case study projects, and beyond formal implementation. However, time restrictions on the nature of doctoral research limited the possibility to conduct temporal data collection. Due to data having been collected within a short time period relative to the time-span of adaptive capacity and intervention outcomes, the data may not have been able to capture features of all of the temporal dynamics of change.

This chapter has reviewed the methodology adopted in this research. The qualitative methods used for data collection respond to the constructivist epistemology which recognises the co-creation of knowledge. The methods used for data collection have been situated in the context of the research questions posed in Section 2.8. Section 4.5 explained three iterations of data coding which supported the analytical framework outlined in Section 4.6. Figure 4.2 summarised the process used to analyse data. Drawing on this framework, the following three chapters examine empirical data in response to the five research questions being investigated. The next chapter responds to research question one by analysing diverse understandings of adaptive capacity within the two case studies. Chapter 6 examines indicators of enhanced adaptive capacity and contributions of participatory project activities to meeting intended outcomes, responding to research questions two and three. Chapter 7 considers the implications of enhanced adaptive capacity for sustainable agricultural livelihoods and lessons from this for policy and planning, responding to research questions four and five.

## Chapter 5 – Evolutions of Understandings: Political-Economies and Social Framings

### 5.1 Introduction

This study is an investigation of the diverse understandings of adaptive capacity within agricultural development interventions, and how those understandings have formed. It is therefore necessary to first discuss what understandings of adaptive capacity are existing within agricultural development interventions and in what ways these differ from one another. In response to research question one this chapter will discuss the diverse understandings of adaptive capacity which are currently identified within the two case study interventions. Secondly, this chapter will examine how these diverse understandings have formed, the interaction between different understandings, and the evolution of understandings over time.

The analytical framework outlined in Section 4.6 indicated how the theoretical framework (Section 2.7) and data analysis are linked to the research questions. This framework proposed several features of social capital and physical and technological capital which emerged as concepts through data analysis. Figure 4.2 indicated links between these concepts and the project objectives of enhanced adaptive capacity and increased sustainability of agricultural livelihoods. This chapter examines how these project objectives were conceptualised in the two case studies and the related understandings of adaptive capacity.

For the purposes of this research, two participatory agricultural development interventions in Northern Ghana were selected as case studies (see Section 3.5). The understanding of adaptive capacity within both the Trax and CODE-WA Projects can be expected to relate to conceptions of what adaptation is, and how and why it may occur. Both case studies state their intention to support farmers to adapt by enhancing their adaptive capacity through agricultural development interventions. However, there are conflicting perceptions of what an adaptation is and what adaptive capacity is among the formal and informal institutions associated with the two projects (Table 5.1).



Table 5.1 Stakeholders involved or associated with the two case studies

	<b>Trax</b>		<b>CODE-WA</b>	
	<b>Directly associated institutions</b>	<b>Indirectly associated institutions</b>	<b>Directly associated institutions</b>	<b>Indirectly associated institutions</b>
<b>Farmers</b>	Pelungu, Kabusgo, and Nakpalig communities		Jonga and Doodiyiri communities	
<b>Local facilitators</b>	Trax field staff		MOFA field staff	
			SARI field staff	
<b>Local directors / managers</b>	Trax Director		MOFA Municipal Director	
			SARI Lead scientist	
<b>National policy and institutions</b>		MOFA	MOFA	SADA
		SADA	SARI	
<b>International funding institutions</b>	Self Help Africa	CIP	ICRISAT	
	UK DfID (Department for International Development)		German BMZ (Ministry for Economic Cooperation and Development)	
<b>International policy and discourse</b>		CGIAR		UNFCCC
		FAO (United Nations Food and Agriculture Organization)		CGIAR

This chapter characterises the diverse understandings of adaptive capacity existing within all formal and informal institutions associated with the two case studies. This positions these diverse understandings within the formal and informal framings of the projects and how these interact and shape one another over time. Formal understandings of adaptive capacity are recognised as those which were held in official project documentation and are agreed, project-wide understandings. Informal understandings of adaptive capacity are those which were held by individuals associated with the projects and were not formally documented under the project statements, reports, activities and objectives. This discussion will relate those understandings to one another with reference to the postulated conceptualisation of adaptive capacity within this research.

## 5.2 The Evolution of Formal Understandings within Trax

There are two dominant routes of international influence on the understandings of adaptive capacity which were formally present within the Trax Sustainable Agriculture intervention. Firstly, the historical influence from when Trax Ghana was established by a group of international individuals has shaped the focus and evolution of Trax's projects and formal understandings over a 27 year period. Secondly, the contemporary influences from international funding organisations inform current project activities and understandings. Alongside these two dominant international influences are a number of other influences which have informed the Trax Sustainable Agriculture intervention in recent years, notably global discourses surrounding climate change. This section will address the two dominant international influences with reference to other global issues which have guided Trax's understandings. This section reports that as a result of the two influences at different times, there are two simultaneous formal framings of the agricultural system and understandings of adaptive capacity evident in different types of documentation. Discussion will situate these international influences on understandings of adaptive capacity within the context of power and participation discourses.

This section draws on discourse analysis from the formal documentation of Trax Ghana and their Sustainable Agriculture interventions. All documentation was written by Trax staff so may not present the farmers' perspectives. However, through the facilitation of participatory methods, farmers produce the responses that form the basis of monitoring and evaluation reports, and thus documentation prepared by staff incorporates some parts of the farmers' responses. It is the intention of the organisation that the perspective, opinions and aims of the farmers are specified and facilitated through the project as the farmers define their priorities through participatory methods (Trax, undated a).

Some of the relevant documentation used for analysis is historical and relates to the development of the organisation and intervention activities since Trax Ghana was established in 1989. The intervention facilitated by Trax is cyclical and although much of the empirical data gathered was through participation of farming communities currently engaged in the Trax project, to fully investigate how understandings of adaptive capacity have formed it is necessary to consider current understandings in relation to historical influences.

#### 5.2.1 Historical International Discourse within Trax Understandings

Trax Ghana was established in 1989 by an international group of former Silsoe College (now incorporated into Cranfield University, UK) students who initiated the NGO to provide community-based technical and advocacy services for smallholder farmers. Documentation records that the group of individuals who established Trax believed that sustainable and low cost practices for soil and natural resource management could support food security for rural farming communities in Northern Ghana (Trax, 2014, unpublished internal document).

With the formal establishment of Trax as an NGO came the introduction of participatory processes to ensure that farmers' priorities were addressed through Trax's agricultural development interventions. The participatory approach was incorporated with the aim of developing self-reliance within the farming communities Trax worked with. This was intended to encourage social sustainability alongside sustainable farming and natural resource management practices. The intervention was planned such that the farming communities developed the capacity to continue to engage once Trax was no longer actively facilitating the agricultural project, intending to reduce communities' reliance on external institutions.

It is apparent that in framing sustainability of the local agricultural system as requiring social structures that enable sustained engagement, some of the social characteristics of adaptive capacity identified in the theoretical framework for this research would be anticipated. Trax documentation makes reference to building capacity to develop self-reliance. Within the conceptualisation of adaptive capacity adopted for this thesis, indicators of self-reliance include characteristics of adaptive capacity such as consensus building, collaborative governance, collective action, and shared learning.

Although historical and contemporary Trax documents state that they support bottom-up participation, the establishment of Trax Ghana occurred through top-down decisions made in the UK, which were then taken to Northern Ghana. There are now multiple forms of participation within Trax's interventions rather than distinct top-down or bottom-up processes. Section 2.6.1 discussed multiple typologies of participation and Table 2.1 presented seven typologies of which five can be identified within the current Trax project, namely: participation in information giving, participation by consultation, functional participation, interactive participation, and self-mobilisation (Chatty and Colchester, 2002).

Although formally the UK-based Board of Trustees was passed to Ghanaian responsibility in 1995, many of the concepts and intentions initially introduced by the international group who established Trax survive in the current agricultural development interventions facilitated by Trax. The 2016 Mission Statement of Trax stated "*Our Mission is to empower rural communities in Ghana through sustainable capacity development to achieve and sustain improvements in their environment and livelihoods*" (Trax, undated b). Despite a participatory review of the organisation's mission and project activities in 2001, this Mission Statement changed little in the 27 years of operation.

The above Mission Statement specifies empowering rural communities as a priority, reflecting the importance of social sustainability in the formal framing of the Sustainable Agriculture intervention (Section 5.2.7) and the informal understandings of adaptive capacity discussed below (Section 5.3). Although it did not specify what was meant by the term 'sustainability', Trax's Mission Statement twice made reference to sustainability, identifying the need for sustainability within community capacity development, the local environment and economic activities through livelihoods. These

three domains of sustainability within the current Trax intervention are discussed further in Section 5.2.6.

Comparison of current project documentation and activities with documentation from the 1990s shows that much of the terminology used within Trax remained unchanged. Further, the project activities facilitated between 15 and 25 years ago are still supported today, the main change in activities being the addition of new initiatives alongside the existing interventions (discussed further in Section 5.2.4). The preservation of organisational terminology and objectives indicates institutional memory within Trax. Institutional memory is held in the concepts, collective knowledge, and experiences of a group of people. As people within the group change over time the group as a whole maintains the collective knowledge, resulting in the memory being held in the institution (Hirshleifer and Welch, 1995). None of the staff working for Trax during data collection for this research worked with the organisation when it was established, yet the concepts, priorities, and knowledge have been maintained for 27 years through institutional memory.

Comparison of historical and current project documentation shows that the principal activities within the agriculture intervention from both periods are: construction of stone bunds, crop residue management and composting, tree planting and protection, and dry season gardening (Trax, 1998, unpublished internal report; Trax, 2014, unpublished internal document). In addition to these, the current project activities include livestock management, cultivation of orange-fleshed sweet potatoes (see Section 5.2.4), and Village Savings and Loans Associations (see Appendix D for further details of Trax project activities).

The heritage of agricultural development interventions from the point at which Trax Ghana was established is evident in contemporary documentation and during organisational meetings. Description of when and why Trax Ghana was established and how the project was structured is included in the current staff induction package. The existing internal documents frame the current agricultural development interventions in the context of the history of Trax Ghana and the project activities that have consistently been a feature of the intervention. Furthermore, the historical development of Trax was outlined during the staff quarterly meeting in July 2014 at which the Director of Trax explained the incorporation of social, environmental, and economic sustainability to current staff. Discussion during the staff quarterly meeting directly related the current

project activities of the Sustainable Agriculture intervention to the initiation of Trax Ghana as an organisation.

This indicates the significance of the initial intentions and processes of Trax Ghana in shaping the recent agricultural development interventions. The concepts which originated with the international group of individuals who established Trax have had a lasting influence on the Mission and structure of Trax's projects. In historical organisational documents there is no reference to adaptation or adaptive capacity. Although this historical international influence may not relate to the primary focus of this study it is still pertinent to examine the influence on understandings of sustainability because this is evident in discussion of adaptive capacity in Section 5.3.

Although the above discussion indicates that the historical international influence on Trax has informed understandings of sustainability but not those of adaptive capacity, it is interesting to note that historical documentation makes reference to encouraging farmers to "adapt to local circumstances" (Trax, 1998, p3, unpublished internal report). This reference to adaptation is in relation to facilitating low external input sustainable agriculture (LEISA). In the context of this study it is useful to note that this reference to adaptation from 1998 referred to local circumstances and not to climate change. This subject will be discussed further in Sections 5.2.2, 5.2.4 and 5.3.1.

While the processes and project activities introduced in 1989 have remained constant within Trax, additional influences throughout the past ten years in particular have led to some extra activities to be incorporated into the interventions. Recent and current international influences on Trax's understandings of adaptive capacity are discussed in the following section.

### 5.2.2 International Funding and Framing within Trax

Since 2006 the majority of Trax's funding has come from UK-based NGO Self Help Africa, with other international NGOs providing smaller funds for specific intervention activities. Self Help Africa is in turn funded primarily by UK Aid and Irish Aid. Being funded by international funding agencies, as an organisation Trax must adhere to the project interventions agreed with and funded by Self Help Africa. Further, Self Help Africa must respond to the expectations and interventions agreed between them and the UK Department for International Development (DfID). In this way, it is possible for large international funding agencies to influence and/or determine the intentions and activities of agricultural interventions in distant regions or countries. The

role that political economy has played in influencing the understanding of adaptive capacity and intervention activities within Trax will be discussed further in Section 5.2.4.

The top-down international understanding of adaptive capacity which is transferred to local development interventions is incorporated within a broader top-down framing of international development. When introducing the reasons for examining the role of power within the development discourse, Crush (1995) stated that: “Africans become objects for the application of power rather than subjects experiencing and responding to the exercise of that power” (Crush, 1995, p2). The concept of Africans as subjects of development is also echoed in the approach of some Self Help Africa staff which positions farmers in Northern Ghana as recipients of agricultural development interventions conceived in the UK.

Records of ethnographic observations during fieldwork indicate the top-down transfer of knowledge approach of Self Help Africa staff towards Ghanaian smallholder farmers. During informal conversation with an international staff member of Self Help Africa, he stated that “*we can support these farmers to modernise away from the backward methods.*” He went on to state that “*if they can move into bush farming instead of just homestead farms then Trax can be successful*” (KI16, 4/8/14). These statements discount the expertise and indigenous knowledge of farmers in Northern Ghana, as well as the capacity of Trax to support them effectively and appropriately. These comments overlook the existing adaptive capacity that smallholder farmers have, which is demonstrated by the fact that farming communities have existed in this region for generations. The latter comment further overlooked Trax’s 27 years of practice in responding to the priorities of smallholder farmers in this area of Northern Ghana.

Although not directly referring to his understanding of adaptive capacity, these statements indicate a top-down framing of power, knowledge and the transfer-of-technology in development discourse in which he positioned the Trax agricultural intervention. Perceiving farmers as recipients of agricultural development interventions overlooks opportunities for collaborative governance and collective learning through multi-directional sharing of information, traits which were postulated as supporting adaptive capacity in Sections 2.2 and 2.7. In this way, the top-down influence of international political economy on contemporary development interventions can become problematic.

During an interview, the Sustainable Agriculture Advisor for Self Help Africa explained that the intervention they funded with Trax had at one point been provisionally titled '*Climate Change Adaptation*'. This had not been the title of the existing intervention Self Help Africa funded and during review it was agreed to continue using the previous title of '*Poverty reduction in Northern Ghana through sustainable agriculture interventions and enterprise development*'. However, Self Help Africa had used the provisional title '*Climate Change Adaptation*' on its website, creating a lack of clarity about the intentions and aims of the intervention (Self Help Africa, undated a). The website has since been amended to reflect the working project title (Self Help Africa, undated b).

In trying to examine the differences in the understandings of the intervention aims and activities of the two project titles, four Self Help Africa staff were interviewed (see Appendix B). When discussing the former provisional title of the Trax intervention, '*Climate Change Adaptation*', the Self Help Africa Sustainable Agriculture Advisor at times used the term 'adaptation' synonymously with the term 'resilience', compounding the lack of clarity. While discussing understandings of adaptive capacity, he framed his understanding in relation to resilience. Section 5.2.3 will examine this resilience framing in detail. He subsequently framed Trax's Sustainable Agriculture intervention in relation to this conceptualisation of resilience. Discussion of the intervention activities and the differing titles presented by the two organisations indicated that Self Help Africa viewed the project broadly as contributing to the resilience of smallholder farmers to climatic shocks. Within this broad resilience framing, he explained that he understood household and community-level actions in response to shocks and stresses as contributing to adaptive capacity.

### 5.2.3 Contemporary International Resilience Frameworks Associated with Trax

In contemporary discourse surrounding theory, policy and practice, adaptive capacity is frequently discussed alongside resilience. At times the two terms are used synonymously, others identify one as a component of the other, while others still consider adaptive capacity and resilience to be mutual goals of development policy and practice.

During an interview with the Sustainable Agriculture Advisor for Self Help Africa, the UK-based funder of Trax Ghana, he outlined in detail a resilience framework



which included the role of adaptive capacity. He explained that Self Help Africa had been party to discussions among the Interagency Resilience Working Group (IRWG) along with Farm Africa and the UK Department for International Development (DfID)<sup>1</sup>. *“We try to actively understand new terms. What is resilience? We focused on resilience in rural communities and the agriculture sector”* (KI16, 4/8/14). He then described the framework for resilience which the IRWG had produced.

The resilience framework described by the Self Help Africa Sustainable Agriculture Advisor outlines three capacities which together enable resilience: absorptive capacity, adaptive capacity, and transformative capacity. He explained that early warning of hazardous events activates absorptive capacity. In explaining his understanding of adaptive capacity within this framework, he stated:

*“Adaptive capacity is the things people do at the household or community level to respond to stresses and shocks, which is often responding to drought, floods, and pests and diseases”* (KI16, 4/8/14).

He went on to explain that transformative capacity is action at the national level.

The Sustainable Agriculture Advisor explained that this resilience framework considers resilience within three domains: ecological, economic, and organisational.

*“So we [Self Help Africa] target economic, ecological and organisational resilience and think with a community to assess these. We use an integrated holistic approach, not prescriptive, so that we can work on absorptive, adaptive and transformative capacities in these three areas.”* KI16, 4/8/14

On further questioning he went on to identify specific features of the Trax agricultural development intervention which he considered to reflect these capacities in the three domains described.

On examination of the documents the Self Help Africa Sustainable Agriculture Advisor referred to, it is evident that the framework for resilience he outlined is not that of the IRWG (IRWG, 2012). Rather, it is apparent that the resilience framework outlined by the Self Help Africa Advisor is that of Béné et al, 2012 which concurs exactly with that described above. Béné et al (2012) provide a resilience framework whereby absorptive capacity enables stability and persistence, adaptive capacity enables

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<sup>1</sup> There were 17 agencies which were party to the Interagency Resilience Working Group. Self Help Africa, Farm Africa and DfID were the only ones which this research participant referred to during interview. Farm Africa were not party to preparing the IRWG document discussed here. Other members of the IRWG were: ActionAid; CDA Collaborative Learning Projects; CAFOD; Care; Christian Aid; Concern Universal; Global Network of CSOs for Disaster Reduction; HelpAge; Plan; Practical Action; Save the Children; Tearfund; IR WorldWide, World Vision, and WWF (IRWG, 2012).

flexibility and incremental adjustment, and transformative capacity as bringing about change and transformational responses.

The understanding of the concepts of adaptive capacity and resilience presented by Béné et al (2012) differ to those within the analytical framework postulated in Section 4.6. Much like the term ‘adaptive capacity’, understandings of ‘resilience’ differ between individuals and institutions. As discussed in Section 2.3.2, and following Holling (1973), here resilience is understood to enable or ensure stability within a system, maintaining the system’s functioning following a shock. As such, transformative capacity would not fall within this understanding of resilience as this characteristic changes the state of the system. Again, adaptive capacity is a system trait which enables adaptation, a form of change to the system no matter how slight. Furthermore, adaptive capacity is considered to also function in response to stresses and long-term change while Leach et al (2010) propose that resilience is a short-term characteristic and robustness the comparable long-term trait. Béné et al (2012) considered absorptive, adaptive and transformative capacities to function over different timescales and thus see resilience as a long-term, or sustained state. As such, Béné et al (2012) understood adaptive capacity as contributing to long-term resilience by functioning at a medium-term scale while interacting with absorptive and transformative capacities at the short and long-term scale, respectively.

The framing of resilience adopted by Béné et al (2012) has similarities to that of the Pathways to Sustainability approach (Leach et al, 2010), although in places using different terminology for similar concepts. For example, Béné et al (2012) propose that absorptive capacity enables stability during shocks, while Leach et al (2010) refer to stability as contributing to dynamic sustainability by controlling short-term shocks. Thus, although there are some differences, the framing of resilience proposed by Béné et al (2012) is relevant to this research and may be appropriate for framing sustainable agricultural livelihoods.

As Self Help Africa were party to the development of the framing of resilience within the IRWG, this understanding can be taken to be that of Self Help Africa and thus is pertinent to this research as they are closely partnered with Trax. The documentation output of the IRWG refers to adaptive capacity only twice but these statements clearly indicate an association between resilience and enhanced adaptive capacity. “Resilience looks at impact beyond achieving project activities to the longer

term positive change and enhancement of adaptive capacity which may result over time” (IRWG, 2012, p5). This is unclear as to whether the ultimate objective of development interventions is to enhance resilience or adaptive capacity, or whether these terms are here being used synonymously. It does, however, identify adaptive capacity as a characteristic which develops over time, implying a long-term time frame in which adaptive capacity functions.

The second reference to adaptive capacity within the IRWG document identified adaptive capacity as a characteristic necessary to respond to uncertainties (IRWG, 2012, p7). Again it is unclear where adaptive capacity fits within that understanding of resilience because the context of this reference was a discussion of the characteristics of resilience. Seemingly, the IRWG recognise adaptive capacity as associated to resilience but do not clarify what they understand the term to mean or how it is related to resilience.

#### 5.2.4 International Political Economy within Trax

As mentioned in Section 5.2.2, as an organisation Trax must facilitate the intervention activities as agreed with the funding agency. When approving funding for an intervention, the planned activities and intended outcomes must therefore respond to the expectations of the funder. Trax is directly funded by Self Help Africa and indirectly funded by DfID. Thus, as the priorities, expectations, and demands of these international funding agencies change over time, the intervention facilitated by Trax must reflect these changes in order to continue to receive funding. An example of a project activity which was introduced by Self Help Africa is discussed below.

In 2013 Trax established a pilot project activity within their Sustainable Agriculture intervention. The activity was a pilot of cultivating an improved variety of orange-fleshed sweet potato (OFSP). The improved variety had been bred by CIP (International Potato Centre) based in Tamale to be fast-yielding and thus grow in a shorter duration as is needed in years of drought. This pilot was introduced to Trax by Self Help Africa who also connected Trax with CIP for the potato vines for cultivation. Following a pilot cultivation during 2013 the OFSP project was expanded in 2014 with further expansion in 2015. The motivation of Self Help Africa in introducing this activity into the intervention was, ostensibly, adapting to the increased risk of drought with climate change through the adoption of the cultivation of drought-tolerant crops.

This differs to the stated objective of enhancing adaptive capacity through increased diversity of agricultural livelihoods.



Figure 5.1 To the left are the improved variety of OFSP following harvest; to the right are the native variety of sweet potato harvested on the same day as the OFSP

Despite being bred to grow in a shorter duration, yields in 2014 show that the improved variety of OFSP is smaller than a native variety of sweet potato from a nearby area, even during drought years (Figure 5.1). Figure 5.1 shows the OFSP variety and a native potato variety harvested on the same day having been grown in neighbouring plots. The native potato variety is not typically grown in this area of Northern Ghana but was grown next to the OFSP as part of a trial to compare the two crops. The native potato variety has a longer growing period than the OFSP so was planted four weeks earlier and both varieties were harvested on the same day. Northern Ghana experienced a drought during the early wet season in 2014. In the three-month cultivation period the OFSP grew well despite the drought. However, the native variety, which requires a four-month cultivation period, also grew well but is naturally of a much larger size. Thus, even though it requires a longer cultivation period, during periods of drought the native variety of sweet potato provides a higher yield per vine than the ‘improved’ OFSP.

Farmers have cited other concerns in growing the introduced OFSP, including the sweet potato weevils damaging crops before harvest and an inability to store the harvested produce for periods of more than a few months. Crucially, sweet potato is not

a traditional part of the diet in this region of Northern Ghana. This means that there is a limited market for sweet potato so restricted scope to expand production. During the 2014 harvest, farmers stated that they were happy with the OFSP but would prefer to grow other crops such as vegetables because they can sell surplus yields at a higher price than sweet potatoes and they are certain there will be a market for them.

Ethnographic observations during fieldwork indicate the authoritative role that Self Help Africa had in the Trax Sustainable Agriculture intervention. During informal conversation and staff meetings on several occasions, the Director of Trax referred to the need to adhere to what Self Help Africa request Trax as an organisation to do. On one occasion he stated “*What can we do? We have to increase on OFSP or they will stop funding us*” (KI1, 21/7/14). This is one example in which Self Help Africa have requested Trax introduce new interventions over which Trax had no influence and have been required to implement to maintain an amenable relationship with their primary source of funding. As also referred to in Section 5.2.2, this top-down external decision-making process goes against the farmer-led participatory approach which Trax had sought to utilise since being established in 1989 (see Section 5.2.1).

Discourse analysis of Trax and Self Help Africa documents has identified that, while Self Help Africa were prioritising new activities within the Trax intervention, the majority of the range of activities which Trax facilitated (see Appendix D) remained the same throughout Trax’s history. The proposal for Trax’s agricultural intervention funded by Self Help Africa from 2014 to 2015 identified poor soils and land degradation as restricting agricultural productivity in Northern Ghana (Trax, 2014, unpublished internal document). The LEISA approaches referred to in the proposal are the same as those which Trax supported following establishment in 1989.

Although this suggests that Trax’s priorities have remained the same for 27 years of operation, this may be a reflection of the priorities of the farmers they work with. Trax utilises a participatory approach to ascertain the needs and priorities of the farmer groups they support. Discussion with farmers during data collection identified that at individual and community levels they recognised poor soils and unreliable rainfall as their principal challenges that impact farming activities. It is reasonable to expect that the challenges and priorities of the farmers may be similar in each new community that Trax works in. Following this, the primary activities of Trax’s

intervention would be expected to be similar in each community and therefore broadly remain the same over time.

Trax has maintained a focus on LEISA and natural resource management with the aim of increasing crop yields while supporting environmental sustainability. Self Help Africa introduced additional activities to broaden the scope for poverty reduction through alternative livelihood sources. In doing so, Self Help Africa also introduced concepts, terminology, and international perspectives of development intervention priorities. Within this introduction of concepts and terminology it was possible to identify the incorporation of adaptation and climate change in Trax's project as originating with Self Help Africa (see Section 5.2.2). Here, the international framing of the need for adaptation in response to climate change, rather than adaptive capacity as postulated more broadly in this research (outlined in Section 2.7) became one of the understandings within the context of Trax's agricultural development intervention.

#### 5.2.5 Trax's Framing of the Agricultural System

The Trax project aimed to assist farmers to instigate agro-ecological farming practices. It is therefore useful to understand the framing of the agricultural system in which the Trax project was implemented. Discourse analysis identified two framings of the agricultural system within which the Trax project intervened and the rationale for those interventions. Firstly, the discourse and rationale which originated with the establishment of Trax Ghana in 1989, which relied on a participatory, social approach to the interventions. Secondly, there was a discourse surrounding crop production as the primary focus, with supplementary incomes which stemmed from Self Help Africa, then the main funder, and a need to measure quantitative outputs for the funders. These two discourses will now be discussed in turn.

The agricultural system within which the documentation of the Trax project framed its activities was viewed through a social perspective, placing farmers at the centre of farming rather than crop production. This responded to the requests and needs of farming communities rather than defining the limits and activities of the project prior to interactions with the farmers (Trax, undated b). Empowerment of rural farmers was a central feature of the rationale to using this approach, citing commitment, innovation, fairness and accountability as underlying empowerment (Trax, undated a). The concept of empowerment within the Trax intervention and its relation to enhanced adaptive capacity will be discussed further in Chapters 6 and 7. This approach had been a feature

of the Trax project since it was established in 1989, a period in which farmer participation was becoming increasingly common and desirable (see Section 2.6). Trax's social perspective of the agricultural system appears to have similarities with the social processes and characteristics which were postulated as traits of adaptive capacity within this research (see Section 2.7), discussed further in Chapter 6.

Although the agricultural system was approached through a social perspective, it was framed within a combined social-ecological system as the farmers' interactions with their surrounding environment is the context within which agricultural development is placed (see Section 2.1.4 for discussion of social-ecological systems). The Trax documentation repeatedly refers to the environment, identifying that environmental resources are depleted and need to be improved and sustained for agricultural production (Trax, undated b).

The project aimed to develop agricultural practices within environmental management activities to ensure sustainable agriculture and environmental resources (Trax, undated a). This approach drew on agro-ecological practices (see Section 2.1.3) to implement environmentally sensitive agricultural production. The intention was for farmers to adopt agricultural practices which are environmentally sustainable so that the community functions effectively and efficiently within their surrounding environment.

This social-ecological approach, which adopts farmer participation as a rationale and process for implementation, has been presented in the formal framing of Trax Ghana in historical and contemporary documentation and public media (e.g. Trax, 1998, unpublished internal report). However, in recent years an additional framing of the agricultural system and rationale for intervention was evident alongside this one. This alternative framing placed crop yields and increasing production at the centre of the intervention, with farmers as a means to achieving that (Trax, 2014, unpublished internal document). This approach drew on the introduction of additional crop varieties within a crop-livestock farming system and supplementary livelihoods, recognising diversification of livelihood sources as enhancing adaptive capacity. This rhetoric is evident in internal documentation shared between Trax and their primary funder, Self Help Africa.

This alternative framing of agricultural systems present within the Trax project placed agriculture within a predominantly economic system, recognising that crop yields are necessary as a source of income to reduce poverty. This economic framing of agriculture has also been evident in the formal title of the project which is funded by

Self Help Africa which acknowledges agriculture alongside enterprise development: *‘Promotion of Sustainable Agriculture and Enterprise Development for Poverty Reduction among Smallholder Farmers in Northern Ghana’*.

Ethnographic observation showed that these two framings of the agricultural system Trax work within were both current. However, they were not discussed together and the framing adopted depended on the context of conversation. Seemingly, the two framings have different understandings of sustainability and how it is related to the overarching aim of the project as poverty reduction. A social-ecological framing considers agricultural production within a long-term perspective requiring the sustainability of natural resources. This approach considers how communities live and work within their surrounding environment and sustaining agriculture within a changing environment. Focusing on crop production ostensibly separates the rationale for the intervention from the society that may benefit from increased crop yields by concentrating on quantitative values of yields and income rather than the impact that increased yields can or does have. This approach is shorter-term, seeking income generation on a seasonal to annual basis.

With this background of dual framing of agricultural systems and how they relate to broader understandings of sustainability, the following sections discuss the formal framing of sustainability within Trax as apparent in publicly available documentation.

#### 5.2.6 Sustainability within the Trax Project

Trax Ghana consider sustainability to be central to poverty reduction. In line with the framing of agricultural systems within a social-ecological context, sustainability was viewed through this framing too. Thus, Trax’s understanding of sustainability includes environmental sustainability, food security and reduced poverty (Trax, undated a). Trax aims to achieve environmental sustainability through improved management of environmental resources (Trax, undated d). The organisation identifies food security as being at a household level and consider security to mean each household is able to access food throughout the year (KI1, 25/2/14). Food security was expected to increase through sustainable agricultural practices which function effectively within their local environmental conditions.

It was anticipated that improved socio-economic conditions for communities engaging with the project were to be met through reduced poverty and maintained



livelihoods. From this perspective, sustainability was considered to require the sustainability of social and ecological features of the system. Sustainability was also considered as the need to sustain these features in the face of climate change and increasing climatic variability. This framing of sustainability echoes the discourse outlined in Section 2.3.1 which followed the Rio Earth Summit in 1992, and places this within the context of agro-ecological systems discussed in Section 2.1.3. Understandings of adaptive capacity within a social-ecological framing of sustainability are discussed further in Section 5.3.6 and in relation to outcomes for system sustainability in Chapter 7.

Within this understanding of sustainability and local agricultural systems, adaptive capacity is apparently seen as adapting agricultural and livelihood practices to variable local conditions, while maintaining and improving natural resources through environmental management. Therefore, adaptive capacity is not seen only as a means for the agricultural system to function effectively within local conditions, but the agricultural system and the practices contained within it must adapt practices so that the environmental resources it relies on are managed and improved (Trax, undated b).

This framing of sustainability recognises the need to sustain physical characteristics of the system, namely the natural environment and human wellbeing (through food security and poverty reduction). It does not, however, address the sustainability of social characteristics of the agricultural system, which Trax recognised within the social-ecological framing. The following section discusses how Trax understood social sustainability.

#### 5.2.7 Collaborative Governance for Capacity Building in Community Groups

Organisational documentation suggested that farmer participation was central to Trax Ghana and the Sustainable Agriculture project. The Trax project aimed to build capacity through strengthening community networks and formalising community groups to enhance their local governance. The project sought to stimulate grassroots innovation, community learning and local governance to build the capacity for the communities to adapt to ongoing changes in circumstances, without the need for external interventions (Trax, undated b). Although the documentation does not use the same terminology, those social processes are seemingly the same as collaborative governance, shared learning, and innovation which were included as characteristics of adaptive capacity outlined in the framework for this research (Section 2.7).

These social processes are recognised by Trax as features of capacity building to support social-ecological sustainability within the agricultural system. As such, farmer participation and community-based project management are ostensibly utilised as a means to achieve enhanced adaptive capacity and sustainability. However, the processes of enhancing social sustainability which Trax identified, and the terminology they used in doing so, do not provide indicators for assessing evidence of these processes existing within farmer groups. Potential indicators for sustainable agricultural livelihoods will be discussed in Chapter 7.

The formal framing of the agricultural development intervention facilitated by Trax indicates how the organisation formally positioned itself and its actions within the broader context. This discussion has referred to the public image of Trax and what is communicated to external individuals and organisations. Although there is limited discussion of adaptive capacity within formal framings of the Trax project, the framings of agricultural systems and sustainability are useful for appropriately examining the associated understandings of adaptive capacity.

This section has identified two formal understandings of adaptive capacity, one originating with the establishment of Trax in 1989 and historical discourse influences at that time, with the second originating with the recent primary funder of the Trax project, Self Help Africa. The first formal understanding of adaptive capacity recognises features of social networks, participation and learning as well as adoption of innovations and diversification of livelihood sources. The second formal understanding focuses more heavily on physical and technological characteristics of adaptive capacity, identifying features of adoption of innovations, experimentation among farmer groups, and diversification of livelihood sources. The following section examines the informal understandings of adaptive capacity within the Trax intervention in parallel with the formal understandings discussed above.

### 5.3 Informal Framings of Adaptive Capacity among Trax Staff and Farmers

This section discusses the diverse understandings of adaptive capacity which informally existed within the Trax project. This considers the understandings articulated by individual staff members associated with facilitating the intervention as well as those

of the farmer groups who were participants of the project. The section identifies diverse understandings which differ from the formal understandings discussed in Section 5.2, and the circumstances in which these informal understandings were active. Some similarities between the multiple informal understandings and between the formal and informal understandings are also examined.

As detailed in Appendix B, four staff responsible for different roles in implementing the Trax Sustainable Agriculture project were interviewed. There were variations in the understandings of adaptive capacity that each individual described. Repeat interviews and discussion of adaptive capacity observed through ethnographic participation indicated some conflicting perceptions of understandings.

### 5.3.1 Framing Adaptive Capacity within Interventions

Qualitative data analysis indicated that when talking about adaptive capacity, Trax staff discussed this specifically in relation to Trax's project interventions. While discussing adaptive capacity during an interview, the Director of Trax made reference to an "*action, intervention, or project*" (KI1, 25/2/14) which supports farmers to adjust. It was evident that he was explaining his understanding of adaptive capacity in relation to Trax's agricultural development intervention. This was a common characteristic of the understandings of adaptive capacity articulated by Trax staff. All but one of the four associated staff members interviewed referred directly to project interventions, and the fourth used the term "*we*", implying Trax and/or formal institutions external to the farming communities.

Although during one-on-one interviews all of the associated Trax staff framed their understandings of adaptive capacity in the context of Trax's project interventions, relevant discussion at other times (informal conversation, staff meetings, and field visits) referred to adaptation more broadly. During an exchange between the Trax Director and the Sustainable Livelihoods Project Coordinator in a staff meeting, the Director spoke about global efforts to adapt in response to climate change. He then took this into a discussion about Trax's response to "*local capacity building*" and a "*need to explore climate change resilience through mitigation and adaptation*" (quote noted in ethnographic records).

This statement linked the Trax agricultural intervention to climate change adaptation discourses. As discussed in Section 3.1.2, recent discussions regarding adaptation and adaptive capacity have focused on climate change (e.g. Pelling, 2011;

Smit et al, 2009; Adger et al, 2006; Mace, 2006). The rhetoric surrounding adaptation to climate change primarily focuses on intervention-based adaptation. Framing an adaptation as an intervention reinforced the concept of physical and infrastructural adaptations that prevailed in international and Ghanaian policy (Sections 3.1.2 and 3.2.2). This broader discourse surrounding the physical change brought about through an intervention supported the framing of adaptive capacity within the Trax intervention. Framing adaptive capacity and adaptation within the Trax intervention runs throughout the understandings of adaptive capacity outlined by Trax staff in the following sections.

### 5.3.2 Indirect Influence of National Agencies on Trax Understandings

Although there is limited formal influence of the Ghanaian Ministry of Food and Agriculture (MOFA) on Trax's projects, understandings and framings, there are routes of informal influence, particularly in the case of individuals rather than the organisation or interventions as a whole. Both of the field officers working for Trax, who were interviewed for this study, had worked for MOFA prior to being employed by Trax. Additionally, the Director of Trax previously worked for the Ghanaian Forest Service. Due to time limitations (see Section 4.8), the empirical data collected for this study does not contain data regarding if or how individual's understandings of adaptive capacity had changed over time. Therefore it was not possible to identify whether their employment with MOFA may have influenced their current understandings. However, both field staff referred to the adoption of techniques as constituting adaptive capacity in the same way that the MOFA staff did.

Previous employment within national governmental ministries or agencies provided indirect routes through which historical influences could be partially responsible for the understandings of adaptive capacity within Trax. As discussed in Section 5.2.1 and 5.2.2, there is evidence that the historical origins of Trax Ghana continue to influence the formal framing of the Trax Sustainable Agriculture project. In the same way it is possible that historical influences continue to inform the understandings of Trax staff.

De Vente et al (2016) and Reed et al (2009) suggested that knowledge exchange among formal institutions and between formal and informal institutions may be an outcome of participatory processes. It is possible that engagement between Trax staff and national governmental ministries and agencies provide scope for Trax staff to influence the informal understandings of those working for the governmental

institutions. However, the influence of Trax on other formal institutions is not directly assessed through this research because the focus is on the Trax project as a case study. In addition, limitations of time and access to governmental ministries and agencies during the fieldwork period did not permit thorough investigation of two-way feedbacks of knowledge exchange. Thus, as there is an indication of historical influences of national governmental institutions in the informal understandings held by Trax staff, it is equally possible that there would be some influence of the understandings held by Trax staff on those working for governmental ministries and agencies.

As a non-governmental organisation there is minimal influence of national governmental policies and other relevant discourse on the intervention activities or over-arching mission on Trax. However, at a local level there was some necessary interaction between Trax and the Ministry of Food and Agriculture (MOFA). When training community livestock workers as a feature of the crop-livestock farming system, Trax collaborated with the veterinary services from the local MOFA stations. Further, at times Trax staff also engaged with other national agencies including the National Fire Service in training farmers on bushfire prevention.

The Trax Director stated that the partnership with MOFA worked well because they supported the objectives of both formal institutions. The MOFA District Director for Bolgatanga Municipality concurred with this statement during interview. He stated that MOFA and Trax were working towards the same goal of reduced poverty and increased food security through an increase in yields. Although the overarching goals of the two institutions may have been the same, the perspectives, processes, and methods they each identified as a means to achieve these goals differed greatly.

As outlined in Section 5.2, Trax identified an agro-ecological and low external input approach as a locally-appropriate method for developing agricultural yields in an environmental sustainable manner. Divergent to this approach, MOFA stated that agricultural yields could be increased through ‘modernisation’ and ‘mechanisation’ but did not directly refer to the sustainability of this approach in formal documentation (Section 3.2.1).

The MOFA District Director stated that the Ministry aimed to “*promote food security through research and technology*” (KI7, 7/3/14). He further outlined some of MOFA’s principal concerns in the Upper East Region, including subsidising fertilisers, pump irrigation and highly commercial commodities. The emphasis on technology, inputs, and commercial farming did not tally with the low external input and agro-

ecological approach adopted by Trax. Furthermore, the MOFA District Director stated that Trax and MOFA had different approaches. He explained that he considered organic agriculture, which Trax supported, was not able to increase yields to a great extent. He suggested that organic farming could increase yields a bit, but combining organic farming with inorganic fertilisers had the greatest potential for the best outcome of yield increases.

The MOFA District Director explained that he considered organic farming not to be sustainable because soils in the semi-arid environment became depleted of nutrients. He stated that farming in the region could only be sustainable by applying fertilisers and pesticides. Conversely, Trax advocated low external input sustainable agriculture because they believed this to be sustainable as farmers do not need to buy inputs and thus farming would not fail when they could not buy the inputs. Thus, although Trax and MOFA stated that they work well in partnership and both institutions are striving for the same objectives, the two institutions have different approaches and understandings of how these objectives could be achieved sustainably.

Individuals belong to informal institutions within society and community structures which influence and instruct indigenous knowledge, ideas and behaviours throughout a lifetime. Within the context of the Trax project, the field staff are Frafra, the local ethnic group (see Section 3.4.2), and have been raised in local farming communities. As such, the staff belong to both formal and informal institutions associated with the Trax project resulting in the potential for multiple or mixed understandings of adaptive capacity and relevant concepts. These understandings may be informed by their engagement with formal and informal institutions beyond those associated with the Trax project. The multiple influences on individuals associated with Trax may create nuanced understandings of adaptive capacity which are then incorporated as informal understandings within the intervention. The following section discusses the diverse understandings of adaptive capacity outlined by staff within the Trax project.

### 5.3.3 Adopting Interventions as a Component of Adaptive Capacity

During interviews, field staff working with the Trax project all referred to the adoption of technologies or techniques while explaining their understandings of adaptive capacity. One field officer described the ability of farmers to adopt the

practices Trax train them on as enhancing farmers' capacity to adapt. She explained that if a farmer adopts a new technique following training then they have adapted it to their own environment and conditions. This means that they have the ability to adapt a technique in the process of adoption. Further discussion added that if training or product is adopted by a farmer then the adoption is part of an adaptation and therefore shows that they have the ability, or capacity, to adapt. This understanding of adoption as constituting adaptive capacity and/or an adaptation indicates the two ways in which adoption was perceived as a component of adaptive capacity.

One Trax field officer stated that once a technique had been adopted, how farmers carry on using it, by adapting it, makes it sustainable. In linking the capacity to adapt with sustainability this participant identified the relationship between adaptive capacity and broader development goals for sustainability.

Adoption related to the use or application of something which was new to the farmer or community concerned. This incorporated the adoption of an idea, concept, behaviour or interaction. During an interview with one of the Trax field staff, they made direct reference to this, stating that adaptive capacity is "*how they [farmers] adapt to the trainings [Trax provide] and how they use it on their farms*" (KI5, 28/2/14). When elaborating on this, they explained that the farmers Trax work with must first adapt to the ideas from the training sessions before they can adapt the techniques during adoption.

The Trax agricultural development intervention applies participatory processes with the farmers engaged in the project. This required the formation of farmer groups and the need for farmers to govern the group's activities and interactions. In this way, the farmer groups form an informal institution which functions as a feature of the intervention which is facilitated by Trax, a formal institution. The participating farmers not only needed to adopt the interaction and behaviours required for collaboration within a group, but to also adopt the concepts the projects introduced through this process of participation.

The readiness and ability of farmers to adopt a form and structure of interactions which was otherwise new to them may indicate adaptive capacity as postulated in the framework for this study. By adopting the behaviours and interactions required of the projects, components of adaptive capacity, including collaborative governance and shared learning, are enhanced. Furthermore, the capacity to adopt an introduced technique and adapt them to local conditions, indicated the capacity for learning and

experimentation. As such, considering adaptive capacity in these terms allows for examination of existing adaptive capacity and processes of how this was enhanced. The consequences of the adoption of diverse understandings of adaptive capacity and the role of participatory processes within this will be discussed in Chapter 6.

#### 5.3.4 Co-Evolution of Adaptation and Change

When asked to explain his understanding of the term ‘adaptive capacity’, the Director of Trax responded by saying that it is an “*intervention that tries to adjust to fit into the status quo*” (KI1, 25/2/14). This definition referred to an adaptation, an adjustment, rather than supporting farmers to develop their capacity to adapt. This understanding recognised an adaptation as an intentional effort to change practices, behaviours, or relationships. The conflation of the terms ‘adaptive capacity’ and ‘adaptation’ within understandings is discussed in the following section.

However, the Director of Trax referred to fitting into the “*status quo*”, while the contemporary discourse surrounding the concepts of adaptation and adaptive capacity considers adaptation the response (planned or unintentional) of a system when the conditions it functions within change away from the *status quo*. This is a nuanced difference in wording and understandings because when questioned further on adjusting to fit into the *status quo*, he clarified that the rainfall pattern and environment are changing so the *status quo* was changing.

Although this understanding of the need for adaptive capacity initially appeared to be conflicting due to a nuanced difference in the use of the term ‘*status quo*’, it raised the question of whether there can be a ‘*status quo*’ within a complex adaptive system. Science philosopher Michel Serres suggests

“States change phase, and systems change state, by transitions of phases or states. But the system itself is never stable. Its equilibrium is ideal, abstract, and never reached” (Serres, 2007, p72).

A complex system is adaptive, it is continually evolving and changing in response to its environment. Thus, within a complex adaptive system, the *status quo* is a process of continual change and adaptation.



### 5.3.5 Adaptive Capacity and Adaptation as Conflated Terms

On multiple occasions the Director of Trax referred to increasing crop diversity and biodiversity of agro-ecosystems as either an adaptation, an adaptation strategy, or as enhancing adaptive capacity. Furthermore, field staff identified specific project activities as either enhancing adaptive capacity or as an adaptation in themselves. Analysis of data from ethnographic observation showed that Trax staff most frequently referred to project activities as adaptation strategies. The project as a whole was described as a means of enhancing adaptive capacity because the project gave farmers access to these adaptation strategies.

Additional crop varieties were described as helping farmers to adapt by providing increased options when rainfall was unpredictable. It was suggested that increased crop diversity enhanced the capacity to adapt because farmers could change their primary focus or source of livelihood in response to changes in their surroundings. However, the act of diversifying the number of crop varieties or sources of income still limits an individual's response to change among the suite of crops or livelihood sources they had previously. There was some confusion about whether diversification was a physical adaptation or a means to enhance adaptive capacity.

### 5.3.6 Social-Ecological Understandings of Sustainability as Adaptive Capacity

The concept of adaptive capacity is often discussed in relation to the concept of sustainability (see Section 2.3). The relationship between the two concepts can be framed in diverse ways according to the individuals' or institutions' understanding of both terms. It is arguable that the two concepts are inseparable and a holistic examination of either term must consider the other.

During an interview with the Director of Trax, he stated that adaptive capacity leads to sustainability. He explained:

*“For sustainable crops, the focus must be on looking at the environment and what is existing. Trax support farmers to be sustainable by looking at local capacity building so that they can adapt through self-mobilisation. If they have adaptive capacity then they can be sustainable” (KI1, 25/2/14).*

He framed sustainability in relation to the local natural environment but then referred to capacity building and adaptation in the context of social characteristics – farmers and their self-mobilisation. This understanding framed adaptive capacity as a trait of human and social processes which is necessary to achieve environmental sustainability. A

social-ecological system is presumed in this understanding of adaptive capacity, as is also seen in the formal understandings of Trax outlined in Sections 5.2.

A framing which understands adaptive capacity as a social trait and sustainability as environmental represents a social-ecological system (e.g. Folke, 2006; see Section 2.1.4). In the context of agriculture, the social elements of such a system are dependent on ecological processes and natural resources for crop production. In understanding adaptive capacity as a trait which brings about environmental sustainability, the ecological elements of the system are in turn dependent on the role of the social in ensuring sustainability. The necessary connectedness and interdependence of the social (adaptive capacity) and ecological (sustainability) reflects an abstracted notion of social-ecological systems within this understanding. Wheeler (2012) presented a similar framing of social ecology in associating the evolution of societies to their environments, although this concept originally related to a branch of deep ecology rather than social-ecological systems.

On other occasions the Director of Trax referred to sustainability in relation to environmental, social, and economic domains but when talking about adaptive capacity he always referred to human and social characteristics and processes. During informal conversation, the Director of Trax spoke about adaptive capacity in the context of farming communities owning capacity and adaptive processes. He stated that:

*“When farmer groups own their process of adaptive capacity then they will carry it on and it becomes sustainable. This is why Trax works on capacity building with farmer groups”* (KI1, 21/7/14).

This again framed his understanding of adaptive capacity, and also of sustainability, within the context of Trax’s agricultural development intervention (Section 5.3.1).

The above understandings consider adaptive capacity to be an attribute which can support or bring about sustainability of the farming systems in question. On further questioning, Trax field staff stated that they understood sustainability to mean that something is continuous. The Director of Trax stated that an intervention is sustainable if it goes beyond the end of the project. He also referred to resilience as being an additional attribute of sustainability at other points during interview.

### 5.3.7 Adaptability in Traditional Culture and Farmer Groups

As outlined in Sections 3.5.2 and 5.2.7, Trax uses participatory process with farmer groups. The participatory process is intended to inform the project activities implemented within each community. Therefore, the understandings of adaptive capacity within the farmer groups and the individual farmers engaged with Trax may also influence the formal and informal understandings within the agricultural development intervention. This section discusses the understandings of adaptive capacity identified during focus groups, interviews and informal conversation with participating farmers.

Most of the individuals engaged with the Trax project belong to the Frafra ethnic group. Through working closely with local translators discussion indicated that there are no direct translations of the terms ‘adaptive capacity’, ‘adaptation’, ‘sustainability’, or ‘resilience’ in the Frafra language. Therefore, translation of these terms required description and iterative discussion between both the translator and farmers, and the translator and researcher.

In trying to examine the farmers’ understandings of adaptive capacity, focus group discussions with farmers of Frafra ethnicity explained the concept as being “*how to handle change*” (FGT8, 3/3/14). Discussions with the farmers referred to interventions and materials used in response to change. This understanding therefore referred to the physical adaptations practiced rather than the traits which enable adaptation.

During focus groups, interviews, and informal conversations, farmers were questioned further on what helped them to adapt or respond to change in their surroundings. A consistent theme throughout farmer groups and communities, both those who are currently engaged with the Trax project and those who have engaged in the past, is that of solidarity and unity within the farmer groups. Research participants repeatedly referred to the ways their farmer group have helped them to respond to change, overcome challenges, or obtain benefits. Examining the use of the terms ‘solidarity’ and ‘unity’ clarified the perceived differences between them. Solidarity was explained as “*assisting your neighbour in times of need to come to their aid*”. Unity was defined as “*identifying a common thing that is a problem to all to bring about unity and purpose*” (FGT6, 26/7/14). The consequences of solidarity and unity within farmer

groups will be examined in Chapter 6 but here it is necessary to note that these are traits the farmers identified as helping or enabling them to adapt.

Other things farmers identified as supporting them to adapt included having access to financial resources, whether through engaging in multiple livelihood activities, having a regular income to supplement farming, or having access to savings or loans. One component of Trax's sustainable livelihoods programme was supporting women farmers to establish Village Savings and Loans Associations (VSLA; see Appendix D). Women who belonged to a VSLA gave examples of how they were able to use their savings to adapt by adjusting the priority given to certain sources of income according to local conditions, or by diversifying livelihood sources so they obtain an income from trading even if poor rainfall meant crops fail. For these women, being a member of a VSLA enhanced their adaptive capacity in multiple ways.

In some Ghanaian ethnic groups the crocodile is a sacred animal, or totem, to be revered and protected. Different ethnic groups have diverse cultural traditions, many of which stem from symbolism and story-telling. A number of Ghanaian ethnic groups regard the crocodile to represent adaptability because of the species' ability to live on land and in water. Within some groups of the Frafra ethnicity, the dominant ethnic group in Upper East Region where the Trax project is located, there is a cultural tradition of painting patterns on the outside of buildings. Particular patterns symbolise different things. One such symbol is the crocodile, or '*Eegba*' in Frafra, representing adaptability and their ancestors' ability to live in the natural and supernatural worlds (Figure 5.2; Asmah et al, 2013).



Figure 5.2 A representation of the Frafra '*eegba*' symbol of adaptability. Source: Asmah et al, 2013, p195, their Figure 4.

Although this tradition is pictorial and symbolic rather than verbal or textual, it is one way in which the concept of ability to adapt exists within Frafra communities.

Some of the farmers' framings blurred the concepts of adaptive capacity with adaptation, just as they are interchangeable in some of the Trax project staff dialogue discussed above. While some farmers individually conflated the two terms, at times some farms used one term while others used another. Despite some differences in the nuances of the understandings of adaptive capacity and adaptation held by the farmers, the understanding of adaptability was consistent across all farmers. Traditional culture relates the ability to adapt ("adapt"- "ability") to being able to live and thrive within two very different states. Although farmers engaged with the case studies understood adaptive capacity in relation to 'how' to respond to change, deeper investigation identified characteristics which supported their ability to adapt. Incorporated within the understanding of adaptive capacity as an adaptation strategy was a need to adopt a technology, method, behaviour or idea. This follows the understandings of adaptive capacity discussed in Sections 5.3.3.

#### 5.4 Summary of Understandings within the Trax Project

This section briefly summarises the diverse understandings of adaptive capacity within the formal and informal components of the Trax intervention. This summary outlines the way in which the formal and informal understandings differed as well as the occasions when the diverse understandings dominated in the facilitation and implementation of the project.

The discussion throughout Section 5.2 identified two formal framings of sustainability and understandings of adaptive capacity. First was the understanding which originated with the establishment of Trax in 1989. Second was the understanding which stemmed from influence of the primary funder, Self Help Africa, and prevailed simultaneously with the first. Alongside these two formal understandings of adaptive capacity are informal understandings, which interacted with the agricultural development intervention through the facilitating field staff and participating farmer groups.

Table 5.2 presents a summary of these formal and informal understandings in the form of the identified features of adaptive capacity. These understandings are presented alongside the corresponding characteristics of adaptive capacity postulated in this research. This indicates some features of similarity in understandings and frameworks, although different terminology is used. Additionally, there are some characteristics proposed in the framework outlined in Section 2.7 which are not evident in the understandings associated with Trax, while the first formal understanding of Trax identifies the role of agency within adaptive capacity which is not reflected in the other frameworks or understandings. The contribution of agency to enhancing adaptive capacity is discussed further in Section 6.2.4.

Table 5.2. A summary of the features of adaptive capacity within the formal and informal understandings associated with the Trax project, alongside the corresponding features within the proposed framework in this research.

<b>Features of Adaptive Capacity Proposed in this Research (Section 2.7)</b>	<b>Features of Adaptive Capacity in Trax's First Formal Understanding</b>	<b>Features of Adaptive Capacity in Trax's Second Formal Understanding</b>	<b>Features of Adaptive Capacity in Trax's Informal Understandings</b>
Social capital	Participation		Social capital
Social networks	Social networks		Community relationships
Collaborative governance	Participation		Solidarity
Consensus	Consensus		Unity
Collective learning	Collective learning		
Anticipation			
Experimentation	Adoption	Adoption	

Innovation	Innovation through alternative livelihoods	Innovation through alternative livelihoods and crop types	
Diversity	Diversification of livelihoods	Diversification of income sources	
	Agency		

The first of these formal understandings originated with a group of international individuals who established Trax Ghana in 1989. Thus, although this understanding survives in the contemporary rationale of the organisation, it was not native to Northern Ghana, but was adopted by the initial international staff team. This formal understanding seemingly responded to highly topical policy and practice discourses in the late 1980s and early '90s concerning sustainability, agro-ecology, and participatory development (see Sections 2.3, 2.1.3, and 2.6 respectively). In line with this discourse, the formal understanding adopted drew on a social-ecological systems framing of the agricultural system and sustainability. As such, the associated understanding of adaptive capacity which evolved over the 27 years of Trax's practice referred to farmers responding to their local conditions, whether stable or under shocks or stresses. This understanding considers the need to adapt agricultural practices to the local environment, positioning adaptive capacity as a social characteristic which acts on a short to medium-term timescale and which supports environmental sustainability at a medium to long-term timescale.

The second, more recent, formal understanding of adaptive capacity is influenced by contemporary international discourse surrounding climate change, adaptation, and resilience. This discourse had been introduced to the formal understanding within Trax through interactions with Self Help Africa when planning the project activities. Self Help Africa engaged with understanding terminology used in contemporary development discourse, particularly through participation with the Interagency Resilience Working Group (Section 5.2.3). As a result, the understanding of adaptive capacity adopted within Trax documentation for the Self Help Africa-funded intervention followed that of a resilience framework. This formal understanding

considered adaptive capacity to allow for flexibility and incremental adjustment over a medium-term timescale. It is understood that adaptive capacity was evident in household and community-level actions in response to shocks and stresses. This understanding particularly considered adaptive capacity in relation to climate change and extreme weather events, as it originated within that discourse. However, in application it did not rule out viewing adaptive capacity in relation to all forms of shock or stress. Having said that, there was some contradiction within this understanding as it implied that adaptive capacity functions on a medium-term timescale, yet the shocks it refers to are short-term.

Discourse analysis and analysis of empirical data suggested that the formal understanding of adaptive capacity which has been influenced by Self Help Africa appeared primarily in documentation and during cross-organisational meetings between Trax and their funder. This theoretical terminology, framing of sustainability, and understanding of adaptive capacity was not referred to by Trax staff at other times and there was no evidence of it being utilised in project activities or discussions with participating farmers. Rather, when relating the project activities to the organisation's framing of the agricultural system and sustainability, and understanding of adaptive capacity, staff referred to the formal understanding which has been the basis of Trax's Mission Statement since establishment (see Section 5.2.1). Therefore, while on paper there were two formal understandings existing within the Trax Sustainable Agriculture intervention, in practice it was only the original understanding that played a role in facilitating the project activities, and this interacted with the informal understandings.

There were multiple informal understandings within the Trax Sustainable Agriculture intervention, as outlined throughout Section 5.3. Those multiple informal understandings were articulated by the four associated Trax staff and the farmer groups who were participating with the intervention. These multiple understandings of adaptive capacity held within single institutions associated with the Trax project were captured through sampling of each of the staff members involved in facilitating the project. Although diverse understandings of adaptive capacity emerged from the different individuals interviewed, at times single individuals expressed differing understandings depending on the context of the conversation (see Section 5.3.1). Thus, through sampling all of the associated individuals, diverse and nuanced understandings of adaptive capacity became apparent.



There was diversity among these understandings as adaptive capacity was variably associated with sustainability, social ownership, change, physical adaptation, and adoption of practices. Notably, Trax staff frequently referred to social adaptive capacity as a feature of meeting environmental sustainability in a social-ecological system. Further, farmer groups particularly understood adaptive capacity in socio-cultural terms and saw adaptability as being able to live within different environmental conditions. There was evidence of a conflation of the terms ‘adaptive capacity’ and ‘adaptation’ within informal understandings.

### 5.5 Co-Evolution of Formal Understandings within the CODE-WA Project

The CODE-WA case study was formally titled ‘*Community management of crop diversity to enhance resilience, yield stability and income generation in changing West African climates*’ but it has commonly been referred to as the CODE-WA Project throughout project documentation and discourse. As such, the discussion hereafter will refer to the abbreviated title of CODE-WA.

This section introduces the two routes through which formal understandings of adaptive capacity have evolved within the CODE-WA Project. It then examines the international-level influences on the formal understandings and project planning, which primarily are the dominant climate change and poverty reduction discourses in international funding bodies and the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT).

This section examines the relationships and interactions between the CODE-WA Project and associated influences from international-level governance, policy and funding discourses. Section 3.1 outlined the most relevant international discourses. Section 3.2 summarised Ghanaian national-level policy which responds to the associated international policy. As the CODE-WA Project was locally implemented by MOFA and SARI, both of which are national governmental institutions, the national policy discussed in Section 3.2 and the related international policy were pertinent to this analysis.

### 5.5.1 Parallel Evolution of Two Formal Understandings in the CODE-WA Project

The CODE-WA Project involved institutions at a range of scales and was implemented in four West African countries (see Table 5.1 in Section 5.1). The individuals responsible for preparing the project proposal, implementing the project in each of the four locations, and writing all project documentation were associated with a variety of institutions which have very different remits. As such, it is reasonable that the formal understanding of adaptive capacity adopted within the CODE-WA Project derived from diverse sources. Although implemented in four countries, this research investigated the understandings of adaptive capacity within the CODE-WA Project in the Upper West Region of Ghana.

Discourse analysis of project documentation and policies associated with the relevant institutions indicated two dominant routes of influence on the formal understanding of adaptive capacity within the CODE-WA Project in Ghana. Namely, these are the international influences across the whole project from the project funder, BMZ (German Ministry for Economic Cooperation and Development), and ICRISAT, as well as the influence of national policy on the institutions that facilitated the project in Ghana. Further, analysis identified the influence of international governance from the UNFCCC on national-level policy.

Due to the different levels of dominance of those influences on the associated institutions, two parallel formal understandings of adaptive capacity have been identified within empirical and secondary data. There are similarities between these understandings but it is important to discuss their different processes of evolution to appropriately identify how they formed within the CODE-WA Project. The remainder of this section examines the formal understanding of adaptive capacity in the context of project documentation for the whole project over the four countries. Section 5.6 then discusses the parallel formal understanding among the local facilitators, which was influenced by national policy.

### 5.5.2 Climate Change Discourse and Political Economy in the CODE-WA Project

In the context of Northern Ghana, climate change is projected to increase climatic variability and extreme weather events (Oppenheimer et al, 2014). Thus, farmer's agricultural livelihoods systems will increasingly need to function in the face

of uncertainty. As discussed in Sections 2.7 and 3.1.2, in recent years, global discourse regarding adaptation has been almost exclusively in reference to climate change. Driven by the United Nations Framework Convention on Climate Change (UNFCCC), the associated Kyoto Protocol and Cancun Adaptation Framework (see discussion in Section 3.1.2) required governments to provide funding for mitigation and adaptation initiatives. This emphasis on funding climate change adaptation initiatives emerged in the expectations of international funding agencies and the subsequent nature of development interventions.

Evidence of these expectations were evident within the context of the CODE-WA Project in Upper West Region, as well as three other sites in West Africa. During an interview with the CODE-WA Principal Investigator he explained that those who planned the project, including himself and ICRISAT staff, were concerned with adaptive capacity and adaptation to climatic variability and an increase in climate extremes. The Principal Investigator explained that when preparing the project proposal the funding agency, the German Ministry for Economic Cooperation and Development (BMZ), requested the project focused on climate change rather than climatic variability. He explained that in practice smallholder farmers in dryland West Africa were experiencing climatic variability and the project was investigating how to increase the adaptive capacity of farmers when one year it's dry and the next season is wet. However, he stated that the project refers to climate change rather than climatic variability because this was how they received funding for the intervention. Thus, all of the project documentation referred to the challenges of climate change.

Ostensibly, through a top-down process, the UNFCCC was informing international funding which transmitted those expectations to national or local-scale institutions, which facilitated the internationally-defined interventions at a community level. As acknowledged by the CODE-WA Principal Investigator during interview, this overlooked the realities of the local contexts in which the development interventions were to be implemented. This followed a similar process to that identified within the Trax project, in Sections 5.2.

### 5.5.3 CODE-WA Formal Framing of the Agricultural System

The CODE-WA Project documentation presented the project from the ICRISAT staff and principal investigator's perspective. As the project was implemented across four country locations by ICRISAT, and locally within Ghana by a research institute

(Savanna Agricultural Research Institute, SARI) and the Ministry of Food and Agriculture (MOFA), the project was framed within a predominantly scientific understanding (CODE-WA, undated a). The documentation stated that the project would work within fields of climatology, plant breeding, phytodiversity, soil science and communication (CODE-WA, undated b). The Executive Summary at the end of the project identified three domains for research: climatology, biodiversity, and communication (CODE-WA, 2012), making communication a significant part of the project focus and combining project activities on plant breeding with phytodiversity into the topic of biodiversity.

The project was identified as interdisciplinary but of the areas stated as fields of research, only one of them referred to social science, but even then there was minimal attention to social processes or structures and their influence on project activities and outcomes. The understanding of an agricultural system the project was working with was framed within a scientific context concerning climatology, plant breeding, phytodiversity and soil science, while acknowledging that communication between farmers is also part of the agricultural system. However, this was the framing of the agricultural system from the perspective of the project staff and facilitators, possibly not the farmers themselves.

#### 5.5.4 Terminology and Formal Understandings within the CODE-WA Project

The full title of the CODE-WA Project presents one of the project objectives as enhancing resilience through management of crop diversity (see Section 3.5.1). The CODE-WA Project proposal repeatedly referred to adaptive capacity and adaptive potential of farm communities (ICRISAT, 2008). Enhanced adaptive capacity was identified as an intended output of the project, but none of the five outputs expected of the project referred to resilience. Despite the project proposal identifying enhanced resilience as a main objective, the Executive Summary of results makes no reference to resilience (CODE-WA, 2012). The CODE-WA documentation implicitly linked an output of enhance adaptive capacity in terms of building resilience. This again followed the framings discussed above in Section 5.2.3 whereby adaptive capacity was understood as contributing to resilience.

At no point in the project documentation was there reference to sustainability or its understanding, but the use of terminology including adaptive capacity, resilience and stability suggest an underlying sustainability rationale. This is an implied assumption

which appears to have framed the projects' interpretation of adaptive capacity, and how and why this needed to be enhanced.

The title of the CODE-WA Project situated the aim of enhancing community adaptive capacity within a framing of sustainability, which considered yield and income stability to be the central concern. Although the concept of stability was not addressed in detail in Chapter 2, the STEPS Centre's understanding of the term, within the context of sustainability, is that stability is "a dynamic property of a system involving the ability to sustain structure or functional value by controlling sources of short-term episodic shocks" (Leach et al, 2010, p xiv). This understanding of stability does not coincide with that of the CODE-WA Project, because the project's activities aimed to enhance the capacity to respond to shocks (shocks being climatic variability) rather than control the climate.

Although the title referred to resilience and stability, which are concepts within sustainability, the project activities and documentation focused heavily on adaptive capacity, diversity, innovation and communication and did not refer to resilience and stability except in the project title. The project activities were ostensibly framed within an interpretation of the need for adaptive capacity to climate change and variability. The dominant message of the CODE-WA Project documentation was that "Crop diversity is the key which allows West African farmers to react to climate variability" (CODE-WA, undated b). This suggests that the project staff and project aims considered crop diversity to be a central feature of agricultural resilience and adaptive capacity.

#### 5.5.5 Implied Understandings of Adaptive Capacity in CODE-WA

##### Documentation

The Executive Summary of the CODE-WA Project referred to farmer innovations and suggested that maintaining incremental agricultural innovation and adaptation requires farmer-based innovation (CODE-WA, 2012). The Summary suggested that communication was assumed to be key to enabling innovation, and that communication between farmers across agro-climatic zones could further stimulate innovative processes (ibid). Therefore, this project understood farmer innovation as a feature of adaptive capacity, suggesting that innovation enabled responses to climate variability. Although not stated explicitly in the project documentation, the conclusions in the Executive Summary suggested that communication and extended social networks also assisted this adaptability. It is possible to infer that farmer participation in this

project was deemed central to encouraging innovation through farmer-to-farmer communication, thereby enhancing adaptive capacity.

There was no reflection of change in agricultural practices or adaptive capacity in the documentation as it does not state how circumstances and conditions differ now to before the project. The Executive Summary at the end of the project did not report any lasting effects of the project. The farmers received a monetary payment to engage with the project so it is possible that the engagement with social networks and innovative interactions and practices stopped when the financial incentive ended. Alternatively, the processes initiated during the project could have continued, strengthened and accelerated since the culmination of the project, therefore giving a lasting environment for enhancing adaptive capacity. Section 6.3 will discuss evidence of enhanced adaptive capacity within the farming communities engaged with the CODE-WA Project, and Chapter 7 will discuss the implications of this for sustainable agricultural livelihoods.

The following section examines the evolution of the understanding of adaptive capacity among the institutions which facilitated the CODE-WA Project locally in Ghana, beginning with a discussion of associated policies which use assumed or implied understandings.

## 5.6 Evolution of Formal Understandings among Local Facilitators of the CODE-WA Project

This section examines the evolution of formal understandings among the local CODE-WA facilitators of the project within MOFA and SARI, tracing the influence of the national governmental bodies and their relationship to the understandings within other Government of Ghana policies. This also identifies how international discourse regarding climate change, specifically from the UNFCCC, is evident within the formal understandings of adaptive capacity within MOFA and SARI.

### 5.6.1 Assumed and Implied Understandings of Adaptive Capacity

As outlined in Section 2.7, this research is framed within the context of a social-ecological system where many of the components which constitute adaptive capacity are social features such as collaborative governance and shared learning. Much

documentation from formal institutions, at a range of scales, refer to the term ‘adaptive capacity’ without clarifying what the term means in the context of the document, assuming that the authors and readers share a common understanding. This section discusses the assumed and implied understandings of adaptive capacity in the international-level governance documents on adaptation to climate change which are pertinent to the CODE-WA Project.

As indicated in Table 5.1, there are a number of international institutions which are either direct or indirect stakeholders in the two case study interventions. Several of these institutions state a concern with adaptation, resilience, and/or sustainability. However, throughout online documentation and policies there was little reference to adaptive capacity.

International climate change discourses often identified both resilience and adaptive capacity as objectives in response to climatic threats. The principal global agreement on adaptation, the Cancun Agreements of the United Nations Framework Convention on Climate Change (UNFCCC) 16<sup>th</sup> Conference of Parties, commonly referred to as the Cancun Adaptation Framework, identified resilience as the goal of adaptation:

“Enhanced action and international cooperation on adaptation is urgently required to enable and support the implementation of *adaptation actions aimed at reducing vulnerability and building resilience* in developing country Parties.” (UNFCCC, 2011, p4, emphasis added)

Although the Framework focused on the concept of adaptation, nowhere in the 31 page document did the UNFCCC refer to adaptive capacity. However, the above quotation did refer to adaptive capacity without using this term as it directly refers to enabling and supporting the “implementation of adaptation actions”, i.e. the capacity to adapt. This statement understood building resilience as the objective of adaptation actions and thus saw adaptive capacity as a component of resilience, without using that term.

The UNFCCC provided a definition of adaptation which did not make reference to adaptive capacity:

“Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in process, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change.” (UNFCCC, 2014b, online)

Although the focus of the UNFCCC is on adaptation, the Convention established a Capacity-building Portal online tool which is intended to “monitor and review the capacity built to better mitigate and adapt to climate change” (UNFCCC, 2014c, online). Although not explicit, “the capacity built to better ... adapt” can be interpreted in terms of adaptive capacity.

The UNFCCC states that adaptation requires “observation; assessment of climate impacts and vulnerabilities; planning; implementation; and monitoring and evaluation of adaptation actions” (UNFCCC, 2014c, online). This understanding relates to formal adaptation activities planned at a national-level and supported internationally through the Convention’s funding mechanisms. However, in the context of this research it is necessary to consider ‘adaptation’ as potentially a process as well as particular actions. It is possible that adaptation may occur without planning, may evolve as actions, interactions and behaviours change, and may comprise long-term process of incremental adaptations or adjustments in the agricultural system.

The understandings of adaptive capacity and associated terms in national governmental policy directly respond to those of the UNFCCC (see Section 5.6.5). In turn, the mandates of both MOFA and SARI responded directly to overarching national policy and therefore influenced the formal understandings of adaptive capacity existing within these institutions at a local level. The remainder of this section will examine the understandings of adaptive capacity identified among MOFA and SARI and the staff who were locally responsible for facilitating the CODE-WA Project in Northern Ghana.

#### 5.6.2 Adoption as Adaptation in National Agencies

The concept of adoption as adaptive capacity was articulated by several research participants and framed in two different ways. Furthermore, discourse analysis of associated documentation also identified the role of adoption within the understandings of adaptive capacity in some associated external institutions. This section examines the ways adoption was perceived as contributing to adaptive capacity within the CODE-WA Project and relevant formal institutions.

The discussion in this section relates to the adoption of something new to those who were adopting it, in this case farmers engaged with the CODE-WA Project in Northern Ghana. The concept of adoption as discussed here largely relates to the use or application of a technology, product, method, or process which was new to the individuals in question. In this context, an external institution could introduce a new



method or technology which the farmers then adopt. Alternatively, it could originate with the farmers or be shared by other farmers and community members.

At the national level, Ghanaian policy documents refer to adoption of technology in relation to adaptation. Adopting a technology is key to the national-scale adaptation strategy. The central policy document, the Ghanaian National Development Policy Framework (NDPC, 2010) referred to the need for farmers to adopt technologies in order to adapt. This implied an understanding of adaptive capacity, suggesting that the adoption of technologies enhances adaptive capacity because farmers need technologies to be able to adapt.

MOFA did not refer to adaptive capacity in either its mission statement or the principal policy, the Food and Agriculture Sector Development Policy II (FASDEP II; MOFA, 2007; see Section 3.2.1). The FASDEP II made reference to adaptation only twice, but unlike other contemporary national and international documentation, the FASDEP II did not refer to adaptation in relation to climate change. Rather, the document identified adaptation within the process of adopting technologies which MOFA introduces. It also places adaptation in the context of sustainable crop production.

The discourse which framed adoption of technologies within an adaptation strategy and adaptive capacity goes beyond Ghanaian policy documents. The Comprehensive Africa Agriculture Development Programme (CAADP) used the terms ‘adaptation’ and ‘adapt’ when discussing the dissemination of technologies (NEPAD, 2003). Further, the CAADP made reference to locally-adapted plant varieties, implying that new varieties needed to be adapted to local conditions before being adopted. The CAADP did not explicitly state what it understood adaptive capacity or adaptation to mean, but the use of these terms indicated their framing centred on technology adoption.

A number of research participants directly engaged with the CODE-WA Project framed their understanding of adaptive capacity in terms of project interventions and physical activities in response to change. Such a response to change would require the adoption of something, be it a technology, method or practice, an idea, or a type of interaction or behaviour. The CODE-WA field staff took this understanding further by stating that if a technology or technique was adopted then it had been adapted. Local-level adaptation of a technology during the adoption process was referred to in relation to the transfer-of-technology by extension officers.

National and international-level policy documents referred to adoption and adaptation in relation to technology dissemination to farmers, rather than technology development with farmers. It was the understandings of adaptive capacity described by field staff of the CODE-WA project where farmers at a local-level are brought into the process of adaptation by either adopting a technology or technique which was new to them, or by locally adapting this during adoption. This highlighted the difference of scales being addressed within understandings of adaptive capacity within different institutions associated with the case studies.

The use of the terms ‘adaptive capacity’ and ‘adaptation’ within the CODE-WA Project became less clear when considering analysis of written documentation alongside discussion during interviews with relevant staff members. Empirical data indicated some conflation of the two associated terms, while at times contradicting the intentions of the project. The intention of the project was, supposedly, to develop the farmers’ adaptive capacities and the means to do this was, in part, the introduction of a physical adaptation strategy. Ostensibly, this project intervention supported farmers to adapt rather than enhanced their capacity to adapt. However, communication processes were a central research theme in the CODE-WA Project and outcomes of enhanced adaptive capacity will be discussed in detail in Chapter 6.

The perception of the adoption of a practice or product being an adaptation and/or enhancing adaptive capacity reflected the same understanding identified among Trax staff, as discussed in Section 5.3.3. Additionally, the conflation of the terms ‘adaptive capacity’ and ‘adaptation’ in relation to the adoption of technologies can be likened to that discussed in relation to the Trax project in Section 5.3.5.

### 5.6.3 Adoption and Innovation as Adaptive Capacity

A further point which relates the discussion of adoption to the adaptive capacity framework postulated in this research is that of innovation. Although research participants did not directly refer to innovation when discussing their understandings of adaptive capacity, the concept of innovation is implied in the adoption of a technology which is new to the community, region, or country. This implication is taken further when viewed in the context of discussion of external formal institutions introducing a technology which has been developed elsewhere. Both MOFA and SARI are directly and indirectly responsible for the development and dissemination of new agricultural

technologies and techniques. Furthermore, adoption as adaptation was discussed in line with technological development in Ghanaian national policy documents such as the National Science, Technology and Innovation Policy (MEST, 2010a).

This discussion of associated understandings of adaptive capacity framed in terms of the adoption of technologies and techniques relates to the broader theoretical discussion regarding the transfer-of-technology and participatory research. As mentioned in Section 2.6, the *Farmer First* and farmer participation movement began with Farming Systems Research. This movement towards farmer participation in agricultural research acknowledged concerns that technologies developed by research institutes were not being adopted by farmers because they were not suitable to local agricultural conditions or they did not address the needs of the farmers. The CODE-WA Project attempted to overcome those concerns by incorporating participatory evaluation of the crop varieties during the project. In this way, the participating farmers made choices regarding the varieties they wanted to trial according to what they judged were most suitable to their own needs. Ultimately, however, the introduced crop varieties had been bred by SARI and transferred to farmers as one of the activities of the intervention.

#### 5.6.4 Sustainability and Adaptive Capacity in National Institutions

MOFA did not refer to adaptive capacity in national policy and documentation. However, at one of the two points at which the FASDEP II referred to adaptation it does so in the context of sustainability. The policy stated that one of the Ministries' strategies is to:

“Stimulate, support and facilitate adaptation and widespread adoption of farming and land use practices which, while in harmony with natural resource resilience, also underpin viable and sustainable production levels.” (MOFA, 2007, p31)

This framed adaptation of practices as contributing to sustainability of crop production. MOFA identified the Ministries' primary objective as promoting sustainable agriculture. Although adaptive capacity was not referred to in MOFA documentation, and the concept of adaptation was not dominant, associating adaptation with contributing to sustainability suggested that adaptation was an important consideration of MOFA. MOFA indicated that sustainable agriculture was their priority and identified adaptation and adoption as a strategy for achieving sustainable crop production, which implied that adaptation and adoption of certain practices was a principal concern of the Ministry.

The Ghanaian National Climate Change Adaptation Strategy also identified sustainability as a priority: “Promotion of sustainable development and poverty reduction are focus areas of the adaptation strategy” (EPA/UNDP, 2010, p7). In the context of a nation-wide adaptation strategy, this clearly framed adaptation as contributing to sustainability. Although this statement did not refer to adaptive capacity, it suggested that subsequent references to the term also interpret the concept in relation to sustainable development. Elsewhere, the Strategy document referred to adaptive capacity and resilience together, discussed in the following section.

#### 5.6.5 Adaptation for Resilience within National Policy Understandings

The Ghanaian National Climate Change Adaptation Strategy (NCCAS), prepared in response to the UNFCCC Cancun Adaptation Framework, likens adaptive capacity and resilience. The NCCAS stated that its goal was:

“To enhance Ghana’s current and future development to climate change impacts by strengthening its adaptive capacity and building resilience of the society and ecosystems” (EPA/UNDP, 2010, p17).

Other references to resilience in the Adaptation Strategy cited “increasing the flexibility and resilience” (EPA/UNDP, 2010, p17). The NCCAS framed the national objective as achieving resilience in the face of climate change, and social-ecological sustainability. The Strategy cites adaptation, and enhanced adaptive capacity, as means to achieve resilience and sustainability. As with Béné et al (2012), discussed in Section 5.2.3, this framing considered resilience to allow for flexibility and thus saw changes brought about through adaptive capacity as contributing to resilience.

This framing of adaptive capacity as contributing to resilience was echoed in the Ghanaian Technology Needs Assessment (see Section 3.2). The Technology Needs Assessment was prepared as part of the Ghanaian national commitment to the UNFCCC and identified adaptation strategies considered to be key within the water and agriculture sectors. The document as a whole gave no explanation of how resilience, adaptive capacity, or adaptation were interpreted. The document identified building adaptive capacity and resilience at the national level as priorities for responding effectively to climate change (Essegby et al, 2012). However, elsewhere the Technology Needs Assessment referred to a need for resilience to climate change adaptation: “The workshop decided Ghana should focus on adaptation for the TNA given that *enhancing resilience to climate change adaptation* was a prime national challenge” (Essegby et al,

2012, p x, emphasis added). It is unclear what was meant by this statement and appeared to confuse the purposes of adapting to climate change and building resilience.

This discussion highlights that the CODE-WA facilitating staff from MOFA and SARI formally presented their understandings of adaptive capacity in line with that of the Government of Ghana's national policy. Although the mission and understanding of relevant concepts of MOFA and SARI and reflected at the local level, each of the individual staff engaged with the CODE-WA Project also had their own informal understanding which may or may not have been influenced by the national policy. The next section examines the informal understandings of adaptive capacity among the associated CODE-WA facilitators and the participating farmer groups in Northern Ghana.

### 5.7 The Role of Facilitation in the Evolution of Informal Understandings in the CODE-WA Project

This section examines the informal understandings of adaptive capacity within the CODE-WA Project. This identified the informal understandings within the local area, particularly those of the main member of field staff responsible for facilitating the project and those of the individuals within the farmer groups participating in the project. This considers the role of past development interventions in shaping existing informal understandings.

#### 5.7.1 Interchangeable Terms in the CODE-WA Project

The discussion in Section 5.5.1 highlighted the interchangeability of the terms 'adaptive capacity' and 'adaptation' in the discourse of Trax staff. The interchangeable use of the terms 'adaptive capacity' and 'adaptation' was less frequent in the CODE-WA Project. Although staff from the CODE-WA facilitating institutions did not switch between the two terms as often as Trax staff, during interview the CODE-WA field staff all explained their understanding of adaptive capacity as a project, a new technology or method, or some form of physical intervention.

A field officer working for the Ministry of Food and Agriculture (MOFA) Municipal office in Wa described adaptive capacity as occurring when an individual "*observes something from some point and bring it to people to adopt*" (KI11, 18/3/14).

This framing can be interpreted in two ways. Firstly, it implies having the capacity to observe something and learn from it to experiment with this in one's own environment. Secondly, it refers to "*something*" which can be moved in geographical location, for example a process, action, or a physical object. An intentional action to introduce an object, method, or behaviour to a new context can be considered an adaptation and part of a process of innovation. Thus, this understanding of adaptive capacity referred to both an adaptation and some of the component characteristics of adaptive capacity postulated in Section 2.2.

One of the MOFA field officers explained her understanding of adaptive capacity as existing when a farmer adopts a technology or technique. Discussion of this indicated that she was referring specifically to adaptive capacity in relation to MOFA objectives and adoption of interventions introduced by MOFA staff, such as the CODE-WA Project. This reflects the discussion in Section 5.3.1 regarding responses from staff facilitating the Trax project describing adaptive capacity in the context of their own intervention. Furthermore, the perception of the adoption of technologies constituting adaptive capacity and/or adaptation resonated with the national-level policy relevant to the CODE-WA Project, discussed in Section 5.6.

The individuals responsible for supporting and directing the CODE-WA Project at the local-level in Wa Municipality also referred to adaptive capacity in a context of achieving sustainability. The lead scientist working for SARI on the CODE-WA Project explained that he understood adaptive capacity as part of being sustainable:

*"The CODE-WA Project helps the farmers to develop adaptive capacity so that it helps them to be sustainable. The climate is changing so they can only be sustainable if they can adapt"* (KI8, 12/3/14).

This explanation was not specific as to what becomes sustainable when farmers have adaptive capacity but the context of this statement indicated that he was referring to the farming practices and crop production associated with the CODE-WA Project. It is interesting to note that although the SARI lead scientist was talking about the CODE-WA Project supporting sustainability through developing adaptive capacity, the CODE-WA Project proposal only used the term 'sustainability' once, and this was in relation to the continuation of the project itself.

The idea of adopting a technology as an adaptation strategy which results in sustainability was also evident in the CODE-WA field staff's understandings. One field officer based with MOFA and responsible for implementing the CODE-WA project

explained that if a farmer or community adopts a new technology or technique then they were able to continue using it after field staff leave the area on completion of formal project facilitation.

#### 5.7.2 Previous Local Interventions within Evolving Understandings

The Kamwinsomte Women's Group which participated in the CODE-WA Project, consists of groups of farmers from two neighbouring communities, Jonga and Doodiyiri, near the eastern boundary of Wa Municipality. Although the farmer group was initially only women, the group in Doodiyiri subsequently allowed three men to join the group while the group in Jonga remained exclusively women.

During focus groups with each of the farmer groups, participants explained that Kamwinsomte Women's Group originally became organised into a farmer group under the requirements of a development intervention led by the World Food Programme sometime in the late 1990s. Several of the farmer group members stated that after the World Food Programme intervention ended, the group dispersed and only came together for the purposes of other development interventions which have subsequently been introduced to the two communities. During one focus group, a number of participating individuals stated that this had changed since the activities of the CODE-WA Project were introduced to them, and they have continued working closely as a group despite the formal end of the intervention.

Although the history of Kaminsomte Women's Group engaging with other development interventions was not directly related to their understandings of adaptive capacity, it is necessary to acknowledge the role of prior interventions in order to appropriately examine the influence the CODE-WA Project had on the group and their understanding of adaptive capacity. Data from focus groups and interviews with members of the Kamwinsomte Women's Group indicated that the CODE-WA Project was the first agricultural development intervention in these communities which expressed a concern with adaptation and adaptive capacity. However, farmers stated that previous interventions had sought to increase crop diversity by introducing new crop varieties. Previous interventions of this type may have made the farmers participating with the CODE-WA Project particularly receptive to these ideas. Additionally, previous interventions may have influenced the way concepts which are introduced to the farmers are understood because the context has been altered, even if unconsciously.

The ways in which the CODE-WA Project had an unexpected beneficial impact on the participating farmers will be examined in Section 6.3. The following section discusses the informal understandings of adaptive capacity among the two farmer groups.

### 5.7.3 Farmer Understandings of Adaptive Capacity in the CODE-WA Project

Wala, the dominant ethnic group of those engaged with the CODE-WA Project, does not have a direct translation of the term ‘adaptive capacity’ or the associated terms ‘adaptation’, ‘sustainability’, and ‘resilience’, as with the Frafra ethnic group in the Trax project. During focus groups with the two farmer groups which participated in the CODE-WA Project, discussion of understandings of adaptive capacity repeatedly referred to being able to cope with something. Repeated questioning during interviews and discussion during focus groups farmers of Wala ethnicity described adaptive capacity as: “*how to cope when something changes*” (FGC2, 22/3/14). Thus, farmers framed adaptive capacity in relation to how they can and/or do respond and adapt to change, identifying the process of adaptation.

When questioned on the characteristics of adaptive capacity which the farmers considered as traits which enable them to adapt, one farmer stated:

*“If you observe something from some point and bring it to people to adopt then you can help people to cope. We have togetherness so we will all work together on an issue. If you see something which can help you then you bring it to your place because it can help others too.”* (IVC19, 29/3/14)

To consider this description using the concepts postulated within this research, the farmer suggested that the capacity to see a process, practice, or technology and identify and attempt to introduce that to their own community could help them and their farmer group to respond to change. As responding to change is locally seen as the process of adaptation, it can be inferred that having the capacity to introduce ideas to aid such a response to change was considered to be adaptive capacity.

The social characteristics of adaptive capacity postulated in the framework for this research (Section 2.7) can also be identified in the above description. This understanding of adaptive capacity requires features of learning, anticipation, experimentation and innovation. Although in parts this understanding of adaptive capacity referred to individual capacity, there was also reference to collective action in



relation to ‘togetherness’. In this way shared learning through collective problem solving was also evident.

### 5.8 Summary of Understandings in the CODE-WA Project

This section summarises the formal and informal understandings of adaptive capacity present within the CODE-WA Project. The sections outlined the evolution of these understandings and influences on them, and the routes through which these various influences resulted in some similarities and some differences between the informal and two formal understandings. This also acknowledges that the formal understandings within the CODE-WA Project stopped evolving at the formal end of project implementation and the publication of the executive summary, but the informal understandings continued to evolve within the local communities.

The above discussion has identified two formal understandings of adaptive capacity which evolved and co-existed. The first of these formal understandings was that presented in the CODE-WA Project as facilitated across all of the four countries. This understanding was influenced by the international institutions which initiated, funded, and oversaw the project as a whole, primarily BMZ and ICRISAT. The second formal understanding of adaptive capacity existed within the national governmental institutions that facilitated the CODE-WA Project in Northern Ghana. This understanding has been described by associated staff in Wa Municipality and directly reflected that of national governmental policy. It is therefore possible to conclude that there is one formal understanding of adaptive capacity in the CODE-WA Project but two within the Ghana-based element of the project which was the case study for this research.

Table 5.3 provides an overview of the two formal understandings of adaptive capacity in the Ghana site of the CODE-WA Project. This summary is presented alongside the informal understandings of the farmers and field staff associated with the CODE-WA Project and the corresponding characteristics of adaptive capacity which were proposed in the framework for this research (Section 2.7). As with the Trax project (Section 5.4), this summary of understandings in the CODE-WA Project highlights differences in terminology to describe similar characteristics. Collaborative governance is identified as a characteristic of adaptive capacity in the framework for this research

but neither the formal or informal understandings within the CODE-WA Project identified this trait as contributing to enhanced adaptive capacity. The contribution of collaborative governance to enhanced adaptive capacity will be examined further in Sections 6.2.2, 6.3.2 and 7.2.1.

Table 5.3. A summary of the features of adaptive capacity within the formal and informal understandings associated with the CODE-WA Project, alongside the corresponding features within the proposed framework in this research.

<b>Features of Adaptive Capacity Proposed in this Research (Section 2.7)</b>	<b>Features of Adaptive Capacity in CODE-WA's First Formal Understanding</b>	<b>Features of Adaptive Capacity in CODE-WA's Second Formal Understanding</b>	<b>Features of Adaptive Capacity in CODE-WA's Informal Understandings</b>
Social capital	Social capital		Social capital
Social networks	Communication		
Collaborative governance			
Consensus	Participation		Togetherness
Collective learning	Farmer knowledge exchange	Farmer knowledge exchange	Shared learning and problem solving
Anticipation	Anticipation		Anticipation
Experimentation	Experimentation	Adoption	Alternative livelihood sources
Innovation	Innovation through alternative crop varieties	Innovation through alternative crop varieties and farming methods	Innovation through alternative livelihood sources

<b>Features of Adaptive Capacity Proposed in this Research (Section 2.7)</b>	<b>Features of Adaptive Capacity in CODE-WA's First Formal Understanding</b>	<b>Features of Adaptive Capacity in CODE-WA's Second Formal Understanding</b>	<b>Features of Adaptive Capacity in CODE-WA's Informal Understandings</b>
Diversity	Increased agricultural biodiversity		Diversification of livelihood sources

The first, project-wide understanding of adaptive capacity has a science-based framing, resulting from the fact that the project was instigated by a research institute, namely ICRISAT. This understanding considered adaptive capacity as desirable and necessary to respond to the effects of climate change. In the context of climate change, the formal understanding within the CODE-WA Project saw adaptive capacity as a means to achieve resilience to climatic variability and extreme weather events. As such, this considered adaptive capacity to function in response to climatic shocks and was therefore at a short-term timescale. However, there was some lack of clarity regarding whether the project's intention was to enhance the adaptive capacity of farmers or to support farmers to adapt. The formal understanding within the CODE-WA Project also suggested an underlying rationale of ultimately working towards sustainability, but this rationale was implied and sustainability was not discussed explicitly.

The second formal understanding of adaptive capacity was that of the institutions which facilitated the project locally. The individuals from both MOFA and SARI stations in Wa Municipality made reference to national governmental policies and priorities for development. Their understanding considered adaptive capacity in relation to the adoption of technologies which were introduced by the intervention. They viewed adaptive capacity in the context of an intervention rather than a characteristic of an individual, community or society more broadly. There was also some conflation of the terms 'adaptive capacity' and 'adaptation' and this was reflected in the understanding of adaptive capacity in relation to interventions, transfer-of-technology, and adoption. These physical characteristics did not consider the social processes behind the capacity to adapt, such as social networks, innovation, and shared learning (Sections 2.2 and 2.7).

Alongside those two formal understandings of adaptive capacity were informal understandings among the primary field officer responsible for facilitating the project and the farmer groups involved. The local field staff understood adaptive capacity in terms of individual and shared learning, experimentation and innovation, and shared problem solving. Again, there was some conflation of the understanding of adaptive capacity with that of adaptation. The informal understandings of adaptive capacity identified among the farmer groups were similar to that of the field staff. This may in part have resulted from influence of previous development interventions that introduced particular concepts. Farmers explained that having the capacity to adapt was being able to cope with change. They further identified traits of shared learning and problem solving, experimentation and innovation, and anticipation.

Collectively, these informal and two formal understandings of adaptive capacity indicated a lack of clarity surrounding what constitutes adaptation and/or the capacity to adapt. It was evident that while some considered increasing the number of crop varieties grown as an adaptation strategy to minimise the risk of crop loss, others viewed this as enhancing adaptive capacity, because farmers had a greater diversity of crop varieties from which to choose. There was some feature of this lack of clarity or conflation of the two terms in each of the understandings of adaptive capacity in the CODE-WA Project.

Due to the time-bounded nature of the CODE-WA Project, being a three-year research project, it was obvious that the formal understandings of adaptive capacity might stop evolving in response to additional influence at the termination of the project in 2011. However, empirical data indicated that the informal understandings among the associated field staff and farmer groups continued to evolve. This was in part due to the social interactions and processes that developed as a result of the project, (examined further in the next chapter) and partly due to the continued influence of external institutions and other unrelated development interventions.

## 5.9 Conclusion

This chapter has examined the diversity of the understandings of adaptive capacity in both case studies. Discussion has considered the similarities between the two case studies as well as the ways in which the formal and informal understandings interact and co-evolve. This analysis of diverse understandings of adaptive capacity and

how they have formed within the two case studies responds to research question one. This concluding section summarises these similarities and the temporal nature of understandings of adaptive capacity.

One of the central purposes of this research was to examine the diverse understandings of adaptive capacity within two agricultural development interventions in Northern Ghana. This investigation therefore assumed that there were more than one understanding among the case study projects. However, data analysis identified not only diverse understandings but that some individuals and formal institutions have multiple understandings of adaptive capacity at any one time. The diversity of these understandings varied according to the context of discussion.

Adaptive capacity was largely seen as a trait which contributed to sustainability and/or resilience. Very few formal policy documents, from local interventions to global conventions, specified how adaptive capacity or associated terms were understood in that document. Further, during a range of interviews and ethnographic observations, few individuals exhibited clear understandings of what constituted or contributed to adaptive capacity. Instead, research participants gave their understandings of what adaptive capacity contributes to, for example sustainability or resilience, or how it may manifest itself, such as an adaptation process or adoption of a technology.

It is challenging to clearly identify, examine and describe all of the diverse understandings of adaptive capacity in this investigation. This chapter carefully considered and analysed the understandings.

There were multiple formal institutions directly or indirectly associated with each of the two case studies. Many of these institutions had multiple understandings of adaptive capacity themselves, and understandings differ from that of other associated institutions. Furthermore, individuals within each institution had their own understandings of adaptive capacity, often several understandings, and in some cases they differed from other individuals', the institutional, and from other institutions' understandings.

The discussion throughout this chapter highlights that the understandings of adaptive capacity within both case study interventions evolved over time in response to multiple differing influences. Some of these understandings were continuing to evolve, particularly among the farming communities and the second formal understanding within the Trax project (Section 5.2). This evolution of understandings and use of terms

indicates the temporality of understandings and suggest that such understandings of adaptive capacity were themselves adaptive to changing influences. In this way, the understanding of adaptive capacity can be conceived as a complex adaptive system, responding to temporal and spatial dynamics. This will be examined further in Chapter 7.

Such a complexity of numerous institutions and individuals associated with each case study resulted in a diversity of understandings. The consequences of enhanced adaptive capacity for intended outcomes within the two case study interventions will be discussed in the next chapter.

## Chapter 6 – Indicators and Outcomes of Enhanced Adaptive Capacity within Farming Communities

### 6.1 Introduction

This chapter examines evidence of enhanced adaptive capacity within farming communities participating in the two case study agricultural development interventions. The discussion responds to research questions two and three by outlining the multiple ways in which individual and collective adaptive capacities were enhanced as a result of engagement with project activities. First, evidence of indicators of adaptive capacity will be examined within both the Trax and CODE-WA case studies. This draws on the indicators of adaptive capacity outlined in the analytical framework in Section 4.6 which, in turn, responded to the components of adaptive capacity proposed in the theoretical framework in Section 2.7.

This chapter will then examine evidence of outcomes resulting from enhanced adaptive capacity associated with the Trax and CODE-WA interventions. This considers both intended and unexpected outcomes of enhanced adaptive capacity resulting from either direct or indirect influence of the respective interventions. Discussion examines the evidence of processes which are, or are not, enhancing adaptive capacity in the ways the projects intended.

For the purpose of this research, adaptive capacity is considered to be a supporting characteristic for sustainable agricultural livelihoods through enabling adaptation as a strategy to reduce risk or increase benefits. Section 2.7 outlined the proposed framework of adaptive capacity and Figure 2.4 indicated how this can support sustainable agricultural livelihoods. Section 2.7.5 proposed that multiple attributes of systems can contribute to enhancing adaptive capacity and outlined the many attributes of social capital which could be considered as features of adaptive capacity. The attributes of social capital, which may contribute to adaptive capacity tested within this study, include collaborative governance, collective learning, social networks, diversity of types of interactions, and anticipation. As secondary, yet important, attributes of adaptive capacity, Section 2.7.5 described physical features of experimentation, innovation, and diversity of agricultural livelihoods. The discussion in this chapter will

examine features of social capital as indicators of enhanced adaptive capacity, and then consider how this influences the physical features of diversity, experimentation and innovation as a secondary concern. Each of these components of adaptive capacity will be discussed in turn, through examination of associated indicators outlined in Section 4.6 and evidence of outcomes resulting from enhanced adaptive capacity.

This study is investigating both the causes of diverse understandings of adaptive capacity and whether this diversity has any consequences for outcomes within agricultural development interventions. Chapter 5 examined how the existing understandings of adaptive capacity formed within the two case study interventions. To respond to the second research question it is necessary to examine indicators of enhanced adaptive capacity within participating farming communities. In order for these indicators to inform lessons for understanding how agricultural development interventions can enhance adaptive capacity, it is necessary to consider how evidence of project outcomes compare with the intended outcomes as examined through the diverse understandings of adaptive capacity discussed in Chapter 5. Two steps were taken in order to do this.

Firstly, empirical and secondary data were collected and analysed to establish the ways in which the two case study interventions intended to enhance adaptive capacity of the participating farmers. Secondly, empirical data were collected through interviews, focus groups, and ethnography. Those qualitative data were analysed to identify ways in which adaptive capacity had been, or was being, enhanced or diminished within the participating farming groups and nearby communities. This analysis considered the potential for both intended and unexpected outcomes of enhanced adaptive capacity. Outcomes of enhanced adaptive capacity caused through either direct or indirect consequences of the agricultural development interventions have been considered. This chapter will discuss the outcomes of enhanced adaptive capacity through direct and indirect interactions.

## 6.2 Indicators of Enhanced Adaptive Capacity

This section examines features of social capital which can function as indicators of adaptive capacity. This uses indicators for social networks, diverse types of social



interactions, collaborative governance and collective learning. Those indicators were used to test the framework of adaptive capacity proposed in Section 2.7. This section considers these forms of social capital in relation to enhanced adaptive capacity. Section 6.2.5 examines features of physical capital which may have contributed to enhanced adaptive capacity, notably diversification of livelihood sources, and experimentation and innovation within agricultural livelihoods. Both case studies will be discussed together.

#### 6.2.1 Social Networks and Diverse Types of Interactions

The Project Proposal for the CODE-WA intervention stated that communication was considered to be a key method of the project for enhancing adaptive capacity and development of agricultural innovation systems (ICRISAT, 2008). The project intended to develop structures for top-down, transversal, and bottom-up knowledge exchange with the expectation that this would enhance adaptive tools for co-learning as well as adaptive policies in relevant local sectors (Ibid, p iv). This understanding of the contribution of communication for collective learning and enhanced adaptive capacity implied the requirement of social capital existing between those communicating with one another. Communication can function as an indicator of social capital, as proposed in the framework of adaptive capacity (see Section 2.7).

One of the methods adopted to develop knowledge exchange structures among farmers was through farmer field schools. Both communities participating in the CODE-WA Project in Ghana stated that farmers from other communities in Upper West Region visited their farms during the project. During a focus group in Doodiyiri, one woman explained:

*“It [the CODE-WA Project] has exposed us to the general public. Before, it was hard to pass before [walk in front of] men sitting but now we have more profile so we can teach others the new farming methods. This has improved communal spirits.”* (FGC2, 16/9/14)

Another continued:

*“We can now work with those outside the group too. We invite others to observe and we show them the new farming methods we are using. We have been able to befriend other communities that haven’t got this method so we can teach them too.”* (FGC2, 16/9/14)

This was indicative of an increased social network for both individual farmers and the farmer groups. The farmers established networks stretching to communities in other

areas of Upper West Region, creating connections and interactions which did not exist prior to the CODE-WA intervention. This provides evidence of an increase in the social networks and a diversity of types of interactions among the farmer group and other associated individuals.

In Jonga, one farmer explained that she had learned about different methods for weeding and cropping by travelling to other farms in the area.

*“I learned a lot by travelling to other farmlands. We saw the similarity, using the same techniques and cropping system, but we saw different methods which we could try on our farms. We were also able to show them what we are doing and teach them new methods. It has enhanced togetherness and sharing of ideas which used not to be there. I can still phone people in other communities who we were exposed to in the project so we can share ideas.”* (IVC9, 18/3/14)

Through connections with other communities the social network, and thus social capital, of the farmer groups was increased, which in turn has increased the social capital which they could draw on when necessary. The farmer quoted above explained that through a larger social network and stronger local ties they have further enhanced their ability to share ideas, solve problems and learn collectively. As such, during periods of change, individual farmers and the group as a whole are able to utilise a greater diversity of relationship and interactions for collective learning and collaborative governance of resources.

The CODE-WA Project intended to enhance adaptive capacity through increased agricultural biodiversity, making the assumption that the risk of climatic shocks will mean some crop types yield when others fail. Although the crop varieties introduced through the project did not increase agro-diversity beyond the formal intervention, there was evidence that the diversity of social structures, relationships and interactions has been increased. Farmers have recognised the ways in which a larger social network and increased diversity of interactions meant they had increased the diversity of ways to respond to shocks and stresses. They have identified that social processes of collective learning could function in different ways between their own farmer group, their wider community, and through interactions with other communities in the region. The diversity of farmer interactions and processes for knowledge exchange were further enhanced through international farmer exchanges, examined in the following section.

The framework proposed in Figure 2.4 (Section 2.7) suggested that social networks as an attribute of social capital can enhance adaptive capacity. The examples

examined in this section provide evidence of ways that the farmer groups in Jonga and Doodiyiri enhanced their adaptive capacity resulting from increased social networks and collective learning. This indicates that attributes of social capital can enhance individual and collective adaptive capacity.

### 6.2.2 Collaborative Governance and Consensus

The use of social capital as a means of enhancing adaptive capacity is evident in the Trax project activities. A central way in which Trax understood their interventions as enhancing adaptive capacity and enabling sustainability was through the use of Community Trainers (CTs) and establishing Community Based Organisations (CBOs). Trax field staff provided additional training to individuals which had been nominated by the farmer groups to act as a CT. Additionally, prior to ending a project cycle with a farmer group or community, Trax supported them to formally establish a CBO so that there was a structure in place for the farmers to continue to engage in a group once Trax were no longer supporting them. Through these particular project activities, Trax intended to ensure that their intervention had a lasting effect and the practices they introduce did not cease once their formal intervention ended. In project documentation this was framed as enhancing sustainability of the project activities. However, when discussing this with staff during interviews and staff meetings, they indicated that they understood CTs and CBOs to support the further enhancement of adaptive capacity within the farmer groups. One member of field staff said during an interview:

*“When we leave a community we have achieved something but the best is yet to come. The CBOs mean they carry on with it [the project activities] so they are more adaptable and do more on the things we couldn’t in the future. They keep us on our toes.” (KI3, 25/7/14)*

This statement indicated that the staff considered the CBOs to result in a continued enhancement of adaptive capacity beyond the formal end of the intervention, and a sustainability of the social structures and interactions which enabled that.

Within the framework of adaptive capacity being tested in this research (see Section 2.7), the attributes of social capital, to which the CTs and CBOs contribute, include an increased diversity of types of interactions, collective learning, and collaborative governance. In the farmer groups participating with the Trax project, collaborative governance was indicated by regular group meeting to discuss livelihood activities, a democratically-nominated chair, and decision-making based on consensus.

The evidence suggested that collaborative governance functioned as a feature of social capital, and this contributed to adaptive capacity in the understandings of both Trax field staff and participating farmers. In particular, the above statement indicates that the field staff considered social capital to result from the actions of the CTs and the establishment of CBOs, and that this enhanced farmers' adaptive capacity and sustainability. Additionally, however, the actions of the CTs highlight the role of self-organisation and agency. These attributes of social capital as a means of enhancing adaptive capacity are examined further in the following two sections.

### 6.2.3 Collective Learning and Problem Solving

The previous section highlighted the ways in which Trax staff and participating farmers considered social capital to enhance adaptability and sustainability through collaborative governance. Within the discussion of social capital as contributing toward enhanced adaptive capacity, it is useful also to examine features of collective learning identified in qualitative data.

Trax established the role of a Community Trainer (CT) within each farmer group they supported, with the intention that they will help drive the continuity of project activities beyond the formal intervention. During interviews, the CTs indicated that their role had developed beyond that of supporting their own farmer group and community with facilitating project activities. Many of the CTs have been requested to provide training to farmers in non-Trax communities, with requests coming from the communities themselves. The following section of a transcript from one interview highlights how CTs and communities self-organised for knowledge sharing and enhanced adaptive capacity.

In the community of Pelungu, Upper East Region, Ghana, there were 24 farmer groups with whom Trax have been facilitating project activities. Each of these farmer groups had at least one voluntary Community Trainer (CT) and some have several CTs. As there were many CTs within one community, they nominated a chair. During interview with him, he explained how the CTs were helping to facilitate Trax's project activities more widely, and the outcomes of adaptability which this is having for communities. This is a section of the transcript from that interview (note, this farmer was able to speak fluent English so a translator was not required during this interview).

**Farmer:** *“We are training people from other communities who are not with Trax. We show them how to use farm yard manure and crop residue for making a fertiliser and how to make bunds. But travelling more than 10 miles on a bicycle is hard. We need motorbikes, it is a main challenge, it’s restrictive. One person asked me to go to a community 80 miles away to train them but I can’t get that far.”*

**Researcher:** *“How do people from other communities hear about you and the farming activities you have been doing with Trax? How do they know to ask you for training?”*

**Farmer:** *“People see what we are doing and ask us to train them. They are kin so we know them, so when they ask us to train them we organise together to show them. When we are going to a community we ask for a group of at least five farmers to train them.”*

**Researcher:** *“How do you train them? Do you use the same methods which you learned from your training with Trax?”*

**Farmer:** *“We combine our own knowledge with training from Trax, but training from Trax is the most important because they want to know the new techniques for contour identification and bunding. We also show them how to get organised as a group so that they can work together.”*

**Researcher:** *“Do you think it helps these communities to learn the techniques Trax taught you? In what ways does it help?”*

**Farmer:** *“Yes, it helps. They can do what we have so it is helping. There is a difference.”*

**Researcher:** *“Earlier we talked about how working with your farmer group and Trax it has helped to make you and other farmers in your group more adaptable. Do you think that when you train other communities it also helps them to become more adaptable?”*

**Farmer:** *“Yes, it has helped them. Now they can share ideas in a group like we do, so they can solve problems. There is a cycle of sharing knowledge and we can also try to solve problems with them by using different ideas.” (IVT42, 4/3/14)*

By sharing the techniques and processes which the CTs learned from engaging with Trax with additional farmer groups and communities, the Trax intervention indirectly enhanced adaptive capacity in other communities. Although the intention of developing the role of CTs was to support facilitation within their own farmer groups, the CTs have also developed capacity to share this knowledge with others. The transcript indicates that the CT considered the additional communities he and other CTs had trained also developed the adaptive capacity and sustainability that Trax had

intended but through a cyclical process of knowledge sharing between the CTs, their farmer groups, and other farming communities. This process also indicates an element of self-advocacy, community mobilisation, and collective action which are discussed in the following section.

Furthermore, this indicates that without engaging with the Trax project farmers have sufficient social capital to be able to self-organise and approach the CTs in their neighbouring communities. The features of social capital displayed by the CTs and farmer groups which have participated with the Trax intervention, indicated that the capacity for self-organisation was also evident and complimentary to collaborative governance. Although collaborative governance is a feature of social capital, which can enhance adaptive capacity, the role of self-organisation as independent of, but complementary to, collaborative governance was not considered in Chapter 2. As such, the significance of self-organisation and subsequent agency has emerged through data collection and analysis, and will be examined below.

The CODE-WA Project was implemented in four countries in West Africa, with the Ghanaian study site providing the case study for this research. International farmer exchanges were used as a method with the intention of establishing new structures for farmer knowledge exchange. During the three year formal intervention, representative farmers from the participating communities in the four countries travelled to each of the study sites in the other countries. As such, two farmers from the Ghanaian study site, one each from Jonga and Doodiyiri, visited the CODE-WA Project sites in Mali, Burkina Faso, and Niger.

During interviews with the two farmers who visited the study sites in the three other countries, they described an additional process of collective learning during the farmer exchanges, and knowledge sharing and collaborative governance of resources once they had returned to their own farmer groups. One farmer from Jonga explained that during the international exchange visits they had observed farming methods, discussed the challenges each project site experiences, and shared ideas. In this way there was a process of collective learning among the farmers from the four project sites. She stated:

*“We could talk as a group while observing their farming methods so we saw what was the same and what was different. It appeared that the land here [Ghana] is more fertile than in Mali and if they can farm there, then we can here. We are now more committed and motivated because we can see what will*

*happen to our farms if we let things drift and the rain pattern fails.” (IVC8, 17/3/14)*

This indicates that the representative farmers engaged in collective learning during the exchange visits. Additionally, there was a process of collective learning among the groups in Jonga and Doodiyiri following the exchange visits because of the ideas, insights, and messages with which the representatives returned. This suggests that social capital was enhanced within strengthened local networks and in longer-distance social networks which were expanded through the project activities.

The above quote provides evidence of enhanced ability to anticipate, as she stated she can now visualise what the farming system would be like in a drier environment. The representative farmer from Doodiyiri also made reference to this during an interview:

*“When I travelled outside [to other countries] I saw that the rain is very low and the farming is a challenge. The rain pattern has been changing here too and if the rains fail then it can become dry like I saw outside. Before, the place was not overpopulated but now there is deforestation and the rain pattern has changed. I have seen how our farms could be if this continues so now we work together on keeping our farms and I have seen how they are farming outside so I can show others here how to farm to save the water in the soil.” (IVC15, 29/3/14)*

By anticipating changes in the environment as a result of climatic variability and unpredictable rainfall, the farmer groups engaged with the CODE-WA Project in Ghana have considered ways to adjust their farming methods in response to drought periods. Through analysis of ways collective learning contributes to social capital and adaptive capacity, the additional role of anticipation has emerged. The framework of adaptive capacity proposed in Section 2.7 suggested that the process of anticipation could contribute to enhancing adaptive capacity because it can instigate action to minimise negative impacts from anticipated change while also increasing insight into alternative options. Data analysis suggests that, in the case of the farmers participating in the CODE-WA Project, the international farmer exchange visits enhanced their capacity for anticipation. This triggered a response to trying to limit the negative impacts of an unpredictable rain pattern on their farming, while also experimenting and innovating with methods which may be more suitable for farming in drier conditions. The associated farmer groups were utilising anticipation as a means of learning about potential future conditions and drawing on social capital as a means to adapt to

anticipated changes. This suggests that collective anticipation can function as an indicator of the capacity for collective learning as well as of social capital.

The knowledge exchange which contributed to collective learning in both case studies was facilitated by the participatory project activities bringing the farmers together on a regular basis. Additional project activities, such as the international farmer exchange in the CODE-WA Project discussed above, also enabled knowledge exchange. The collective learning which resulted from exceptional and/or frequent knowledge exchange within participatory processes concurs with the findings of De Vente et al (2016).

However, support from the facilitating institutions was required to either enable or initiate knowledge exchange and collective learning processes in both case studies. Although the farmer groups continued to engage in collective learning and problem solving after formal project implementation had ceased, that support to initiate the process was necessary. As such, in cases which are lacking access to interventions of this type there may be a barrier to effective knowledge exchange. Likewise, in cases where not all members can engage in knowledge exchange activities, such as limited numbers of farmers being able to travel to engage in activities further afield, scope for knowledge exchange and collective learning may be limited. Similar interventions should consider this when planning participatory project activities for knowledge exchange and learning.

#### 6.2.4 Empowerment, Agency and Autonomy

The features of social capital which were postulated to contribute to enhanced adaptive capacity in Section 2.7 did not consider the role of agency and autonomy. Furthermore, the capacity of empowerment to enhance and strengthen social capital was not identified in the proposed framework of adaptive capacity. However, data analysis identified evidence of the significant role of empowerment and resulting agency and autonomy in enhancing the adaptive capacity within participating farmer groups in both case studies. This section examines examples from the Trax intervention. Evidence of empowerment, agency and autonomy resulting in outcomes from enhanced adaptive capacity will be discussed in Section 6.3.3.

Through engaging with Trax and connecting farmer groups with other associated services, such as MOFA veterinary services, Trax intended to help build



capacity for advocacy in those farmer groups. Discussions observed during staff meetings suggested that the intention was to develop advocacy skills in relation to agricultural livelihoods so that the farmer groups acquired the capacity to access appropriate support from external services after the end of Trax's formal intervention in the community. Interviews and focus group discussions with farmer groups who had engaged with the Trax intervention several years previously indicated that the capacity for community self-advocacy had extended beyond the intervention.

During interviews and focus groups in both Nakpalig and Beo-Tankoo communities, farmers explained that through the self-organisation of their farmer group they had been able to advocate to other external institutions for additional support or services. One of the farmers who had been nominated to act as a CT in Beo-Tankoo explained that they had begun engaging with the Trax intervention in 2001 and formal intervention from Trax had finished in 2007. He explained:

*“Previously we felt that the government should just give us what we need but now we know that we have to negotiate and tell them what you need. Through the efforts of Trax we learned how to form Tanda, our CBO, so now we can go to the government or other NGOs and ask for help.” (IVT45, 7/3/14)*

On further questioning he went on to describe how this had influenced the ability of farmers to adapt to changes in their circumstances. He explained:

*“It has helped with socialisation, before there was no unity in the community. It has changed social awareness because now we work together. Before Trax came our outlook was negative, there was doom. Now we work together to solve our problems, we have a united culture. By working together we have lobbying skills, we can raise labour and raise funds to help on the issues we face. [...] We made a communal decision to stop cutting trees and plant more so that we can bring the rain and can provide fruit for our children and shelter for our animals.” (IVT45, 7/3/14)*

This example indicates ways in which collaborative governance, collective learning and shared problem solving resulted in an increased sense of autonomy and agency, consequently enhancing adaptive capacity within the community of Beo-Tankoo. The theoretical framework being tested in this research (see Section 2.7) proposed that collaborative governance and collective processes of learning and problem solving are characteristics of social capital which contribute to communal adaptive capacity. In this example, qualitative data suggest that these characteristics and the attributes of autonomy and agency functioned as features of adaptive capacity through community action. The evidence indicates that the attributes of autonomy and agency were also

functioning within collective actions and thus it may be appropriate to consider them as additional features of social capital which can enhance adaptive capacity.

#### 6.2.5 Diversification, Experimentation and Innovation

The above discussion highlights the significant role of social capital functioning within farming communities which have participated with the two case study agricultural interventions under investigation. The framework of adaptive capacity for sustainable agricultural livelihoods proposed in Section 2.7 suggested that, alongside features of social capital, a diversity of livelihood options as well as experimentation and innovation among farmers can also enhance their adaptive capacities. Examination of contemporary discourse in practice-based agricultural development interventions indicates that it is the physical diversity of agricultural livelihoods which are often perceived as indicators of adaptive capacity (e.g. FAO, 2013b). This section considers the project activities in the case studies which were intended to focus on increasing diversity of agricultural livelihoods with the objective of enhancing adaptive capacity and livelihood sustainability.

During a field visit with Trax staff in June 2014, two staff members stated that farmers were able to switch between their livelihood sources when one of their crops failed or when they had greater demand on their income. A farmer explained how he had decided to grow vegetables when his early millet harvest failed. The vegetables required more work because they had to be watered by hand rather than left for rain-fed irrigation. The farmer explained that he would be able to make more money from the vegetables by selling them at the local markets. *“I have many crops I can grow so when one fails I can turn to something else to make sure I can still provide for my family”* (pers. comm., 28-6-14, Pelungu). This identifies diversification of crops and livelihood sources as a component of enhancing adaptive capacity to sustain agricultural livelihoods, implying that the capacity was held in the options available and the action of adaptation was effective when the farmer made use of the diversity of options available in response to a shock.

The understanding and indicators of adaptive capacity evidenced in this example shows the intention of Trax to support risk-spreading through crop and livelihood diversification. However, in Trax’s formal understanding of enhancing adaptive capacity (see Sections 5.2.5, 5.2.6, and 5.2.7) by increasing options of crops or

livelihood sources available to farmers also enhanced their adaptive capacity through other means. By providing seeds for crop varieties which grew well in local conditions or had been bred to be drought-tolerant, Trax hoped to increase yields. By understanding adaptive capacity within the context of interventions (Section 5.3.1) and adoption of techniques (Section 5.3.3), Trax staff believed increased yields enhanced farmers' adaptive capacities because they then had increased food security and higher income. One staff member suggested that reduced poverty and increased food security can help to build adaptive capacity by increasing the farmers' capacity to access additional support, infrastructure, and employment. Risk spreading through providing access to alternative livelihood sources was considered to enhance the capacity of farming communities to adapt in response to shocks.

The informal understandings of Trax staff and farmers and one of the formal understandings within the Trax project considered an increase in diversity of crop varieties and livelihood sources as enhancing the adaptive capacity of farmers. This was also reflected in the second formal understanding within the Trax intervention, that influenced by the current primary funder and international policy discourse (see Sections 5.2.2 and 5.2.4). This understanding considered the need to adapt in response to, or in anticipation of, climate change. The formal understanding identified physical intervention activities such as providing new crop varieties or developing enterprises as enabling a means to adapt as and when necessary. Following this, the formal understanding of Self Help Africa saw crop and livelihood diversification as enhancing adaptive capacity, because farmers were then able to draw on this diversity to adapt in response to climatic shocks.

In this initiative to enhance adaptive capacity through crop diversification, Trax were providing women farmers with seeds to grow groundnut and soya beans. In addition, Self Help Africa introduced the cultivation of orange-fleshed sweet potato (OFSP; see Section 5.2.4). While the crop diversification introduced by Trax achieved its intended outcome when understood as enhancing adaptive capacity through providing choices for adaptation strategies, the OFSP introduced to Trax and associated farmers by Self Help Africa has not achieved this outcome. As explained in Section 5.2.4, although participating farmers did cultivate the OFSP when requested to, they were not keen on the crop for several reasons.

The rationale Self Help Africa staff gave for introducing the OFSP was two-fold: it had been bred to have a higher level of Vitamin A, thus helping to reduce

nutrient deficiency in children; and it had been bred to grow in a shorter period of time, providing a source of income during drought years. The project planned to develop the market for the sale of OFSP, with the intention of ultimately being able to sell the crop internationally. These two reasons why they considered OFSP to be suitable were in tension with each other. If the farmers are feeding the OFSP they grow to children to reduce Vitamin A deficiency then they would not be able to sell it at the market for income, and likewise, if the crop was being sold they would not be able to eat it. Meanwhile, Self Help Africa had anticipated both benefits of increased income and improved childhood nutrition within the same households and communities. Due to the small scale at which the farmers were able to grow the crop, it would not be possible for one farmer to produce enough OFSP to meet both objectives.

In the context of the formal understanding of adaptive capacity under examination here, it is the rationale that cultivation of OFSP would provide an additional livelihood source and income during drought years which is relevant. The framework of adaptive capacity and contributions to sustainable agricultural livelihoods in Figure 2.4 (Section 2.7) proposes that a diversity of livelihood options can support adaptive capacity. However, the rationale for OFSP relates directly to the second formal understanding of adaptive capacity within the Trax intervention, outlined in Section 5.4.

Although the OFSP intervention introduced by Self Help Africa uses the same rationale that Trax used in providing groundnut and soya bean seeds for cultivation, the case of the OFSP overlooked the local context in which the crop was to be grown. The rationale may make sense in principle but in the area of Upper East Region, Ghana, sweet potatoes are not part of the local diet and there is no market for them. Although diets may change in response to the food sources available, this typically takes a period of years to become engrained within local customs so it could take many years before consumption of OFSP is considered to be a preference. As such, in current circumstances the production of OFSP would not provide an income during drought years because farmers would be unable to sell it. This highlights the importance of considering the local context when planning an intervention.

The farmers participating in the CODE-WA Project undertook a participatory evaluation of crop varieties under cultivation at the Savanna Agricultural Research Institute (SARI) station during the first year of the project. During interview the Project Principal Investigator stated that he considered it to be important that the farmers

participating in the project had a choice of the crops they would trial during the intervention. Staff working with ICRISAT and SARI stated that by observing the crops growing on the station before using participatory evaluation would encourage the farmers to experiment with different species and varieties. The SARI Research Programme Coordinator explained:

*“We trained them in evaluation and provided them with seeds for comparison. They decided what they wanted, what they were interested in, and then they could experiment with different varieties to see what they liked the best on their farms.” (KI9, 14/3/14)*

Experimentation is one of the characteristics of adaptive capacity proposed in the framework for this research (Section 2.7), because of ways in which experiments can interact with processes of innovation and iterative learning. Additionally, through the use of participatory evaluation methods and farmer exchange visits, the CODE-WA Project sought to utilise collective learning processes within the farmer groups. The evaluation procedure and farmer group structure required by CODE-WA indicated the existence of processes of consensus, collaborative governance, and collective learning, which were also proposed in Section 2.7 as characteristics of social capital which may enhance adaptive capacity.

Although supposedly participatory, the evaluation process in the CODE-WA Project adopted a typical transfer-of-technology model, whereby ICRISAT and SARI had decided which crop types to breed with which specific characteristics, and the farmers were then able to select their most preferred varieties from those. Arora (2012) suggested that agricultural innovation systems need to move away from this and incorporate farmers into the process of research and development in innovation (discussed in Section 2.1.2). This argument echoes that of farmer field schools and participatory plant breeding initiatives over the past four decades (Section 2.6). A separate project activity of CODE-WA adopted a farmer field school approach.

Only some of the farmers who engaged with the on-station participatory evaluation of the crop varieties found this process useful. One woman in Doodiyiri explained *“It was better when we had the seeds to grow them on our farm because we could come together to see how the crops were doing next to our native crops”* (IVC21, 22/9/14). This suggested that this farmer found experimenting with introduced crop varieties to be of greater benefit when they could engage in a ‘learning by doing’ process.

Farmers in both communities stated that when they were trialling the new varieties on their own farms, the groups would work together on cultivating them and observing how the crops were doing. During a focus group, a farmer in Jonga stated:

*“We come together and meet each week and look at how the crops are growing. We observe the farms together to share ideas on the way forward. This helps us with learning and we can now advise each other.”* (FGC1, 15/3/14)

This reflected the concept of collective learning which was postulated as a feature of adaptive capacity through increased social capital in Section 2.7. The farmers participating with the CODE-WA Project indicated that, by collaborating and sharing ideas, they were able to solve problems and learn together. Further, data analysis indicated that collaborative processes of sharing ideas and collective learning resulted in increased experimentation, using a strategy of ‘trial and error’ to establish which methods provided the most beneficial outputs. Thus, although those facilitating the CODE-WA Project intended to increase experimentation through the on-station participatory evaluation of crop varieties, it was evident that the farmer groups established a process of experimentation once they were growing the new varieties on their farms.

A primary activity of the CODE-WA Project was the distribution of new crop varieties, which had been bred by SARI to be drought tolerant. As outlined in Section 3.5.1, the CODE-WA Project intended to increase agricultural biodiversity in order to limit negative impacts of climatic variability and spread risk during periods of environmental shocks. The objective of this intervention was not only to increase the resilience of crop yields during periods of drought but also to enhance the adaptive capacity of the farmers by diversification of crop types and varieties. This was relevant in the region of Northern Ghana as farmers reported both a change in the rain pattern to a delayed onset of the wet season, and an increase in the frequency of drought periods during the wet season. The framework of adaptive capacity outlined in Section 2.7 proposed that diversification of livelihood sources, through diverse crop varieties or additional non-agricultural livelihoods, may contribute to enhanced adaptive capacity.

During interviews MOFA and SARI field staff explained that farmers from the two participating communities had attended the SARI station to observe the crop varieties which had been bred locally. The SARI Research Programme Coordinator

stated that SARI had bred crop varieties which were locally used by farmers as well as sorghum and groundnut which had been bred by ICRISAT. He explained:

*“They [the participating farmers] decided what they wanted, what they were interested in. We did training in evaluation and they chose the seeds they were interested in using participatory evaluation methods using coloured cards. Then we provided them with seeds for comparison with their native variety.”* (KI9, 14/3/14)

Farmers in both communities corroborated this, stating that they had selected the varieties they considered most appropriate to their needs and then taken them to cultivate on both household and group farms. Farmers in the community of Jonga said that they had tried growing introduced varieties of sorghum (locally referred to as guinea corn), millet, maize, cowpea, and several varieties of groundnut. In the community of Doodiyiri farmers said they had trialled growing millet, guinea corn, cowpea, groundnut, and okra. During a focus group in Jonga, farmers explained that they had grown the new varieties next to their native varieties to draw comparisons.

Although the crop varieties, which were introduced to the farmers during the CODE-WA Project, had been bred to be more drought tolerant than the native varieties, farmers in both communities consistently stated that the crops had failed to yield during the 2013 drought. One woman in Jonga stated:

*“We continued growing the crops but due to the poor rain pattern we lost the crops so now we need to revisit SARI if we want to grow them again this year but it costs money to replace the seeds. It was only the rain pattern which failed last year. Now we have lost our seed stock.”* (IVC5, 17/3/14)

Farmers in both communities explained that they no longer have any seeds for the varieties which were introduced to them during the CODE-WA Project, except for a small amount of okra seeds in Doodiyiri which are still grown. As such, the objective of enhancing adaptive capacity by increasing agricultural biodiversity through the introduction of drought-tolerant crop varieties was not met. However, although the primary activity of the CODE-WA Project ostensibly failed, this does not mean that the project did not contribute to enhancing adaptive capacity in the two participating communities. Other evidence reported above indicate that strengthened social capital enhanced individual and collective adaptive capacity in the associated farmer groups.

### 6.3 Evidence of Enhanced Adaptive Capacity Impacting on Project Outcomes

The previous section considered indicators of enhanced adaptive capacity, examining evidence of features of social capital within the farmer groups associated with the Trax and CODE-WA Projects, as well as physical features of livelihood diversification, experimentation, and innovation. To further this analysis, this section examines the evidence of enhanced adaptive capacity positively impacting the outcomes of both projects. This discussion will first examine social capital and its components which have impacted project outcomes, followed by an examination of the role of livelihood diversification. Intended and unexpected project outcomes are discussed, highlighting the significant beneficial outcomes resulting through engagement with the associated agricultural development interventions.

#### 6.3.1 Social Capital and Diverse Types of Interactions

A central organisational objective of Trax was to support environmental sustainability (Section 5.2.6) by reducing soil erosion, increasing biodiversity, preventing deforestation, and enabling reforestation (see Appendix D for details of Trax project activities). The formal understanding of the objectives of Trax relied on the underlying assumption that environmental sustainability will increase crop yields and enable sustainable agricultural livelihoods. During interview, one of the field staff stated:

*“The environment is changing very fast. We do what we can so that they [farmers] can survive. Being adaptable is a way of surviving in the environment, so we put in place certain strategies to make sure it’s continuous. Projects are not an end, it’s a process so a means to an end.” (KI3, 25/7/14)*

This indicated that Trax staff understood improved environmental conditions as supporting adaptability but also that enhanced adaptive capacity, as well as the project activities, supported longer-term sustainability of the community within the environment.

However, although Trax staff may have seen increased yields and environmental sustainability as enhancing adaptive capacity of the farmers in the context of their agricultural intervention, farmers did not see it that way. When asked about how they choose to spend increased income from alternative livelihoods or sale of increased crop



yields, farmers consistently stated that they were now able to pay for their children to go to school. Therefore, the farmers, who had ostensibly improved their environmental sustainability and increased their income, did not use this to enhance their own adaptive capacity as Trax staff expected, instead investing it in their families and the enhancement of their children's adaptive capacities. This reflected a difference in the understandings of adaptive capacity and sustainability of the farmers and Trax staff. For the farmers, investing in education was seen as investing in the future of the community because it will enable their children to be adaptable by living within multiple states, as the traditional cultural understanding examined in Section 5.3.7 outlined. This indicated that the farmers recognised adaptive capacity as consisting of features of social capital while the second formal understanding of Trax centred on physical diversification of livelihoods and experimentation.

This example reflects the long-term, temporal dimension of adaptive capacity in relation to sustainability. The farmers chose to invest their increased capacity into enhancing the adaptive capacity of their children's futures. This was perceived as investing in the future of the community because it would increase the livelihood options the children would have once adults by moving out of farming into salaried employment. Farmers anticipated that the increased opportunities and income from this would later benefit themselves as their children would be better able to provide for their extended family. As such, the farmers had developed a theory of change based on investing their enhanced capacity in their children's education.

In this example, it was clear that the primary outcomes of enhanced adaptive capacity through increased income were not recognised by Trax, as the organisation was not concerned about expenditure on schooling. However, the understanding of the farmers that increased social capital through access to education enhances adaptive capacity supports the framework proposed in this research. Increased access to education can function as an indicator of enhanced social capital and the utilisation of that social capital is here proposed as an indicator of enhanced adaptive capacity. This supports the discussion in Section 6.2 which identified several indicators of social capital which contribute to adaptive capacity. The framework of adaptive capacity proposed in Figure 2.4 did not refer to access to education as enhancing social capital, but the discussion here suggests that it is an important component of social capital when viewed in a longer-term perspective and the farmers' understandings of investing in future capacity of their families and communities.

In order for collaborative governance and collective learning to function effectively, or even to exist within a group, there must also be an element of social capital in the community. Social capital and social networks are identified as likely characteristics of adaptive capacity in the framework proposed in Section 2.7. Section 2.4 suggested that social capital can consist of features of networks, leadership, and shared values and norms, and trust. Pretty (2002b) suggested that only interactions which are beneficial for collective action constitute social capital. Consequently, the framework for adaptive capacity within sustainable agricultural livelihoods proposed in Figure 2.4 (Section 2.7) hypothesised that a diversity of types of relationships and interactions could also facilitate enhanced adaptive capacity.

McPherson et al (2001) suggested that homophily of social characteristics can exist within a local context even when there is demographic heterogeneity in relatively small geographical areas. In the Trax Sustainable Agriculture project, the participatory methods they facilitated utilised existing social structures and sought to optimise prevailing relationships and interactions among the farmers. By building on existing social interactions, the diversity of types of relationships and interactions may be increased. Further, engagement with Trax, and the additional services the project activities required, for example MOFA veterinary service, expanded the social networks of the farmer groups, increasing the diversity of resources the community could draw on.

The increased diversity of actors within a social network as well as diversification of social structures, interactions, and social resources enhanced both individual and collective adaptive capacities. Just as diversification of crop types or livelihood sources provided options to choose from, so too did the diversification of characteristics of social capital. This enhanced the capacity to adapt in several ways. Firstly, there was simply access to a larger pool of knowledge and information which could inform decisions and enable experimentation. Secondly, a larger social network allowed for collective action whereby multiple strategies were initiated in response to, or anticipation of, change, increasing the likelihood that a successful strategy would be trialled. Drawing on a range of options throughout a social network spreads the risk presented by change and uncertainty in agricultural livelihoods. Finally, enhanced social capital and a larger social network meant that, should an individual or group be

subjected to risk and negative outcomes, they would have access to a greater number of resources and a stronger support network to assist their recovery.

The beneficial impact of increased social networks was evident in Pelungu, as described during a focus group with farmers.

*“We used to use our traditional methods to treat our animals [livestock] when they get sick but we saw that traditional methods were no longer working and the animals were dying. When Trax came they trained the CTs to care for our animals and gave them some medicines. Last year many people were losing animals and the CTs couldn’t treat the sickness. Because Trax introduced us to the veterinary service with MOFA we were able to go to them and they helped us so the animals didn’t die.” (FGT8, 3/3/14)*

This indicated that, because the social network of the farmers had been expanded by Trax to include the MOFA veterinary services, the community was able to respond and draw on those resources when needed. In the context of those smallholder farming communities, caring for livestock was particularly important for adaptive capacity, because animals were used as a type of savings account. When other livelihood sources fail, such as crop yields, farmers sold their livestock to raise income to feed their families. As such, the sale of livestock was a short-term adaptation strategy in response to a lack of food or other sources of income. Although the sale of livestock as a short-term adaptation strategy had been used among farming communities in Northern Ghana prior to the establishment of Trax, the intervention meant there was greater capacity to treat livestock sickness and therefore the number of livestock surviving and available for sale in response to a shock increased.

The CODE-WA Project required farmers to be in formalised groups, which is why the Kamwinsomte Women’s Group was identified as suitable participants for the intervention, as discussed in Section 3.5.1. Although necessitating some level of existing social capital, the Principal Investigator explained during an interview:

*“The project didn’t plan to reinforce the farmer organisations but sought to use an existing group because the time limits of the project meant that there wasn’t time for us to create new farmer groups. We were looking at how their farming systems could be adaptable to climatic variability rather than how the farmer groups could be adaptable themselves.” (KI24, 25/3/15)*

The intervention utilised processes of consensus-building and participatory evaluation methods to identify optimal crop and natural resource management strategies. Qualitative data indicate that the social processes initiated through this

resulted in multiple unexpected beneficial outcomes for the farmer groups beyond their farms.

Participating farmers in both communities spoke of ways in which the farmer groups had been empowered by collaborating during the CODE-WA Project. During focus groups and interviews, farmers consistently referred to attributes of social capital which had been either created or strengthened through collaborative governance and collective learning. One farmer in Jonga stated:

*“Based on collective decisions taken it can enhance the way forward, but if doing it individually you may not know what way what you are doing will lead you. Because we have sharing of ideas it can take us forward to do well. We have unity and togetherness now.”* (IVC1, 16/9/14)

The terms ‘solidarity’, ‘unity’, and ‘togetherness’ were frequently used during discussions about the farmer groups, as also discussed in Section 5.3.7 in relation to the Trax project. Through examining these three terms with the translator, they were respectively defined as: assisting one another, identifying a common purpose or problem, and working collectively on an issue. Data analysis indicated that these collective attributes, which developed within the farmer groups, assisted in successful collaborative governance, consensus building, and collective learning. Thereby, social capital was increased and strengthened and contributed to enhanced adaptive capacity through a diversified and increased pool of resources the farmers could draw on.

This example confirms the framework of adaptive capacity being tested in this research. Furthermore, data analysis also identified a significant positive influence on social capital and, subsequently, adaptive capacity through empowerment of the farmers, which was not included in the framework in Section 2.7. The role of empowerment will now be discussed in relation to this example in Jonga.

Further to enhancing communal adaptive capacity through collaborative governance and collective learning, it is evident that the positive outcomes of these social processes led to empowerment within their communities. Several farmers explained that their group had an increased profile within the community and surrounding area and others came to them for advice. Some women stated that they now had an increased status and the men and elders in the community now recognised that they are able to contribute. One woman in Jonga explained: *“We have status now so we have been able to teach others. We used to hang on our husbands to feed the family so*

*we would quarrel but now we can assist with feeding*” (FGC1, 15/9/14). Another farmer continued:

*“There have been tremendous changes. There is now envy in the community that we come together because they can see that we exchange ideas and help each other so we are advancing.”* (FGC1, 15/9/14)

In this way, the empowerment of the predominantly female farmer groups resulted in shifts in some of the cultural norms, because the wider community observed the opportunities for beneficial outcomes. This also enabled the farmer group to innovate and seek additional opportunities. For example, in Jonga the farmers stated that they were trying to lease some land from the traditional leader, the *Tindana*, so that they could develop a mango plantation to expand their sources of income. The collaborative governance and agency that enabled the farmers to develop this initiative increased the diversity of their livelihood sources and further enhance their adaptive capacity. The male farmers in these groups and the women’s husbands were supportive of the initiative because they recognised the benefits of the increased livelihood sources. In addition, the women reported that men in the community encouraged their activities. This indicates feedbacks to increased empowerment and agency, discussed further in Section 6.3.3. The next two sections further this discussion of empowerment and agency through the characteristics of collaborative governance and autonomy.

### 6.3.2 Collaborative Governance and Collective Learning

As discussed in Section 6.2.2, Trax intended to develop structures within their participating farmer groups to facilitate collaborative governance. The intended outcome of collaborative governance were processes which enabled the sustainability of project activities beyond the end of the formal intervention. Analysis of empirical data indicates that governance structures established as a feature of the Trax project resulted in unanticipated beneficial outcomes as well as those discussed above.

When initiating an intervention with a community, Trax used participatory methods so that the farmer groups are self-organised with minimal input from Trax staff. Using such methods, groups are then asked to identify and prioritise the problems they face (see Appendix D for full details of Trax project activities). To ensure gender equality in this process Trax staff facilitated problem identification and ranking exercises with males and females separately as the organisation recognised that their priorities may be different. For example, in problem rankings facilitated by Trax, in the

community of Pelungu the male farmers stated that poor soils was their main challenge for their agricultural livelihoods, while female farmers identified access to sufficient clean water as their priority. Although the problem ranking exercises focused on agricultural livelihoods, several communities who had previously participated with Trax have used the same approach to identify and address other collective challenges. Examples of the ways different communities utilised social capital to take action on the collective challenges they identified will now be examined.

During a focus group discussion with women farmers in the community of Dachio, one woman explained that the methods they learned for building consensus while working with Trax they subsequently used to make decisions as a group on other matters as well as their farming. During a focus group discussion and individual interviews with the farmers in the Abotitaabasum farmer group in Dachio, several women made reference to their shared problem of access to water. One woman explained:

*“We have come together and seen that access to water is the priority. Now we are looking at how we can come together as a group to see if there is any organisation that can help with the water. We have seen that when we approached Trax they could help us and now we are looking to see if there is an organisation that can bring us a borehole.”*(IVT15, 14/2/14)

Further to this, many of the women in Dachio explained that they were widows and each had individually struggled with the increased financial demands following their husbands' death. One woman elaborated, stating that she wanted to start trading to increase her income but couldn't do it on her own, so discussed it with the rest of the group. She learned that many wanted to begin trading at the market in Bolgatanga, in particular there was a collective interest in selling their woven goods. As a result she suggested that they opened a group bank account and they now take collective responsibility for trading their goods so that no one is alone.

This indicates that the processes of collaborative governance and problem identification initiated by Trax became established within the social capital and the group structure. Furthermore, consensus-building and collaborative governance created a sense of unity, ownership, and empowerment within the group. This in turn led to increased autonomy and advocacy for shared problem solving.

In the context of this example, the experiences of unity, empowerment, community autonomy and advocacy described by the farmers are all collective attributes. Therefore, these attributes contributed to enhanced social capital as the women increased their capacity to work together effectively to achieve their objectives. Through this increased social capital the processes of collaborative governance and collective learning were strengthened and subsequently enhanced the collective adaptive capacity of the group. This confirms the assumptions of the framework of adaptive capacity, outlined in Section 2.7, but goes further by also indicating that the farmers perceived the role of unity, empowerment, autonomy, and agency as also building social capital and enhancing their adaptive capacity. The contribution of empowerment, autonomy and agency to project outcomes will be examined further in Section 6.3.3.

To interpret the above examples using the terminology adopted throughout this study, evidence of collaborative governance and consensus building resulting in changes within the social capital of the community and grassroots advocacy was apparent in communities which participated with the Trax project some years ago and the formal project intervention has since ceased. For example, farmers in Nakpalig, Beo-Tankoo, and Dachio described ways in which the group had worked together to mobilise other forms of development locally. These communities were weaned off the formal Trax intervention, in 2001, 2007, and 2012 respectively. The corresponding community-based organisations subsequently successfully lobbied local governmental Ministries for funds or increased infrastructure, including restoring a micro-dam in Nakpalig and building a health centre and school in Beo-Tankoo, among other initiatives. While this indicates the principles and assumptions of Trax that participatory processes can lead to lasting positive impacts, it ostensibly suggests that once collaborative structures are functioning, farmers can then expand on those processes to enhance autonomy and establish autochthonous development. The participatory methods utilised within the Trax project drew on existing social capital and strengthened structures and interactions within the farmer group. This in turn enabled longer-term outcomes of reinforced social capital to enhance adaptive capacity in areas beyond those directly and intentionally targeted by the Trax intervention.

The framework for adaptive capacity proposed in Section 2.7 identified collaborative governance and consensus as features of social capital which may enhance adaptive capacity. This section has explained how strengthened social capital initiated

through participatory methods used by Trax resulted in lasting outcomes of consensus building and collaborative governance among the participating farmer groups. As features which may enhance adaptive capacity, these processes pool resources and knowledge, and encourage individuals to engage. These collective processes led to shared problem solving and learning, further leading to groups seeking ways of adjusting their practices in response to changes and demands.

Analysis of interviews with farmers suggests that all of the individuals interviewed perceived the collaborative actions of their group to be of greater benefit to them than they would have been able to achieve if working alone. This implies that collective adaptive capacity is greater than the sum of the adaptive capacities of each member. In the context of the examples presented here, this goes beyond the utilisation of adaptive capacity in the typically perceived manner of responding to change. Rather, by drawing on social capital these communities self-organised, and through those processes they recognised their collective adaptive capacity and sought to initiate change which they deem beneficial to the community as a whole. Section 6.2.4 examined an example from the community of Nakpalig in which the group continued to expand in response to high demand despite having engaged with the Trax intervention 21 years ago. This ostensibly indicates that it is possible for the attributes of social capital to have a lasting outcome of enhanced adaptive capacity.

As outlined in Section 3.5.1, the CODE-WA Project was formally implemented from 2008 until 2011, with an informal extension locally facilitated by MOFA until 2012. The intervention was a research project initiated by ICRISAT and had goals for short-term outputs. The project gave minimal consideration to long-term impacts or outcomes for the sustainability of the agricultural livelihoods in the participating communities, using short-term research findings to indicate the potential for diversification to contribute to sustainability rather than assessing longer-term outcomes. The ways in which outcomes of enhanced adaptive capacity contributed to sustainable agricultural livelihoods will be examined further in Chapter 7. Here it is relevant to note that the social capital the farmers' groups developed during the CODE-WA Project was still evident at the time of fieldwork for this research, three years after the end of the formal intervention.



This case study shows that the strategy of collective learning and experimentation contributed to enhancing communal adaptive capacity. During a focus group in the community of Doodiyiri, one farmer explained:

*“This project brought us together on [sic] a different style. We use consensus. We come to each other’s aid so communal spirit is boosted. It has exposed us to different farming methods so that we can use different ways of working when the rain pattern changes.”* (FGC2, 16/9/14)

Another farmer elaborated:

*“We have an improved system of learning and teaching. We are working toward sustaining the community and growing. Now we come together to share ideas and work on problems together, we realise we have a common interest. Now if one person has a problem then we can all help to solve it which means we have more options to respond to common challenges.”* (FGC2, 16/9/14)

This indicates that the collective adaptive capacity of the farmer group had been enhanced by adopting collaborative processes for learning and experimenting. As a result of strengthened social capital, the farmers increased their pool of resources and ideas on which to draw and increased diversity of options during periods of change or challenges. Ways in which unexpected outcomes of collaborative governance and experimentation contributed to enhanced adaptive capacity through empowering experiences will be discussed in the next section.

### 6.3.3 Empowerment, Agency and Autonomy

Section 6.2.4 examined the ways in which the CODE-WA Project strengthened constituents of social capital which in turn resulted in the farmer groups having an empowered status within their communities and the surrounding area. As evidenced in the Trax case study (see Section 6.2.4), collaborative social processes and an empowered status can lead to an increase in communal agency. Both of the farmer groups which engaged with the CODE-WA Project described ways in which they had utilised increased agency to develop more resilient and beneficial structures for non-agricultural livelihoods.

In the community of Jonga, the women’s group explained that, prior to the CODE-WA intervention, some of them were engaging in rice processing: shelling the husks, cleaning and par-boiling the rice, before selling it at a higher price. Through collaboration and sharing of ideas, other women in the group took up this activity. Furthermore, by pooling their resources the group was able to establish a system for an

increased rate of rice processing, transportation to the market which reduces losses, and a regular space at the market in Wa with a reliable customer-base. By working together on this initiative the group increased their income from rice processing such that more women were earning income from it and each individual was earning more than they were previously.

This self-organisation and the collaborative governance of rice processing was possible due to collective action and agency. This in turn enhanced the autonomy of the group within their community by providing the women an additional source of income independent from farming activities. During an interview, one woman in Jonga stated:

*“Before, I wasn’t engaging in the rice commercial venture. I came to it with the group because we saw that it was one way apart from the farming so we could have some funds if the crops fail. It has funded me to some extent so now my children can go to school.” (IVC12, 18/3/14)*

This indicates that the group in Jonga established a livelihood source which did not rely solely on farming, so that they have something to fall back on should crops fail during climatic shocks. The rice processing initiative functioned as an adaptation strategy by spreading the risk of short-term shocks to their livelihoods. The ability of this group to adopt this strategy as a means of adapting to the increased threat of drought indicates that they had enhanced their adaptive capacity. In this example, the attributes of social capital associated with the formalisation of the rice processing initiative required the local sharing of ideas, collaborative governance, collective learning, experimentation, anticipation, and innovation. This shows that initiating or optimising these collective social processes can enhance adaptive capacity through social capital. This exemplifies the framework of adaptive capacity being tested. The following section examines ways in which the diversity of types of interactions also supports adaptive capacity while enabling experimentation and innovation.

There is further evidence of the characteristics of agency and self-organisation as contributing to social capital in the community of Nakpalig. The farmer groups in Nakpalig were established when they began participating in the Trax project in 1993. Although many of the original group members had either moved away or died in the intervening 21 years, the groups are in such high demand from farmers seeking to become members that they had split the groups into two because they became too large for effective collaborative governance. Despite splitting to create additional farmer

groups, they continued to collaborate on community-wide issues. One such issue was a demand for water to allow women to irrigate crops for dry season gardening.

Collectively, the community successfully lobbied the local government for funds to restore a local dam and the farmer groups provided the necessary labour. Farmers explained that this has helped them to be more adaptable:

*“Now there is water to irrigate vegetables when there is a drought and we can care for our animals when the rains don’t come. Because there is water in the dam we have more options for farming.” (FGT9, 26/2/14)*

In the community of Beo-Tankoo, one farmer explained that in the 13 years since they began engaging with Trax, the rainfall pattern had been changing and the wet season had been starting later than it had before. He explained that as a group they developed water harvesting to care for livestock and to water vegetables to ensure an income. He stated that when others saw what they were doing they decided to join in and now the whole community works together to harvest water and conserve soil fertility. Here, attributes of social capital can be recognised as features of enhanced adaptive capacity because they have in turn resulted in autonomous collective action in the development and implementation of adaptation strategies. In this example, attributes of social capital provide evidence of project outcomes of enhanced adaptive capacity.

The examples from Beo-Tankoo (also discussed in Section 6.2.4) and Nakpalig indicate that the attributes of autonomy and agency resulted in increased self-mobilisation and self-organisation of communities through the characteristics of collaborative governance, collective learning and shared problem solving. These characteristics are all attributes of social capital and indicate the significance of social features for enhancing adaptive capacity. In the examples discussed here, social capital has contributed to the outcome of enhanced adaptive capacity, which resulted in the utilisation of adaptation strategies within the communities. It is interesting to note that both of these examples are communities that had engaged in the Trax project cycle some years prior to this research and similar evidence of autonomy, agency, or self-advocacy was not apparent in the groups currently participating in the Trax project. This suggested that the participatory features of the formation and governance of farmer groups during the Trax project can initiate processes of collective action which developed over time and can result in wider-ranging, lasting outcomes of enhanced adaptive capacity. This supports Borrini-Feyerabend et al (2007) who claimed that

collective processes in co-management structures require time to mature to reach the most beneficial outcomes.

While Trax intended to develop the capacity for autonomous agency in the farmer groups, and to incorporate project activities to ensure sustainability of these outcomes, discussion with Trax staff suggested that they had not anticipated their intervention would result in such large-scale and long-term outcomes. Although increasing agency was intended through the Trax project, the extent of the long-term outcomes was unexpected. The extent to which social capital and contributing social attributes enhanced adaptive capacity and resulted in increased sustainability of agricultural livelihoods was unexpected in this case study.

#### 6.3.4 Diversification, Experimentation and Innovation

Section 6.3.2 described how collaborative governance led to farmer groups collectively identifying problems and seeking solutions. This was referred to as ‘shared problem solving’ during focus groups and interviews with farmers and with Trax staff. Analysis of descriptions of shared problem solving and records of ethnographic observation shows that the process farmers described corresponded to the term ‘collective learning’ suggested in the framework in Section 2.7. Relevant contemporary literature also refers to ‘collective learning’ (e.g. Arora, 2012; Walker and Salt, 2006); ‘shared learning’ is an alternative term used particularly in relation to participatory learning and action (e.g. Hammett et al, 2015). Tschakert and Dietrich (2010) identified joint, or collaborative, processes of problem solving as key in learning and co-production of knowledge, which were also identified as a central feature of the constructivist paradigm in which this research is grounded (Section 4.1).

Borrini-Feyerabend et al (2007) argued that collective learning processes are necessary for successful co-management of natural resources. In the context of this research, co-management and co-production of knowledge related to collective learning within agricultural livelihoods and the resources on which they depended. Borrini-Feyerabend et al (2007) devoted a chapter to ‘learning by doing’ and their use of this term related the concept of collective learning to that of shared problem solving, which the farmer groups referred to during fieldwork for this study. Further, ‘learning by doing’ hints at processes of experimentation and innovation which were also identified as potential characteristics of adaptive capacity in the framework proposed in Section 2.7.

During a focus group in the community of Pelungu, one farmer explained that his group had been talking about how their rice yield was not good because of drought periods during the wet season. He said that the farmers cultivated rice on a small area of low-lying land where water collects in the wet season. He explained

*“The rain pattern is unstable so our rice did not yield well. We came together and had a collective idea, or solution, which is done in a meeting from a vote by majority. We decided to try a different variety of rice which will yield in a shorter time so can grow better when the rains fail. We learn together so we decided to grow a small area of the new variety next to our local rice so we could see the difference.” (FGT11, 31/7/14)*

Figure 6.1 shows a photograph of the two rice varieties being trialled next to one another.



Figure 6.1 Two varieties of rice being trialled next to one another in 2014. The variety commonly grown in the community is on the right. A dwarf variety is on the left and the grains of rice can be seen to be yielding on this variety while they are not yet apparent on the local variety.

Another farmer explained that because they now try to solve problems collectively and learn together, more ideas are shared among them so they can experiment to see what works. She stated:

*“We share an idea and the group decides whether to try it out. It brought in new innovations. Now we can recognise that we as a community can solve our own problems if we work together. We can learn by trying things out because if it doesn't work then we know the rest of the farmer group will help us out because we have unity now.”* (FGT11, 31/7/14)

This example indicated that collaborative decision-making can result in collective learning and problem solving through experimentation and innovation. Furthermore, it suggested that by working collectively to trial innovations they can minimise the risk of such experimentation because one farmer will not be responsible for all of the labour or the resource burden should the innovation fail.

This farmer group responded to a change in climatic conditions by experimenting with a different variety of rice, with the intention to adapt according to the yield from the new variety. In the process of reaching this adaptation strategy the community members drew on their adaptive capacities through collaborative governance, consensus, shared problem solving and collective learning, experimentation and innovation. Those characteristics enabled this group to identify a potential solution by pooling knowledge and ideas, and they tested the solution with minimal risk to each individual.

The framework of adaptive capacity supporting sustainable agricultural livelihoods proposed in Section 2.7 suggested that there are multiple attributes of social capital which can contribute toward enhancing adaptive capacity. The framework also implied that attributes of experimentation, innovation, and diversification of livelihood sources can enhance adaptive capacity. The example of experimentation and innovation examined here indicates that farmers had increased their capacity to innovate when acting collectively. This is significant because it suggests that the attributes of experimentation, innovation, and diversification can be enhanced by various components of social capital. Consequently, social capital may be having a double effect on enhancing adaptive capacity, firstly by supporting adaptive capacity, and secondly by facilitating the physical attributes, which in turn support adaptive capacity.

The potential for features of social capital to enhance development of alternative livelihood sources and innovation had not been included in the formal understandings of

adaptive capacity or sustainability in the Trax project (see Section 5.2). As such, this influence of social capital on outcomes of enhanced adaptive capacity was unexpected in the Trax project.

The discussion above highlighted the multiple ways in which the CODE-WA Project activities contributed to increased diversity of several factors within the local communities. The intervention initiated processes which resulted in diversification of livelihood sources, network interactions, relationships, and social structures. As Ellis (2000) argued, diversification can function as an adaptation strategy while, in the context of agricultural livelihoods, diverse options can provide adaptive capacity although adaptation does not necessarily require diversification. In this research, diversity was proposed as contributing to enhanced adaptive capacity through two means: diversity of types of interactions as an attribute of social capital; and diversification of livelihood options (Figure 2.4, Section 2.7). This section discusses ways in which those two forms of diversity were linked in the CODE-WA Project.

The CODE-WA Project encouraged the diversification of agricultural biodiversity through the introduction of crop varieties which had been bred to be drought-tolerant. However, the collective learning demonstrated by the participating farmer groups indicated an increase in experimentation. Data analysis identified ways in which experimentation during the CODE-WA Project resulted in innovation, greater diversity of livelihood sources, and an increased diversity of social structures within the two communities.

During a focus group in the community of Jonga, the group described how, after observing a particular method of cooking with moringa leaves during the international farmer exchange visit, they decided to create a plantation of moringa trees (see Figure 6.2). The moringa tree is native to West Africa and is frequently found growing naturally in Northern Ghana. However, it is not usual to intentionally cultivate moringa to use the leaves and flowers as a food product. In this respect, the moringa plantation in Jonga was innovative, not only because it was an idea that was new to the area but also because it has added a different food to the diet of the community.



Figure 6.2. A moringa tree growing on the plantation planted in 2012 on the farms of the community of Jonga

When talking about the moringa plantation, one woman stated:

*“We know it grows well here so we thought we could have a plantation and it would not take much work for it to grow, and then we will have the leaves to eat when they have grown. We know it will grow even when the rain pattern fails so the plantation will always provide for us”* (FGC1, 15/9/14)

This indicates that the women recognised that intentionally cultivating moringa as a food product would require less labour than growing cereals, vegetables, and other legumes. Furthermore, the moringa plantation provided an adaptation to rainfall variability and enhanced adaptive capacity due to the increased diversity of food and livelihood sources.

The initiative to create a moringa plantation was inspired by knowledge exchange during the international field visits under the CODE-WA intervention. Although the CODE-WA Project intended to increase experimentation through farmer knowledge sharing, in Jonga this experimentation also resulted in unexpected outcomes that enhanced adaptive capacity. One woman said that, now they have the moringa



plantation, others in the community have recognised they are able to develop ideas. She explained that people in the community asked them for advice on their farms while others brought them their ideas in the hope that the group will help them to develop it.

During an interview with the chair of the Kamwinsomte Women's Group in Jonga, she explained that a larger farmer group working in the community requested to join the two groups together. She said: "*Tourusung [the larger farmer group] want to link up with us so they can see how we are working because they have seen what we are doing and how it is helping*" (IVC4, 17/9/14). The moringa plantation had demonstrated to others in the community that the farmers have the collective capacity to innovate, which increased the profile and status of the group. This, in turn, increased the diversity of types of social capital and interactions within the community, creating new relationships for collaborative governance, knowledge exchange, collective learning, and innovation.

Although the development of the moringa plantation indicates features of enhanced adaptive capacity, such as diversification and innovation, additional resources were required for this initiative to be possible. While the farmers demonstrate capacity for collective learning, anticipation, and experimentation, they would not have been able to establish the plantation had the CODE-WA Project not paid for the international farmer exchange. It was through the farmer exchange that the idea was conceived and the seeds for the plantation were collected. In addition, the women farmers group required the support of the wider community of Jonga and the *Tindana* in order to have access to the land to grow the plantation. Thus, while this is a positive example of enhanced adaptive capacity contributing to project outcomes, it would not be possible through adaptive capacity alone and other resources were required.

Within the context of a social-ecological system (discussed in Section 2.1.4), Norberg et al (2008) suggested that diversity of institutional structures, norms, and processes is a key feature of social adaptive capacity within a complex adaptive system. The farmer groups which participated with the CODE-WA Project showed evidence of increased diversity of social processes through collaborative governance. Although increased diversity of crop varieties was an intended outcome of the CODE-WA Project, the features of the farmer groups which has seen the greatest increase in diversity are social structures, collaborative processes, and livelihood diversification. These diversified features of the local community were unexpected outcomes of processes initiated by the CODE-WA Project activities. Furthermore, the farmers

interviewed for this research did not report any adverse or undesirable outcomes resulting from their engagement with the CODE-WA Project.

#### 6.3.5 Insufficient Adaptive Capacity and Maladaptation

The discussion in the preceding sections has identified ways in which enhanced adaptive capacity among the farming communities has supported beneficial outcomes of the Trax and CODE-WA Projects. However, there are some circumstances in which the adaptive capacity of the farmers is insufficient to respond to shocks. Additionally, it is possible for adaptations adopted by the farming communities to be ineffective or even a hindrance or damaging in responding to shocks and stresses, termed maladaptation. This section outlines some cases where the farmers engaged in the two projects stated that they struggled to respond to shocks.

During the fieldwork period for this research, an elder within the community had unexpectedly died and a large funeral took place. In traditional culture in Upper West Region, it is customary for funerals to last for at least three days but often up to a week. Due to the profile of the elder who had died, many hundreds of people travelled to Jonga to take part in the funeral. This experience initiated a conversation during a focus group with the farmer group in Jonga which engaged with the CODE-WA Project. The women farmers described the impact of funerals on the community and their livelihoods. The farmer group discussed the significance of funerals with the researcher again when reviewing the photographs they had taken as part of the visual ethnographic data collection. The farmers had taken photos of the funeral of the elder in Jonga (Figure 6.3).



Figure 6.3. A photograph of the funeral of an elder in Jonga, Upper West Region, taken on a celluloid film camera by one of the members of the farmer group which had engaged with the CODE-WA Project

During the focus group the farmers explained that when there is a funeral they must suddenly cater for many people. This often included slaughtering their livestock and using all of their crops which had been stored for consumption at a later date. One woman farmer explained that cost of catering for a funeral, both in terms of resources and financial cost, could result in a total loss of food and capital to draw on in the months which followed. Another woman explained that they would not be able to buy supplementary food items to replace the stores used for the funeral because they had not capital remaining after slaughtering their livestock for meat. In addition, because they were women they did not have access to financial credit from institutions in nearby Wa, the regional capital.

In the case in Jonga shown in Figure 6.3, this was a particularly large funeral with high profile guests, so it was a particularly large shock to their livelihood. Although guests attending the funeral provided gifts for the grieving family and helped to provide food for the gathering, it still fell on the community to provide most of the food, fuel, and labour to provide for the funeral. Thus, although providing for the

funeral was a collective effort shared by the community, the whole community of Jonga was impacted by the loss of food stores, livestock, and financial capital.

The farmers explained that funerals impacted their agricultural livelihood in different ways depending on when in the year it occurred. If the funeral took place during the dry season then some farmers would seek additional labour or alternative means of earning income. Some farmers stated that in years when there had been a large funeral, they would plant more of the cash crops for sale at the market in Wa rather than for household consumption because they needed a source of income, as well as food, to replace the livestock they had used for the funeral. However, during the focus group the women farmers concurred that they would all suffer a period of hardship following a large funeral. One woman clarified that this would mean not eating as many meals each day and being unable to pay school fees or healthcare costs.

In this example, the women farmers were able to draw on their adaptive capacity in response to the shock by drawing on their diverse livelihood sources, social network, and collective responsibility for the funeral. However, the farmers recognised that on this occasion their capacity to respond to the shock caused by the funeral had been insufficient and their only option was to suffer significant hardship.

Sections 5.2.4 and 6.2.5 discussed the introduction of a variety of orange-fleshed sweet potato (OFSP) in the Trax project activities, initiated by Self Help Africa. The OFSP had been introduced as an adaptation strategy to ensure crop yields during periods of drought because the variety had been bred to be drought-tolerant. However, the introduced variety of OFSP had not produced as good a yield as a native variety during a drought year (see Section 5.2.4). Instead, the farmers who had trialled the introduced variety had grown a crop which their families would not eat as potatoes did not form part of the local diet. Additionally, they could not sell the potatoes at the market because there was not a demand for them, and they did not store for long periods so went to waste quickly.

One farmer in Pelungu explained he had turned some of his land over to trialling the OFSP variety instead of the crop types he was familiar with and would have been able to sell. As such, he had used his land and labour for a crop which would go to waste and thus had less food supply or income for his family. This presents an example of a maladaptation where the initiative intended to act as a beneficial adaptation to drought in fact resulted in a detrimental outcome for the farmers.

This section has shown that in some cases of enhanced adaptive capacity, it is still possible to have insufficient capacity to respond to some shocks. In the case of Jonga, although they provided evidence of increased adaptive capacity, this was not enough to respond to a significant shock without enduring a period of hardship. In the case of Pelungu, OFSP production presented a maladaptation which had reduced the farmer's agricultural livelihood.

## 6.4 Conclusion

This chapter has examined the realised outcomes of enhanced adaptive capacity apparent within the communities participating in the two case study agricultural development interventions. It identified the intervention as resulting in both intended and unexpected outcomes, resulting in beneficial consequences for the projects' participants. The evidence shows that if development interventions were able to identify any unexpected outcomes from their project, both positive and negative, they may be able to capitalise on emerging outcomes. However, Section 6.3.5 provided evidence of circumstances when enhanced adaptive capacity may still be insufficient to respond to a shock or an initiative may create a maladaptation. This section discusses the role of the characteristics of adaptive capacity identified in the theoretical framework for this research (Section 2.7) in relation to the outcomes of enhanced adaptive capacity identified within the two case studies.

### 6.4.1 Summary of Indicators of Enhanced Adaptive Capacity and Associated Impacts on Project Outcomes within Trax

This section summarises the multiple ways in which adaptive capacities were enhanced by the Trax intervention and the outcomes of that enhanced adaptive capacity. In response to research question three, discussion particularly considers the ways in which the participatory elements of the intervention stimulated social processes which incorporated the informal understandings of adaptive capacity in the associated communities. The summary refers to existing social capital (discussed in Section 5.3.7) and how this interacted with collective governance, shared problem solving and collaborative learning, consensus building, and experimentation and innovation.

The discussion throughout Sections 6.2 and 6.3 highlighted multiple ways in which individual and communal adaptive capacities were enhanced through interaction with the Trax Sustainable Agriculture project. The discussion identified diverse outcomes which were associated with social capital and attributes which contributed to this capital. Table 6.1 presents a summary of the realised outcomes of enhanced adaptive capacity against the features of adaptive capacity proposed in the framework for this research and the features within the formal and informal understandings of adaptive capacity discussed in Chapter 5.

Table 6.1. Summary of the indicators of enhanced adaptive capacity impacting on project outcomes evidenced within the Trax project. This is shown alongside the indicators of enhanced adaptive capacity proposed in the framework in this research (Sections 2.7 and 4.6) and the equivalent terms used within the formal and informal understandings of adaptive capacity identified in the Trax project (Section 5.4).

<b>Indicators of Enhanced Adaptive Capacity Proposed in this Research (Section 2.7)</b>	<b>Indicators of Enhanced Adaptive Capacity within Understandings in Trax (Section 5.4)</b>	<b>Evidence of Enhanced Adaptive Capacity Impacting on Project Outcomes within Trax Farmer Groups</b>
Social capital	Participation (formal understanding) and Social capital (informal understanding)	Strengthened social capital and social cohesion
Social networks	Social networks	Increased social networks
Collaborative governance	Participation	Collaborative governance
Consensus	Consensus	Consensus
Collective learning	Collective learning	Collective learning
Anticipation	<i>No equivalent term</i>	<i>No evidence of impact on project outcomes</i>
Diversity of types of interactions	<i>No equivalent term</i>	<i>No evidence of impact on project outcomes</i>

<b>Indicators of Enhanced Adaptive Capacity Proposed in this Research (Section 2.7)</b>	<b>Indicators of Enhanced Adaptive Capacity within Understandings in Trax (Section 5.4)</b>	<b>Evidence of Enhanced Adaptive Capacity Impacting on Project Outcomes within Trax Farmer Groups</b>
Experimentation	<i>No equivalent term</i>	Experimentation
Innovation	Innovation through alternative livelihoods	Innovation
Diversity of livelihood sources	Diversification of livelihoods	Diversity
	<i>No equivalent term</i>	Empowerment, increased profile and status
	Agency	Self-organisation and agency
	<i>No equivalent term</i>	Self-mobilisation and autonomy

A range of social processes were initiated through the participatory methods facilitated by Trax as part of the project activities. The required self-organisation of farmer groups, and consensus and collaborative governance within the groups, subsequently triggered further social processes and increased social capital. The shared problem-solving among the groups, and concurrent collective learning and experimentation, resulted in a sense of empowerment within the farming communities. Within the communities that engaged with the Trax project some years ago there is clear evidence that collaborative governance and communal empowerment led to greater collective autonomy and agency to self-mobilise to enhance benefits to the community. The role of empowerment and long-term outcomes for sustainability will be discussed in Section 7.3.3.

This evidence also raises the temporal nature of features of enhanced adaptive capacity, with some features having a more significant role over a longer timescale than others. For example, diversification of crop types and livelihood sources, to provide more options when responding to a shock, increases the capacity of farmers to adapt quickly. Experimentation and innovation through cultivation of new crop varieties

enhanced adaptive capacity over several years as the new variety became integrated into the system and was available as an alternative livelihood source. Self-organisation and collaborative governance can enhance adaptive capacity and collective learning processes in the short, medium, and long-terms. These attributes of social capital not only enhanced individual and communal adaptive capacity but they enabled processes which sustained and further enhanced that adaptive capacity.

Features of autonomy and agency for self-organisation became apparent as having contributed to adaptive capacity, although they were not identified in the framework of adaptive capacity proposed in the current research in Section 2.7. Iterative data analysis and discussions with farmers during fieldwork indicated that engagement with the Trax project had been empowering, in the sense that farmer groups recognised that they were able to solve some common problems through collective action. This in turn contributed to increased autonomy and agency within these farmer groups, further enhancing their adaptive capacity because they were less reliant on external support.

During a focus group discussion with women farmers in Dachio, they explained that their group was stronger since having worked with Trax. They stated:

*“We now have unity, love and peace among ourselves. We can support one another and come out of meetings happy. We use Abotitaabasum [the group] as a way to be happy. The women in our group can take ownership of goats and livestock, we can take ownership and take strength.”* (FGT5, 13/2/14)

In the two years since the Trax formal intervention ended in Dachio, this group had utilised its empowered status in the community to collaborate on increasing their earning potential through the sale of produce in Bolgatanga.

The examples from Nakpalig, Beo-Tankoo, and Dachio (discussed in Sections 6.2.4 and 6.3.2) indicated how social processes enhanced the capacity of the farming communities to obtain support for some initiatives beyond agriculture. In the case of Trax seeking to reduce poverty as an overarching objective, there was evidence that this was accomplished through various means including those which are indirect and unexpected outcomes. Furthermore, the farming communities considered that their capacity to adapt to future conditions was enhanced by increasing infrastructure and access to healthcare, education, and clean water. The significance of these indirect and unexpected outcomes of the Trax intervention to further enhance sustainability and broader socio-economic development was reflected in their prominence in the



Millennium Development Goals and the Sustainable Development Goals (United Nations, 2013 and 2015; Section 2.3.1). As such, the empowerment of farming communities through strengthening social capital including attributes such as collaborative governance and collective learning contributed to achieving enhanced adaptive capacity and sustainability of agricultural livelihoods at both short and long-term time scales.

#### 6.4.2 Summary of Indicators of Enhanced Adaptive Capacity and Associated Impacts on Project Outcomes within CODE-WA

This section summarises the ways in which the CODE-WA Project resulted in enhanced adaptive capacity among the participating farmer groups, through both direct and indirect processes. It outlines the way in which formal understandings of adaptive capacity resulted in the intended outcomes, and how locally-constructed informal understandings resulted in unexpected outcomes. It also considers how these outcomes of enhanced adaptive capacity support sustainability as framed by the CODE-WA Project goals.

The discussion throughout Section 6.3 highlighted multiple ways in which characteristics of adaptive capacity were enhanced. This highlighted both intended and unexpected outcomes of enhanced adaptive capacity, including examples which indicated the outcomes were not achieved through the intended means. Instead the project activities initiated processes that enhanced those characteristics through unexpected means and in unanticipated ways. Table 6.2 provides a summary of the features of adaptive capacity which have been identified as enhanced through the CODE-WA Project. This juxtaposes the realised outcomes against the formal and informal understandings of adaptive capacity within the project and the characteristics of adaptive capacity proposed in Section 2.7.

Table 6.2. Summary of the indicators of enhanced adaptive capacity impacting on project outcomes evidenced within the CODE-WA Project. This is shown alongside the indicators of enhanced adaptive capacity proposed in the framework in this research (Sections 2.7 and 4.6) and the equivalent terms used within the formal and informal understandings of adaptive capacity identified in the CODE-WA Project (Section 5.8).

<b>Indicators of Enhanced Adaptive Capacity Proposed in this Research (Section 2.7)</b>	<b>Indicators of Enhanced Adaptive Capacity within Understandings in CODE-WA (Section 5.8)</b>	<b>Evidence of Enhanced Adaptive Capacity Impacting on Project Outcomes within CODE-WA Farmer Groups</b>
Social capital	Social capital (informal understanding)	Strengthened social capital and social cohesion
Social networks	Communication	Increased social networks
Collaborative governance	<i>No equivalent term</i>	Collaborative governance
Consensus	Participatory evaluation	Consensus
Collective learning	Farmer knowledge exchange	Collective learning
Anticipation	Anticipation of climate change	Anticipation
Experimentation	Experimentation	Experimentation
Innovation	Innovation through introduced crop varieties	Innovation
Diversity	Increased agricultural biodiversity	Diversity
	<i>No equivalent term</i>	Empowerment, increased profile and status
	<i>No equivalent term</i>	Self-organisation and agency
	<i>No equivalent term</i>	Self-mobilisation and autonomy

The CODE-WA Project intentionally engaged an existing farmer group, which meant there was some initial social capital which enabled governance prior to the

intervention. The participatory features of the CODE-WA Project drew on this existing governance structure and, in doing so, strengthened the associated social capital and increased the level of collaboration and collective action. The degree to which the farmers enhanced their social collaborations demonstrated that they had prior capacity for collective action, but this had not been fully capitalised. As such, the CODE-WA Project successfully utilised existing social capital by initiating processes which transformed them from capacity for collaboration into collaboration for adaptive capacity.

The collaborative processes enhanced through participation with the CODE-WA Project have in turn triggered other processes such as extensive knowledge exchange, sharing problems and ideas, and collective learning. Further, collaboration enabled the farmer groups to experiment with their ideas with less risk than if they had trialled them individually. Increased experimentation and collective action increased innovation and diversity of livelihood sources, social structures, and system interactions. Whether intended or unexpected outcomes of the CODE-WA Project, the collective adaptive capacity of the groups was enhanced. This is, in part, demonstrated by the adaptation strategies which the groups instigated since engaging with the project.

Although the CODE-WA Project focused primarily on physical attributes of adaptive capacity through crop diversification and experimentation, the realised outcomes for their adaptive capacity primarily resulted from their increased and strengthened social capital. Although this supports the proposed framework of adaptive capacity outlined in Section 2.7, the evidence indicates that there are additional attributes to social capital which can contribute to enhanced adaptive capacity which were not considered in that framework.

#### 6.4.3 Summary of Comparisons between Trax and CODE-WA Projects

The examples within the Trax and CODE-WA Projects examined above provide evidence of social capital functioning as an indicator of enhanced adaptive capacity and impacting on outcomes of the two projects. This responds to research question two by assessing indicators of enhanced adaptive capacity. There are many similarities between the features of social capital which have been identified in both case studies. Table 6.3 presents a summary of the indicators of enhanced adaptive capacity and the resulting impacts on project outcomes in the Trax and CODE-WA Projects.

Table 6.3. Summary of comparisons of indicators of enhanced adaptive capacity and resulting impacts on project outcomes in both Trax and CODE-WA Projects and the framework of adaptive capacity proposed in this research.

<b>Indicators of Enhanced Adaptive Capacity Proposed in this Research (Section 2.7)</b>	<b>Indicators of Enhanced Adaptive Capacity Evidenced</b>		<b>Evidence of Enhanced Adaptive Capacity Impacting Project Outcomes</b>	
	<b>Trax Project</b>	<b>CODE-WA Project</b>	<b>Trax Project</b>	<b>CODE-WA Project</b>
Social capital	Social capital	Social capital	Strengthened social capital and social cohesion	Strengthened social capital and social cohesion
Social networks	Social networks	Social networks	Increased social networks	Increased social networks
Collaborative governance	Collaborative governance	Collaborative governance	Collaborative governance	Collaborative governance
Consensus	Consensus	Consensus	Consensus	Consensus
Collective learning	Collective learning and problem solving	Collective learning and problem solving	Collective learning	Collective learning
Anticipation	<i>No equivalent term</i>	Anticipation	<i>No evidence of impact on project outcomes</i>	Anticipation
Diversity of types of interactions	<i>No equivalent term</i>	Diverse types of interactions	<i>No evidence of impact on project outcomes</i>	Diverse types of interactions

<b>Indicators of Enhanced Adaptive Capacity Proposed in this Research (Section 2.7)</b>	<b>Indicators of Enhanced Adaptive Capacity Evidenced</b>		<b>Evidence of Enhanced Adaptive Capacity Impacting Project Outcomes</b>	
	<b>Trax Project</b>	<b>CODE-WA Project</b>	<b>Trax Project</b>	<b>CODE-WA Project</b>
Experimentation	Experimentation	Experimentation	Experimentation	Experimentation
Innovation	Innovation	Innovation	Innovation	Innovation
Diversity of livelihood sources	Diversification	Diversification	Diversification	Diversification
<i>Not identified in research framework</i>	Empowerment	Empowerment	Empowerment, increased profile and status	Empowerment, increased profile and status
<i>Not identified in research framework</i>	Agency	Agency	Self-organisation and agency	Self-organisation and agency
<i>Not identified in research framework</i>	Autonomy	Autonomy	Self-mobilisation and autonomy	Self-mobilisation and autonomy

The comparisons presented in Table 6.3 show that the features of social capital evidenced in the two case studies were the same, with two exceptions. The evidence of anticipation and of a diversity of types of interactions do not appear to function as indicators of enhanced adaptive capacity within the farmer groups engaged with the Trax project. Meanwhile, the increase in the diversity of types of interactions and the capacity for anticipation seemingly had an impact on project outcomes in the farmers engaged with the CODE-WA Project. Despite this, the medium- to longer-term impacts

of the interventions on enhanced adaptive capacity and the resulting outcomes were markedly similar. Although anticipation and a diversity of types of interactions may not be evident in impacts on project outcomes within the Trax project, the participating farmer groups enhanced their adaptive capacity and this impacted on achieving similar outcomes to those engaged with the CODE-WA Project.

This may suggest that anticipation and a diversity of types of interactions are not essential features of social capital for enhancing adaptive capacity but can still act as suitable indicators for stakeholders. Alternatively, this evidence could indicate that the capacity for anticipation and diverse interactions may not be dominant impacts on project outcomes within the CODE-WA Project, and that perhaps similar enhanced adaptive capacity would be evident even in the absence of these two indicators. A third possibility is that this difference in the evidence of these two indicators of enhanced adaptive capacity may have resulted from differences in the interventions. The CODE-WA Project had a particular interest in the role of anticipation, which was raised through the international farmer exchanges, during which farmers in Northern Ghana had the opportunity to visit more arid environments than those in which they lived. Additionally, the differences may have been due to the two interventions beginning at different starting points, or as a result of different intervals since the end of the formal project intervention. Thus, the limitations of this research may in part have resulted in the differences in these two indicators in the case studies but this can only be verified through further research examining additional agricultural development interventions.

This discussion has focused on the two indicators which were different between the two case studies. However, there were many similarities which deserve being highlighted further. Although the framework of adaptive capacity proposed in Section 2.7 did not identify the role of empowerment, autonomy and agency in enhancing adaptive capacity, empirical data repeatedly raised these features as contributing towards positive project outcomes. In both agricultural development interventions, there were interactions and feedbacks between the participatory components of the project activities, features of social capital, diversification of livelihoods, innovation, and empowerment and increased agency. In both cases, the participatory requirements of the projects' activities strengthened existing social capital and enhanced associated features. The resulting empowerment increased the capacity for the groups to experiment and innovate, as well as increasing their community autonomy and agency. This in turn fed back, enhancing the features of social capital, further enhancing adaptive capacity.

Although the two case studies had some differences in project objectives, understandings of adaptive capacity (discussed in Chapter 5), project activities, and facilitation, they both resulted in enhanced adaptive capacity and positive outcomes for the participating farmers. The outcomes which research participants referred to most frequently were the beneficial outcomes that were unexpected and have occurred as a result of indirect influences of the project activities. The prevalence of discussion about the strength of social relationships within empirical data indicates that the farmer groups recognise the value of social capital. Furthermore, the dominance of features of social capital in impacting project outcomes, rather than the intended physical features of diversification, experimentation and innovation, implies that social capital can be an appropriate and a useful indicator of enhanced adaptive capacity. This concurs with hypothesis four, postulated in Section 2.8.1, which suggested that features of social capital may benefit outcomes of enhanced adaptive capacity. Chapter 7 will consider the lessons of this in relation to the sustainability of agricultural livelihoods in further detail.

#### 6.4.4 Indicators and Outcomes of Adaptive Capacity within Diverse Understandings

The formal understandings of adaptive capacity within both case studies informed the respective project activities, and therefore the intended outcomes and direct influences on the outcomes. The planned cause-and-effect processes of intervention and outcome did not consider the prevailing local dynamics or heterogeneity. As a result of those local conditions the project activities also resulted in unexpected and indirect outcomes of enhanced adaptive capacity. Although those outcomes were positive and were directly relevant to the intervention goals, they were not recognised by the project facilitators, so the full impacts went unacknowledged. It would be useful for interventions to recognise the unexpected and indirect outcomes of enhanced adaptive capacity and identify the processes that result in these outcomes.

Within both Trax and CODE-WA, the formal understandings of adaptive capacity resulted in project activities that were intended to increase the diversity of crop types or varieties, and in the case of the Trax project, also to increase non-agricultural livelihood options. Within the Trax project, the formal understanding of adaptive capacity, which originated with the current funder Self Help Africa, resulted in the introduction of orange-fleshed sweet potato (OFSP) with the intention that it would

enhance the capacity of farmers to adapt to climate change. However, the OFSP was not considered by local farmers to be a suitable crop in the local region due to socio-economic and cultural factors. In the CODE-WA Project, the formal understanding of adaptive capacity, which originated with ICRISAT, SARI and MOFA, resulted in the introduction of crop varieties which had been bred to be drought-tolerant. Although not opposed by the participating farmers, these crops failed to yield during a drought year, meaning the farmers lost their seed stock and did not have the financial resources to re-purchase seeds.

The informal understandings of adaptive capacity in both case studies recognised the role of local cultural influences and traditions, but in practice these were overlooked by the actions stemming from formal understandings. The existing traditional social structures and processes supported farmer groups to self-organise and participate within the agricultural development interventions. The participatory and collaborative nature of the Trax and CODE-WA projects utilised their social capital. This enhanced the levels of collaboration and collective actions, strengthening social processes. It was largely through the unanticipated extent to which the farmer groups could draw on their social capital for engagement that the unexpected outcomes of enhanced adaptive capacity occurred. The discussion throughout this chapter, but particularly in Section 6.3.2, identified processes through which collaborative governance and collective learning were enhanced. This subsequently increased experimentation, innovation, diversification of livelihood sources and social behaviours, while also empowering the farmer groups and enhancing their agency and autonomy.

Neither of the two case studies have undertaken post-project impact evaluations with beneficiaries. As outlined in Section 4.3, this research acted as a post-project evaluation of the CODE-WA Project, as requested by the Principal Investigator of the project. Beyond this research, post-project impact evaluations have not been possible in either case study because of the short time-frame which funding supports the interventions. As such, the project outcomes resulting from enhanced adaptive capacity discussed in this chapter are not recorded elsewhere.

Many of the characteristics of adaptive capacity identified within the farmer groups which participated in the Trax and CODE-WA projects, were postulated as features of adaptive capacity in the framework for this research (Section 2.7). However, the evidence showed that empowerment of the farmer groups led to other attributes



which also contributed to adaptive capacity. In particular, empowerment increased the capacity for self-mobilisation, agency and autonomy among the farmer groups and their communities. As such, empowerment, agency and autonomy can be considered as additional attributes of social capital which can support enhanced adaptive capacity. The increased agency for actions intended to reduce risks or optimise the benefits of change enhanced adaptive capacity.

This chapter identified multiple diverse ways in which the interventions initiated processes that enhanced adaptive capacities within participating farmer groups. Whether intended or unexpected outcomes of the project activities, research participants consistently discussed this positively, describing the benefits they obtained as a result of those outcomes. Both projects sought to enhance adaptive capacity with the intention to increase the overall sustainability of the local communities and their agricultural livelihoods. The discussion in this chapter has contributed evidence for research questions two and three. The following chapter will examine the ways in which the complexities associated with diverse outcomes of enhanced adaptive capacity contribute to the sustainability of the local social-ecological system and which lessons can be learned from those results.

## Chapter 7 – Complexity in Adaptive Capacity: Understanding Outcomes of Adaptive Capacity for System Sustainability

### 7.1 Introduction

The findings presented in the previous two chapters provide insight into how the Trax and CODE-WA Projects did, and/or didn't, enhance adaptive capacity, as indicated by features of social capital, within farmer groups. When considered in relation to the broader objectives of these two projects, and the recognised links between adaptive capacity and sustainable livelihoods (as discussed in Sections 3.5, 5.2, and 5.5) these insights may be useful for indicating the potential for positive project outcomes and opportunities for future interventions. This chapter will further examine relationships between the types of adaptive capacity discussed in Chapter 6 and the projects' objective of increasing the sustainability of agricultural livelihoods. The potential for enhanced adaptive capacity to increase the sustainability of agricultural livelihoods will be examined through economic, environmental, physical, and political indicators of sustainability (see Sections 2.3 and 2.4).

Lessons for ongoing and future agricultural development interventions with similar objectives will then be drawn from this analysis. This is with the purpose of informing the planning of future projects; with an explanation of the benefits of recognising emergent characteristics of social capital, dynamic features of adaptive capacity, and co-constructed understandings of objectives. The discussion in this chapter responds to research question four by examining what implications arise from enhanced adaptive capacity for overarching project objectives of sustainable agricultural livelihoods. Additionally, this chapter responds to research question five by examining lessons drawn from this research to inform policy and benefit the planning of similar interventions.

Finally, this chapter will consider the potential for using the concept of complex adaptive systems as a tool to recognise indicators of enhanced adaptive capacity in similar interventions. This discussion examines complex dynamics in the links between enhanced adaptive capacity and sustainable agricultural livelihoods. Characteristics of complex adaptive systems are identified in the case studies and the potential

contribution of these to the projects' objectives of increased sustainability of agricultural livelihoods will be discussed.

### 7.1.1 Key Findings for Drawing Lessons

This chapter examines pertinent lessons for agricultural development interventions drawn from key findings highlighted in Chapters 5 and 6. First, the key findings that will contribute to the discussion in the later sections of this chapter will be summarised. Tables 5.2 and 5.3 summarised the formal and informal understandings of adaptive capacity within the Trax and CODE-WA Projects and the ways in which those understandings recognised that features of social capital, such as social networks and communication, may contribute towards enhancing adaptive capacity. Despite this, the project activities primarily focused on what they perceived to be physical indicators of enhanced adaptive capacity, including diversification of livelihood options and innovations in farming practices. This approach focuses attention only on some of the components of adaptive capacity which were identified in the formal understandings of adaptive capacity within the Trax and CODE-WA Projects. The project activities, focused on physical characteristics of agricultural livelihoods, resulted in direct and intended outcomes (see Sections 6.2.5 and 6.3.4), meaning the features of social capital which contributed towards enhanced adaptive capacity were often overlooked and at times unrecognised by the intervention facilitators and funding institutions.

Despite an apparent continued focus on physical characteristics, this research found that features of social capital did in fact enhance adaptive capacity in the farmer groups and contributed to the sustainability of their collective actions in the medium to long-term. These project outcomes, although indirect and unexpected, have resulted in increased sustainability of agricultural livelihoods through improved crop yields, the addition of collective income-generating activities, complementary livelihood activities, and supplementary livelihood sources. The farmer groups have been able to adapt those additional livelihood sources to suit their immediate and ongoing needs.

The physical project activities incorporated into the interventions as a result of the formal understandings of adaptive capacity of the funders and implementing institutions were expected by CODE-WA to support overarching sustainability of agricultural livelihoods. The CODE-WA Principal Investigator stated that:

*“By diversifying crops the system is more resilient because with several crops then we expect at least one will yield during periods of climatic variability. If we increase the diversity then we can increase sustainability.” (KI24, 25/3/15)*

Evidence in Section 6.2.5 indicated that activities which involved the introduction of new crop varieties did not achieve the expected outcome in either case study. Despite this, there was evidence of farmers increasing experimentation and innovation following these project activities, which resulted in enhanced adaptive capacity as understood by the field staff and farmers. Sections 6.2.5 and 6.3.4 discussed evidence of collective learning through experimentation in farming communities participating in the Trax project. The discussion in those sections indicated that the social collective engagement surrounding processes of experimentation resulted in the social capital components of adaptive capacity being enhanced and sustained.

Similarly, collective learning resulting from processes of experimentation and innovation directly influenced by the CODE-WA Project provided an enabling community structure and empowerment. This indicates that, because the associated individuals and institutions had different understandings of adaptive capacity, they perceived the project activities in different ways and for different purposes, which allowed them to achieve outcomes which were unexpected in the formal conception of the intervention.

The evidence reported in Chapter 6 indicated that impacts on project outcomes of enhanced adaptive capacity predominantly resulted from features of social capital. Therefore, the ostensibly intended cause-and-effect of project activities on diversification of agricultural livelihoods was not the dominant process in enhancing adaptive capacity within the farming communities. Drawing on this, the following discussion will identify the implications of these findings for the policy and planning of ongoing and future agricultural development interventions.

The remainder of this chapter will examine the implications of these key findings for the project objectives of sustainable agricultural livelihoods within the Trax and CODE-WA Projects and the lessons for similar ongoing and future interventions.

## 7.2 Enhanced Adaptive Capacity and Indicators of Sustainability

Throughout this thesis, a possible relationship between adaptive capacity and sustainability has been highlighted. This was introduced through examination of relevant literature in Sections 2.2 and 2.3, and consequently was included in the proposed framework of adaptive capacity in Section 2.7. Both of the case studies identified the objective of sustainable agricultural livelihoods for the participating smallholder farmers and considered enhanced adaptive capacity as a means to achieving that. The following discussion draws together the theoretical understandings of sustainability in relation to adaptive capacity (Section 2.3), the objectives of the case studies (Section 3.5), the understandings of adaptive capacity and sustainability within the two case studies (Sections 5.4 and 5.8) and the outcomes of enhanced adaptive capacity (Section 6.2). This will examine how enhanced adaptive capacity impacted indicators of sustainability, including social, political, economic, environmental, and physical sustainability.

### 7.2.1 Sustainable Collaborative Governance and Empowerment

The evidence presented in Chapter 6 highlighted the prevalence of features of social capital functioning as indicators of adaptive capacity. Within the context of this study, features of social capital, such as social networks, collaborative governance, and collective learning, were also suitable indicators of sustainability. Literature on social capital in sustainable agricultural livelihoods was examined in Section 2.4, and related to the prior discussion of components of sustainability (Section 2.3.2). This was reflected in the framework of adaptive capacity proposed in Section 2.7, and also informed the hypotheses underlying this study, set out in Section 2.8.1. In particular, hypothesis 4 suggests:

If agricultural development interventions focus on enhancing features of social capital there are opportunities for outcomes of adaptive capacity to support the sustainability of agricultural livelihoods.

This hypothesis recognises the potential relationship between features of social capital, enhanced adaptive capacity, and outcomes of sustainable agricultural livelihoods. The following discussion reflects on the evidence of features of social capital supporting sustainability outcomes within the Trax and CODE-WA Projects.

In the Trax project it was possible to assess the lasting impact of the project activities on farming communities which had engaged with the initiative up to 25 years ago. It was possible to observe that the social structures which had been developed during the project facilitation had endured. As such, the informal institution of the farmer group had maintained institutional memory (e.g. Hirshliefer and Welch, 1995). The practices, processes, experiences, and constitution of the farmer group had been preserved over time despite some change in membership as people had either died or moved away. Thus, institutional memory had enabled the social structures to endure long-term.

As outlined in Section 3.5.4, when farmers form groups under the Trax participatory project activities, the farmer group defines its constitution and rules for governance. Collaborative governance among the farmer group continued to be the dominant process for decision-making regarding farming activities, community development, and management of natural resources. In the community of Nakpalig, the women's farmer group continued to uphold the constitution, formed during engagement with the Trax project, collectively amending it as the group changed size. This ensured that the group continued to use collaborative governance as the dominant process underlying subsequent decisions and activities concerning agricultural livelihoods and the wider development of their community. The farmer group continued to make decisions regarding their income-generating activities and collectively took action to increase opportunities for agricultural livelihoods. Through lobbying the local government and collective provision of labour, they were able to restore a small dam to provide irrigation water for growing vegetables during the dry season. This not only supported a sustainable agricultural livelihood but increased their opportunities for gaining income from their farming activities.

The persistence of collaborative governance structures within Nakpalig demonstrated the role of social capital in sustaining agricultural livelihoods. Furthermore, this example also highlights how collaborative governance, the shared empowered status of the farmer group, and the resulting increased agency enhanced the political and economic capital of the community. The agency, which the farmer group developed, enabled them to advocate for themselves and lobby the local government for additional resources. The collective action and shared risk, through these group activities, increased economic capital of individuals and the group, through increased

income sources. In this example, collaborative governance, empowerment, and agency provided useful indicators of social features of sustainable agricultural livelihoods.

Borrini-Feyerabend et al (2007) suggested that participatory processes may support collaborative governance of natural resources. In particular, they suggested that participation in governance is essential for the governance process to be legitimate. In the case of the Trax project, it was a requirement that the farmers governed the constitution of their group through consensus and collaborative decision-making. As such, the participatory project activities facilitated through the farmer groups may have supported the development of collaborative governance, and thus enhanced adaptive capacity.

Similar features of social capital supporting the sustainability of agricultural livelihoods were also evident in the CODE-WA Project. The physical activities of the CODE-WA Project did not continue because the farmers lost their seed stock of the bred varieties introduced during the project due to a drought in 2013. Despite this, the features of social capital, which were enhanced during the project, were not only evident, but were highly active and dominated the relationships among the individual farmers, and between the farmer group and the rest of the community. Examples discussed throughout Chapter 6 highlighted the prevalence of collaborative governance, collective learning and problem solving, empowerment, agency and autonomy among the farmer groups in Jonga and Doodiyiri. As with the Trax project, the farmer groups had rules they had devised and followed collectively, including payment of fines for late attendance to group meetings. These features of social capital had previously been examined in relation to enhanced adaptive capacity. However, evidence suggested that these social features of adaptive capacity support sustainable agricultural livelihoods, thus functioning as indicators of sustainability.

Although the introduction of novel crop varieties was the primary focus of project activities during the CODE-WA Project, this was undertaken with the expectation that it would contribute towards the broader objective of sustainable agricultural livelihoods. The role of features of social capital within enhanced adaptive capacity impacting on project outcomes was discussed in Section 6.3. Project outcomes, such as access to land for farming and collaborative production and processing methods, indicated an increased sustainability of agricultural livelihoods by ensuring continued farming and income-generation. These project outcomes came about due to

collaborative governance, empowerment, and increased agency and autonomy. In this example, the project outcomes reflected not only social capital but also increased political and economic capital because the women were able to request land from the community *Tindana* and increased income from collaborative processing and marketing of rice.

In the case of the CODE-WA Project, the project outcomes went beyond those anticipated by the facilitators in MOFA, SARI and ICRISAT. Due to these outcomes resulting from enhanced social capital, the broader objective of sustainable agricultural livelihoods had been met, at least to some degree, despite the failure of the expected outcomes. As features of social capital, collaborative governance, empowerment, and agency can function as indicators for sustainability of the project interventions, and consequently, of sustainable agricultural livelihoods.

Beyond the evidence of project outcomes supporting sustainable agricultural livelihoods, the farmers described their social network and community relationships in terms of sustainability. When describing the collaborative governance and autonomy among their farmer group, one farmer in Pelungu stated: “*Sustainability is something that comes to live, it can grow*” (IVT12, 13/2/14). He described the ability of the farmers to mobilise collective action for shared benefits and the flexibility of the farmer group to respond to individual and community needs. He perceived the strength of the social capital among their farmer group as indicating the capacity for their group to live, grow, and be sustained.

#### 7.2.2 Experimentation, Innovation and Diversity in Sustainability Indicators

The previous section examined the role of social capital in supporting the sustainability of agricultural livelihoods in the Trax and CODE-WA Project. The examples also identified political and economic capital as supporting the sustainability of farming and income-generating activities. However, in much theoretical discourse (as discussed in Sections 2.3 and 2.4.2), agricultural livelihoods were perceived as being sustainable only when they incorporated features of social, political and economic sustainability with environmental and physical sustainability. This section considers the evidence of environmental and physical capital supporting sustainable agricultural livelihoods in the case studies.



A key activity within the Trax project was to support farmers to develop the use of agro-ecological practices. It was anticipated that agro-ecological farming methods were more sensitive to the local environmental conditions than intensive mechanised farming, and would therefore support environmental sustainability. Trax field staff responsible for facilitating the project considered the adoption of interventions as contributing to enhanced adaptive capacity. In these circumstances, the farmers were encouraged to adapt the introduced practices to their local circumstances in order to make them context-appropriate. This required an element of experimentation among the farmer groups and the adoption of an introduced farming method represented innovation and a diversification of agricultural practices in the community. One farmer in Pelungu explained how this had contributed to environmental and livelihood sustainability:

*“It has helped us tremendously. We saw the trees were helping with our activities so we now have a tree nursery to plant more. After we were working with Trax we wanted to take it further because we saw that some trees were better than others. Now we are keeping bees and we can sell mangoes and cashews.” (IVT25, 24/2/14)*

The farmer identified different areas on his farm where he had observed that the mango and cashew trees were yielding non-timber forest products more quickly than other tree varieties. He went on to explain:

*“The trees act as a wind break when there is the Harmattan, the Harmattan winds are getting stronger. We have planted trees near the house because they act as a wind break from the dust, and also on the farm.” (IVT25, 24/2/14)*

Through experimenting with tree planting from seedlings provided by Trax, this farmer had identified the most suitable locations for tree planting as well as productive tree types. This innovative approach to afforestation increased the environmental and physical capital available to the farmer while also providing additional livelihood sources. In this example, the experimentation with tree planting increased environmental capital. This may result in greater sustainability of the local environment and agricultural livelihoods as an outcome of experimentation and innovation.

Although experimentation, innovation and diversification of livelihood sources can contribute towards sustainability of agricultural livelihoods, they were an indirect contributor. The evidence in Chapter 6 confirms that experimentation, innovation, and diversification of livelihood sources contribute towards enhanced adaptive capacity. Furthermore, it implies that the enhanced adaptive capacity has the potential to increase

the sustainability of agricultural livelihoods through adaptive responses to changing circumstances. As such, it supports the project's assumption underlying the relationship between Trax's objective of sustainable agricultural livelihoods and the activities expected to enhance adaptive capacity.

The above discussion presents evidence of innovation supporting enhanced adaptive capacity. However, it may be possible for innovations to result in maladaptation or reduced adaptive capacity. Reid et al (2013) suggested that maladaptation may occur in cases where they are not considered in the context of the intervention and existing adaptation strategies. As discussed in Section 6.3.5, the introduction of OFSP to farmers participating with the Trax project was an innovation intended to be a strategy to adapt to increased frequency of drought. Despite a good rationale for the innovation, it proved to be a maladaptation. The following section will discuss the potential for sustainability to be compromised.

### 7.2.3 Potential of Multiple or Severe Shocks to Compromise Sustainability

The discussion throughout this section has identified the potential ways in which enhanced adaptive capacity is linked to sustainability, in particular in relation to sustainable agricultural livelihoods, in line with objectives of Trax and CODE-WA Projects. However, as discussed in Section 6.3.5, there could also be circumstances where enhanced adaptive capacity would not result in increased sustainability. For example, adaptive capacity may support a community to maintain agricultural livelihoods during periods of economic stresses but should this coincide with other types of shocks, such as extreme weather events or disease outbreaks, adaptive capacity may not be sufficient to sustain farming practices and crop yields. Although there is little evidence of this occurring within data from the Trax and CODE-WA Projects, this does not mean that the relationship between adaptive capacity and sustainability could not prove insufficient at some point in the future or in other similar interventions.

Thornton et al (2006) suggested that development interventions can cause maladaptation if they do not consider local priorities. This could reduce capacity for agricultural livelihoods to be sustained. De Vente et al (2016) suggested that participatory processes could result in more locally-appropriate solutions in interventions. However, avoiding maladaptation is dependent on well-planned participatory processes which are engrained in the intervention from the outset.

This section has examined social, economic, and physical features of sustainability. In circumstances where sudden dramatic shocks to several of these features occur simultaneously, it could potentially result in a need to adapt in so many different ways that the sustainability of the system may become temporarily, or permanently, impaired. An event like this may cause the system, in this case agricultural livelihoods in a social-ecological system, to reach a threshold and transform to a different system, instead of sustaining the existing one. For example, in Northern Ghana there is a history of ethnic tension which continues to flare up into violence occasionally. While this has recently been localised and typically short-lived, historically there have been widespread civil wars between ethnic groups in the three northern regions of Ghana. Should an event such as this occur again, it is feasible that social, economic and political tensions would result in the sustainability of agricultural livelihoods being compromised in the short-term, and possibly long-term.

Although shocks such as these cannot practicably be planned for, it is important to recognise that enhanced adaptive capacity may not result in sustainability in all cases. While adaptive capacity may support a community to maintain a livelihood during periods of shocks, or to minimise the negative impacts of shocks, this could be through a transition away from agricultural livelihoods. Transformations can have positive outcomes, particularly when a transition to a more efficient system is identified, making sustainability more achievable (Stirling, 2014). Westly et al (2013) suggested that significant socio-economic, political and cultural changes or pressures may cause the relationship between adaptive capacity and sustainability to breakdown or transform.

For example, there is a trend in Ghana, and many other Sub-Saharan African countries, for children and young adults to migrate into towns and cities in search of non-agricultural employment. While this may enable a sustained livelihood, it is no longer an agricultural livelihood. Furthermore, in circumstances of multiple or severe shocks such as those described above, it is possible that adaptive capacity may be lost. This could not only reduce the potential for sustainable agricultural livelihoods, but may mean it ultimately takes longer to achieve sustainability in social, environmental, economic and political features of livelihoods than would otherwise be the case.

### 7.3 Implications of Project Processes and Outcomes for Sustainable Agricultural Livelihoods

Throughout Chapter 6, examples of diverse ways in which engagement with project activities resulted in outcomes for the participating farming communities were examined in relation to enhanced adaptive capacity. Both projects stated in their formal documentation that they intended to enhance adaptive capacity of the farmer groups as a means of increasing the sustainability of their agricultural livelihoods. This section examines the implications of processes within the projects and relevant project outcomes for particular aspects of sustainable agricultural livelihoods. This first considers the role of participatory methods within the two interventions and how those processes strengthened social capital. Diversity and empowerment will then be examined in relation to perceptions of project outcomes resulting from enhanced adaptive capacity. The implications of social capital, diversity and empowerment for sustainable agricultural livelihoods are also outlined.

#### 7.3.1 Identifying the Process of Participation for Enhanced Social Capital

The emergence of participatory development as a key model within international development interventions centred on the proposition that farmers have greater knowledge about their local environment and cultures than external agencies and that participation could be empowering for all. Section 2.6 introduced the origins of farmer participation in development interventions and various typologies of participation. Pimbert and Pretty (1995) identified collective learning, diversity, and governance within participatory natural resource management and proposed that this could lead to sustained action. Reviewing the history of the participation movement, Holland et al (2015) suggested that the practice of incorporating participatory elements into development interventions and research had contributed to empowerment and good governance processes.

The Commission on Sustainable Agriculture and Climate Change suggested farmer participation in governance and collective actions is required for agricultural systems to be sustainable and adaptive (CGIAR, 2011). Much of the recent discourse from agricultural development practitioners suggests that farmer participation is

necessary for enhancing adaptive and sustainable agricultural livelihoods (e.g. Mansuri and Rao, 2013).

Since Trax was established in 1989 it has used a participatory approach to work with farmer groups. The participatory methods Trax used when initiating engagement with farmer groups were discussed in Section 3.5.4 and outlined further in Appendix D. The Director of Trax stated:

*“We use participatory methods so that the farmers can identify their needs and solve their own problems. We build the capacity of farmers to support their self-reliance once they have been weaned off the Trax programme.” (KI1, 25/2/14)*

This statement indicates that Trax perceived the participatory approach they adopted as a capacity building tool, specifically with respect to building the capacity for collaborative governance and collective learning. Further, the Director suggested that supporting those social interactions increased the sustainability of the project interventions once Trax had formally finished the project.

Empirical data from the farmer groups, who engaged with the Trax project several years ago, indicated that the features of social capital which were enhanced through the project activities persisted. Furthermore, those groups became self-mobilising in seeking additional forms of enhanced adaptive capacity and sustainable livelihoods beyond those introduced to them by the Trax project. Due to the successful collaborative governance demonstrated through the group sustainability and the initiatives they have undertaken, the farmer groups were in high demand in their communities. For example, in the community of Nakpalig, one farmer group had so many requests for membership that it became too large and was divided into two groups. In addition, no farmers reported difficulties, contestations, or failures in collaborative governance, further indicating the successes of collective management of decision-making processes (e.g. Borrini-Feyerabend et al, 2009).

Both case studies focused primarily on the use of physical and natural capital as means of enhancing adaptive capacity. The CODE-WA Project targeted agricultural biodiversity through the introduction of crop varieties which had been bred to be drought-tolerant. The Trax project activities concentrated on environmental sustainability through soil and water conservation practices and diversifying livelihood options. The focus on physical and natural capital follows the multiple formal

understandings of adaptive capacity within each case study examined in Sections 5.2, 5.5, and 5.6, and the adoption of introduced technologies. This also reflected the formal understandings of adaptive capacity which were framed in the context of the respective interventions, discussed in Sections 5.3.1 and 5.7.1, and the need for quantitative metrics for monitoring and reporting to project funders.

Although the activities in Trax and CODE-WA ostensibly focused on physical and natural capital to enhance adaptive capacity, the discussion in Chapter 6 identified several indispensable features of social capital that were constitutive of enhanced adaptive capacity contributing to positive outcomes. This suggests that participative collaborative governance, collective learning, and other features of social capital (outlined in Section 2.7), which were evident in the farmer groups associated to the two projects, enhanced adaptive capacity with respect to more than just the physical attributes of experimentation, innovation, and diversification. The strengthened social capital, which was initiated through the group participatory activities, enhanced adaptive capacity and subsequently increased the sustainability of agricultural livelihoods.

The role of participation in increasing empowerment and strengthened social capital had implications for the outcomes of enhanced adaptive capacity and sustainable agricultural livelihoods. Although participation had been considered as contributing to adaptive sustainability and social empowerment for over two decades (e.g. Holland et al, 2015; Pimbert and Pretty, 1995), this research highlights that some participatory development interventions continue to focus their attention on quantifiable characteristics of physical and natural capital, to the neglect of social capital. Ludi et al (2011) suggested that development interventions need to make a big shift in approach to acknowledge power dynamics within participatory activities in order to enhance agency. As evidence discussed in Sections 6.2.4 and 6.3.3, agency could act as an indicator of enhanced adaptive capacity.

In the context of the increase in interventions seeking to enhance adaptive capacity, the continued focus on quantifiable physical characteristics is pertinent because the evidence examined in Section 6.2 suggested that social capital indicators of adaptive capacity are dominant in achieving desirable project outcomes. This finding contributes to adaptive capacity discourse by bringing together the contributions of participatory interventions, social capital, and enhanced adaptive capacity.

### 7.3.2 Non-Linear Responses to Interventions and Perceptions of their Diverse Outcomes

This section considers examples of the diversity of outcomes which resulted from project activities in the Trax and CODE-WA Projects. The potential for non-linear outcomes is examined, whereby objectives may be met but not through simple, linear cause-and-effect relationships, and thus outcomes may be difficult to predict. Non-linear responses to project activities may trigger widespread and lasting impacts from small interventions, or conversely, may require a large-scale intervention to achieve a small or insignificant outcome. Holland (2014) described non-linearity as occurring when

“the behaviour of the whole CAS [complex adaptive system] is not obtained by *summing* the behaviours of the component agents or, using a familiar phrase, ‘the whole is more than the sum of the parts.’” (Holland, 2014, p25, emphasis in the original)

Norberg and Cumming (2008b) add that non-linear dynamics in complex systems result in self-reinforcing feedbacks within the system, in this case agricultural livelihoods. Non-linear responses are pertinent to the indirect outcomes examined in Chapter 6 and the role of thresholds in shifting to a different, and/or sustainable, system. Evidence of non-linearity within the Trax and CODE-WA Projects will be discussed in relation to the implications for achieving project objectives of sustainable agricultural livelihoods.

One of the field staff facilitating the Trax project stated that “*it takes 3 to 4 years to see the benefits from increased yields from soil and water conservation*” (KI3, 25/7/14). He recognised that the objective of increasing environmental sustainability to support agricultural livelihoods did not function over a short time scale and may not even have been observable within the five year project cycle of formal facilitation. Despite this, whether farmers utilised the agro-ecological practices to conserve soil and water, introduced through the project activities, was used by Trax and Self Help Africa as an indicator of progress towards achieving the objectives of their intervention. For example, monitoring and evaluation reports to international funders recorded the length of bunds constructed each season, the number of farmers who were producing compost using crop residue and farmyard manure, and the numbers of tree seedlings planted. Those indicators focused on the physical interventions and concepts of larger-scale infrastructural adaptation for broad sustainability objectives. Those indicators did not

signify adaptive capacity or sustainability from the perspective of the farmers or the field staff.

One farmer in Beo-Tankoo explained that the community had collectively recognised that, over a period of several years, there had been an increase in the number of their chickens and guinea fowl which were being stolen by hawks. The farmer explained that he had visited Northern Region and observed that there was higher tree coverage in the area and people did not report hawks stealing their fowl. He said that he suggested to his community that a loss of tree cover meant the fowl were no longer hidden from hawks flying overhead. He stated:

*“Before, we were cutting trees, women were cutting for fuel wood. We made a communal decision to stop cutting trees and to plant more. We decided to plant local species of fruit tree because fruits help children a lot so when the trees were cut the fruit was lost from their diet. We also decided to regenerate by planting species which are dying out and can help medicinally. We saw that planting trees could help with bringing fruits for children and medicines so we decided to stop cutting and plant more and then see if our fowls did not get stolen. It has helped.” (IVT45, 7/3/14)*

This provides an example of a farming community recognising a shared problem and then making a collective decision and using collaborative governance to experiment with a possible solution to the problem. In the process the community identified other ways in which the solution could support local needs and collectively learned from the outcomes. The community began tethering ruminant livestock near the trees and the leaves provided feed for the animals. This meant that children were not required to take livestock out to pasture during the dry season and could instead go to school. Furthermore, women began collecting and selling non-timber forest products so income was increased, and children in the community were able to eat more mangoes which improved their nutrition. These changes the farmer had observed in the community had spread beyond the farmer group which had taken the initial action, bringing widespread change. Due to strong community relationships and integration of the Trax project in the community, traditional cultural governance structures supported the ideas originating with the farmers. He explained that he still saw the effects of the changes in the community, although the formal facilitation of the Trax project had ended in 2007, indicating lasting change.



This example provides evidence of some of the characteristics proposed in the framework of adaptive capacity in Section 2.7. The farmer quoted explained that the community learned to solve their problems as a group through the interaction with the Trax project activities. Planting trees to prevent fowl from being stolen by hawks was an indirect outcome of the Trax project, resulting from social attributes of enhanced adaptive capacity. This example also shows how these features of social capital supported the sustainability of local agricultural livelihoods through other means. The community-wide outcome was not predictable at the outset of the Trax project, or indeed when formal facilitation ended in 2007. Additionally, this example reflects features of non-linearity, where infant nutrition and attendance at school was increased through an intervention to reduce hawks stealing fowls. A small change in practices of clearing trees had resulted in significant, widespread, lasting benefits for the whole community, where the positive effects were perceived by the farmers as greater than the sum of their parts.

In Chapter 6, there was evidence of non-linearity resulting in indirect and unexpected outcomes of the Trax and CODE-WA Projects. The discussion here suggests that the existence of diverse understandings of adaptive capacity, and of how they can contribute to sustainable agricultural livelihoods, resulted in diverse project outcomes, which have some linear and some non-linear characteristics. The non-linearity and diversity of project outcomes and influences on sustainable agricultural livelihoods resulted from complex interactions and relationships, and the multiple associated stakeholders responding in different ways to the intervention, because of the context they inhabited. For example the Trax staff and the participating farmers identified different features of adaptive capacity as priorities for an intervention seeking to enhance adaptive capacity. In the CODE-WA Project, the ICRISAT and SARI scientists were primarily concerned with physical and technological capital of innovation and increased agrobiodiversity. Meanwhile, the local MOFA field officer and the participating farmers identified priorities of collaborative governance, unity, solidarity and togetherness. As such the diverse understandings of adaptive capacity underlying the project's activities led to diverse project outcomes.

### 7.3.3 Enhanced Empowerment and its Contribution to Sustainability

Chapters 5 and 6 suggested that the informal understandings of adaptive capacity of the participating farmers and facilitating field staff viewed the social capital held within community structures and traditional cultural norms as being key to realising successful outcomes. Farmers in both projects understood empowerment as increasing the sustainability of their agricultural livelihoods because the consequences of that empowerment were perceived as having enhanced the farmers' capacity to act and self-mobilise.

This perspective on empowerment, and its potential to enhance collective adaptive capacity through social capital, was only evident when the farmer groups discussed outcomes in hindsight (see Sections 6.2.4 and 6.3.3). The farmer groups that had recently begun participating with the Trax project made no reference to social capital in this form at any time during fieldwork. Neither did the formal understandings and objectives of the interventions refer to empowerment or enhanced social capital. However, the farmers, who had previously engaged with the two case studies and had experienced empowerment resulting from changes in their collective actions due to enhanced social capital, were able to reflect on the impact this had had in triggering subsequent processes which further enhanced their adaptive capacity.

In the community of Jonga, women farmers who participated with the CODE-WA Project explained that, through the intervention, they had been empowered and consequently had a raised profile within the community (see Section 6.2.1). In turn, this raised profile increased their opportunities for engaging in additional livelihood activities, and they were given access to land to develop their moringa plantation. In this example, the empowerment of the women resulted in more sustainable agricultural livelihoods and increased incomes. Thus, empowerment increased their agency, capacity for autonomous action, and enabled adaptive sustainability within this group.

## 7.4 Lessons for Agricultural Development Interventions

In this chapter, characteristics of diversity, non-linearity, and emergent behaviour have been identified within examples from the Trax and CODE-WA Projects. These are all key features within the concept of complex adaptive systems. This section considers the lessons of the above discussion for similar ongoing and future agricultural

development interventions. These lessons will be discussed in relation to complex adaptive systems and the potential for the use of this concept for better planning and implementation of projects.

Although analysis of empirical data identified characteristics of complex adaptive systems to be prevalent in both case studies, neither project used this concept as a framework for articulating their theory of change within agricultural development interventions. The simple, presumed linear cause-and-effect framing of change within project activities and outcomes meant that the implementing and funding institutions failed to recognise the diverse and longer-term outcomes directly or indirectly resulting from their interventions. The participating farmers identified these medium to long-term outcomes as beneficial for themselves and their communities. The strengthened social capital, which enabled many of these outcomes, was not a primary focus for enhancing adaptive capacity and increasing the sustainability of agricultural livelihoods in either project.

Distinct lessons can be taken from this analysis for understanding the beneficial and negative, direct and indirect, social and physical, and short and long-term outcomes resulting from participatory agricultural development interventions. Firstly, recognition within intervention facilitators that different stakeholders may have differing understandings of the objectives, and how project activities may achieve these, is useful for understanding how processes of change may unfold. Acknowledging that different stakeholders may understand the context of the agricultural system in different ways could be beneficial for identifying context-specific characteristics that may support and/or inhibit successfully achieving the project objectives.

A second lesson recognises the dominant role of social capital in achieving the beneficial outcomes resulting from the Trax and CODE-WA Projects, even though they were largely unexpected outcomes. The case studies demonstrated that participatory development interventions, which required group formation and collaborative governance, were able to strengthen and enhance their social capital.

Through building on the existing conditions, the collaborative and collective actions undertaken within the project activities were, over time, adapted to local cultural expectations and social conditions. This increased opportunities for strengthened social capital to be sustained, thus further enhancing adaptive capacity and supporting sustainable agricultural livelihoods beyond the formal development interventions. Interventions which focused on social capital as a means to achieve positive outcomes

for the participating farmers were not only able to achieve the project objectives but also to initiate processes which enabled increased agency, autonomy, empowerment, and ultimately, autochthonous development.

Both agricultural development interventions displayed characteristics of complex adaptive systems at multiple spatial and temporal scales of analysis. This suggests that interventions which conceptualised project activities through a complex adaptive systems lens may consequently be able to identify a wider range of dynamic and diverse outcomes from the project than would otherwise be possible.

Acknowledging that project activities may result in unexpected outcomes is important, so using a framework which draws on complex adaptive systems may help facilitators and funders of interventions to identify indirect, non-linear, and emergent outcomes. The use of developmental evaluation proposed by Patton (2011; discussed in Section 4.3) may be helpful for identifying relevant characteristics of complex adaptive systems emerging from interventions through repeated, concurrent evaluation of project impacts and outcomes. An adaptive evaluation process during an intervention may facilitate recognition of indicators of adaptive capacity discussed alongside characteristics of complex adaptive systems, which in turn may enable adjustment of project activities which the evaluator observes to be having the greatest positive impact.

Fuller understanding of the dynamic and complex interactions, which result in positive or negative outcomes, could present opportunities for policy-makers and practitioners to capitalise on the relationships and behaviours that support beneficial outcomes. A fuller understanding of these dynamic complexities may be possible through incorporating adaptive evaluation and reflexive project activities into ongoing and future interventions. As the evidence of similar dynamics and interactions between project activities and outcomes increases, it should become easier to operationalise the use of these tools in development interventions.

This discussion highlights the value of using the concept of complex adaptive systems as a tool for framing smallholder farming systems. The framing of sustainability within the concept of complex adaptive systems will be examined further in the following section.

## 7.5 Framing Sustainability within Complex Adaptive Systems

This section considers the diverse framings of sustainability, as outlined by the two case study projects, in relation to the theoretical framework for this research (Section 2.7). Relationships between the framings of sustainability, broader framings of agricultural systems, and the diverse understandings of adaptive capacity in both case studies are examined. The analysis draws on characteristics of complex adaptive systems as conceptual tools to examine the diverse processes of change within multiple framings of sustainability.

Development interventions often use a rationale of simple, single linear cause-and-effect for justifying project activities. The dynamics within complex adaptive systems result in diverse, emergent and non-linear outcomes being difficult to predict (e.g. Gunderson et al, 2008). Thus, the processes which may, or may not, enhance adaptive capacity and sustainable agricultural livelihoods might not follow obvious cause-and-effect relationships to bring about change. This section examines the characteristics of complex adaptive systems in the Trax and CODE-WA Projects and respective outcomes of adaptive capacity. Diverse framings of sustainability will be examined in relation to the concept of complex adaptive systems.

### 7.5.1 Complex Adaptive Capacity and Sustainable Agricultural Livelihoods

The CODE-WA Project did not approach the intervention with the concept of the local farming system being a complex adaptive system. Yet, the outcomes of enhanced adaptive capacity resulting from this project provided a good example of complexity and adaptive capacity within a social-ecological system. The discussion in Section 6.3.3 indicated how one process, which enhanced adaptive capacity led to another, which developed an iterative feedback process. By requiring participation with the farmer groups and processes of evaluation and consensus, the CODE-WA Project stimulated collaborative governance within the groups. This enhanced opportunities for further collaboration, collective learning and knowledge exchange. By pooling resources, from ideas and knowledge to land and labour, the farmers increased experimentation, innovation, and diversity of their agricultural livelihoods and physical capital. These processes in turn increased the diversity of social structures and

interactions in the communities, empowering the farmer groups and developing their collective autonomy and agency.

Within a complex adaptive system, when one element of the system changes other elements adapt in response, creating a state of continuing and often non-linear adaptation. In the CODE-WA case study, the project activities changed the level of engagement and collaboration among the members of the existing farmer groups. As the level of collaboration changed, other social characteristics of the system responded in ways which increased collective action and outcomes for enhanced adaptive capacity. Non-linearity is a characteristic of complex adaptive systems and while some of the adaptive responses within the farmer groups in the CODE-WA Project may clearly follow other responses, there were multiple outcomes which at a glance may appear to be unconnected with the intervention. However, through examination of social behaviours and interactions with the local environment and culture this study identified some non-linear adaptive responses, which resulted in enhanced adaptive capacity within the local social-ecological farming system.

The capacity for the farmer groups to self-mobilise on an initiative following the sharing of ideas exemplifies processes observed within complex adaptive systems. A complex adaptive system has characteristics of evolution, adaptation, and new behaviours emerging. By recognising and enabling this adaptive process the system may become sustainable. Within a complex adaptive system the whole is greater than the sum of its parts. One farmer in Jonga captured this, stating: *“If we can’t develop individually then we can collectively develop”* (IVC2, 16/9/14).

Holland (2014) suggested that emergent behaviour is characteristic of complex systems, recognising that co-evolutionary processes can result in non-linearity. Within the context of the CODE-WA Project, it was possible to perceive local collective behaviours and interactions emerging from a relatively focused intervention of project activities. Through initiating collaborative processes among the farmer group, the CODE-WA Project activities became a feature of a local complex adaptive system. These collaborative interactions then influenced other features of the system resulting in emergent behaviours that utilised the enhanced social processes into other elements of the system.

Norberg and Cumming (2008b) suggested that the governance of self-organisation provides solutions which increase diversity, enhancing adaptive capacity

within a complex adaptive system and increasing sustainability of the system. In the case of the CODE-WA Project agricultural livelihoods within a social-ecological system developed adaptation strategies, thus supporting the sustainability of the community and socio-cultural structures. As such, the activities of the CODE-WA intervention had a lasting impact on the local communities beyond the adaptive capacity of agricultural livelihoods. Framing sustainability in terms of complex adaptive systems allowed for a recognition of adaptive understandings, interactions, and objectives in response to changed perceptions of sustainability.

## 7.6 Conclusion

This chapter discussed the various interacting links between the different framings of the agricultural system, the framings of sustainability, the understandings and outcomes of adaptive capacity, and the contribution towards sustainable agricultural livelihoods. Analysis located this summary of adaptive capacity and relationships to sustainability in relation to the concept of complex adaptive systems. The diverse, non-linear, and emergent characteristics of complex adaptive systems, which were evident in the processes and interactions examined have been discussed in relation to the understandings, indicators, and outcomes.

The overarching objective to increase the sustainability of agricultural livelihoods informed the project activities of the Trax and CODE-WA Projects. Section 7.2 examined the contribution of characteristics of enhanced adaptive capacity towards sustainable agricultural livelihoods in relation to social, political, economic, environmental and physical indicators of sustainability. This discussion concluded that features of social capital, such as collaborative governance and agency, can function as indicators of increased sustainability of agricultural livelihoods within the case studies. However, physical characteristics such as experimentation and innovation directly enhanced adaptive capacity and had an indirect relationship with increased sustainability of livelihoods. The analysis throughout Section 7.2 highlighted that features of social capital can be more reliably used as indicators of sustainable agricultural livelihoods in the context of these interventions than physical indicators.

In examining the relationship between enhanced adaptive capacity and sustainable agricultural livelihoods, the discussion also recognised that there may be circumstances where this relationship could break down. The potential for multiple and/or severe shocks to a system could cause the link between adaptive capacity and sustainability to break or transform to a non-agricultural system. Furthermore, it is possible that adaptive capacity may be reduced during such shocks, resulting in negative implications for achieving sustainability in the longer-term.

In both case studies, the outcomes of enhanced adaptive capacity, which have the widest, most beneficial and lasting impact, were those which drew on, and contributed to enhancing, social capital. The characteristics of enhanced social capital became embedded within existing social and cultural heterogeneity. These processes, relationships, and interactions were stimulated by the participatory elements of the interventions. The participatory elements required that farmers formed groups in which they practiced collaborative governance and consensus building. This then triggered other components of adaptive capacity included in the theoretical framework postulated for this research, including shared problem-solving and shared learning, experimentation and innovation, and anticipation. These interactions resulted in collective senses of solidarity among the farmer groups, enhancing their capacities for agency, and driving collective and individual empowerment and autonomy.

Social interactions, processes, and behaviours instigated by the participatory elements of interventions contributed to enhancing adaptive capacity. The diversity of individual and collective responses to participation with the interventions resulted in greater potential for enhanced adaptive capacity. The enhanced components of adaptive capacity, including collaborative governance and shared learning, lasted in farmer groups because they incorporated local dynamics and temporal and spatial heterogeneity. Although the potential for, and impact of, participation within development interventions was discussed and examined widely, to date there has been no specific analysis of how this influences adaptive capacity or local complexity and dynamics. This, therefore, constitutes a novel finding.

The discussion in Section 7.4 suggested the potential value of incorporating developmental evaluation as a means to identify indicators of enhanced adaptive capacity and emergent behaviours. This may facilitate adjustments to the project activities and/or objectives to enable optimal beneficial outcomes from any dynamic, non-linear, or emergent characteristics identified through evaluation. This suggests that



features of complex adaptive systems may assist evaluation and analysis of project activities during the lifetime of the intervention. In cases where indicators of enhanced adaptive capacity are identified, this evaluation may enable adjustment of activities to optimise opportunities for the adaptive capacity to result in outcomes of sustainable agricultural livelihoods.

A complex adaptive system has characteristics of evolution and adaptation, with new behaviours emerging. If interventions recognise and enable continual adaptive processes the system may become more sustainable. Within a complex adaptive system the whole is greater than the sum of its individual parts. Section 7.4 identified the implications of recognising characteristics of complex adaptive systems functioning within the case studies in achieving the objectives of sustainable agricultural livelihoods. This chapter has found that the concept of complex adaptive systems can be beneficial for identifying emergent and unexpected outcomes resulting from project activities and enhanced adaptive capacity and the processes by which they emerge. In this context, features of social capital which were proposed as components of adaptive capacity in Section 2.7 have supported adaptive sustainable agricultural livelihoods within a complex system.

Complex adaptive systems discourse has to date been largely theoretical in context and texts which have applied the concept to development interventions, such as Burns and Worsley (2016), have done so in the context of development research rather than practice. The findings in this chapter contribute to complexity discourses by developing a framework in which to adopt characteristics of complex adaptive systems for assessing outcomes from enhanced adaptive capacity in practice.

## Chapter 8 – Conclusion

### 8.1 Introduction

This research set out to investigate understandings, indicators, and outcomes of enhanced adaptive capacity within two agricultural development interventions in Northern Ghana. Chapter 2 outlined the theoretical discourse underlying this research and the gaps in knowledge, understanding, and application. Following this, five research questions were outlined which covered three strands of the research: project stakeholders' understandings of adaptive capacity, indicators of enhanced adaptive capacity, and the implications of enhanced adaptive capacity for sustainable agricultural livelihoods. The five questions were:

1. What are the understandings of adaptive capacity that are identified within agricultural development interventions in Northern Ghana and how have they formed?
2. What indicators of adaptive capacity exist within agricultural development interventions in Northern Ghana?
3. How do participatory project activities of agricultural development interventions contribute to outcomes of enhanced adaptive capacity in Northern Ghana?
4. What implications does enhanced adaptive capacity have for sustainable agricultural livelihoods?
5. What lessons are there for informing policy and planning of ongoing and future agricultural development interventions which seek to enhance adaptive capacity?

In response to research question one, Chapter 5 examined the diverse understandings of adaptive capacity within the Trax and CODE-WA Projects and the influences on these understandings over time. Chapter 6 examined the evidence of indicators of adaptive capacity within the two case studies and any project outcomes which have resulted from enhanced adaptive capacity, responding to research question two. Chapters 6 also considered the role of participatory project activities in enhancing adaptive capacity, providing evidence for research question three. In response to research questions four and five, Chapter 7 considered the implications of these

outcomes for achieving the project objectives of enhanced sustainability of agricultural livelihoods and lessons for similar interventions. This concluding chapter will examine the contributions of this research to theory, policy, and practice within agricultural development interventions and participatory development more broadly.

#### 8.1.1 Adaptive Capacity within Farming Systems in Northern Ghana

With the advent of threats from climate change taking a priority within global development policy and discourse, international development interventions have adopted climate mitigation and adaptation as project objectives. This has contributed to discourses surrounding social, economic and environmental sustainability. In the context of international development and vulnerability to climate change, the Intergovernmental Panel on Climate Change have identified smallholder farmers as being particularly vulnerable to the threats of climatic shocks and stresses (Oppenheimer et al, 2014). Due to this perceived vulnerability, agricultural development interventions in particular have adopted strategies to build mitigation and adaptation into project activities. Frequently such interventions have sought to enhance the adaptive capacity of rural smallholder farming communities in developing countries.

One concept adopted within development interventions is that of climate-smart agriculture, discussed in Section 2.1.7. Climate-smart agriculture has been criticised for permitting any form of agricultural practice, and was not used by either case study in this research (e.g. Neufeldt et al, 2013). Therefore, although it is a prolific discourse in recent policy and practice, climate-smart agriculture was not adopted as an approach in this study.

The objectives of agricultural development interventions, which have sought to enhance adaptive capacity, sit within a broader objective to increase the sustainability of agricultural livelihoods. Such interventions have an underlying assumption that adaptive capacity supports sustainability, and the overarching objective of sustainability is desirable for international development targets and poverty reduction. This study has used a framing of sustainability which requires social, environmental, economic and political sustainability within complex and dynamic social-ecological systems (Sections 2.3, 2.7.3, and 2.7.4).

The framework of adaptive capacity proposed in Section 2.7 considered the need for the capacity to adapt to change beyond just climatic change, including environmental, social, economic, and political changes, and at a local level, changes to

household demands. It is important to note that different forms of change may require different attributes of adaptive capacity for an appropriate response to the experienced or anticipated change. An analysis of indicators of enhanced adaptive capacity during periods of different forms of change was beyond the scope of this research. However, this broader conceptualisation of adaptive capacity is pertinent to smallholder farmers who commonly rely on a range of agricultural and non-agricultural livelihood sources within the context of complex social, human, economic and cultural interactions. Thus, this research has used a broad framing of the individual and collective need for enhanced adaptive capacity.

This research investigated adaptive capacity through the use of two case studies of agricultural development interventions in Northern Ghana. Northern Ghana presented a suitable context for this research because agriculture continues to provide the main livelihood source for up to 80 percent of the population. The north of the country is semi-arid and experiences characteristic climatic variability, while farmers observe that the seasonal rainfall pattern has been changing over recent years and extreme weather events are predicted to increase with climate change (see Section 3.4.1). The Ghanaian government is engaged in international discourse surrounding adaptation to climate change and the Ghanaian National Climate Change Adaptation Strategy was adopted in 2011 in response to the United Nations Framework Convention on Climate Change (UNFCCC; see Section 3.2.2). Additionally, socio-economic development in Southern Ghana has resulted in shifting governmental priorities and limited investment in the agricultural sector in the north (see Section 3.2.1). As a result of this, many non-governmental and governmental agricultural development interventions in Ghana focus on the three regions of Northern Ghana.

In this context of Northern Ghana, the Trax Sustainable Agriculture project and the Community Management of Crop Diversity to Enhance Resilience, Yield Stability and Income Generation in Changing West African Climates (CODE-WA) Project were identified as suitable case studies because they both cited objectives of enhancing adaptive capacities. Additionally, both case studies ostensibly adopted a participatory approach to the implementation of the project activities so presented opportunities for engaging with farmer groups during data collection (see discussion of data collection methods in Section 4.4).

## 8.2 Summary of Key Findings

Each of the three preceding chapters highlight important findings which contribute to the understanding of adaptive capacity and sustainable agricultural livelihoods in theory, policy, and practice. These findings centre on the diversity of understandings of adaptive capacity, indicators for adaptive capacity and sustainable agricultural livelihoods, and project outcomes resulting from enhanced adaptive capacity.

### 8.2.1 Diversity of Understandings of Enhanced Adaptive Capacity

Within both the Trax and CODE-WA Projects there were multiple understandings of adaptive capacity, how adaptive capacity can be enhanced, and how this contributes to overall sustainability of agricultural livelihoods. Analysis identified informal and two formal understandings of adaptive capacity within each of the case studies and that those understandings have evolved over time in response to relevant discourses. The formal understandings were evident in project documentation and through interviews with international funders and intervention managers. The informal understandings existed among participating farmers and the projects' field staff, but were not formally documented. The different understandings within each of the case studies existed at different points of project implementation.

In the Trax project, the first formal understanding had evolved from the historical influence of the establishment of the NGO in 1989, it was apparent in the project documentation and reflected the understanding articulated by the Director (Section 5.2). The second formal understanding within Trax originated with recent international funding agencies, notably Self Help Africa, and associated documentation. The informal understandings were held by Trax field staff and the participating farmers, drawing on local cultural traditions (Section 5.3). Table 5.2 (Section 5.4) provided a summary of the attributes of adaptive capacity within each of the identified understandings in the Trax project.

Likewise, within the CODE-WA Project one formal understanding of adaptive capacity had evolved from international discourse, governance, and funding agencies which had informed the activities of the ICRISAT intervention (Section 5.5). A second formal understanding existed among the project staff and documentation at SARI and

MOFA and was informed by the Ghanaian governmental priorities for agriculture and socio-economic development (Section 5.6). As in the Trax case study, farmers and field staff associated with the CODE-WA Project had informal understandings of adaptive capacity which related the concept to traditional customs (Section 5.7). Table 5.3 (Section 5.8) summarised the attributes of adaptive capacity within the formal and informal understandings identified in the CODE-WA Project.

In both case studies, the formal understandings of adaptive capacity recognised the need to adapt to climate change rather than change in environmental, social, economic or political circumstances more broadly. Those formal understandings identified features such as social networks, communication, and self-reliance as contributing towards enhanced adaptive capacity. Table 6.3 (Section 6.4.3) highlighted the commonalities and differences in the features which the projects' formal understandings identified and those which may be relevant for a broader conception of adaptive capacity as used in this research.

Despite the formal understandings identifying social attributes such as communication and self-reliance, the resulting project activities focused primarily on physical characteristics of adaptive capacity, such as agrobiodiversity and livelihood diversification. For example, both case studies introduced crop varieties which had been bred to be drought-tolerant with the expectation that this would enhance the adaptive capacity of the farmers. Although project activities focused on farmer adoption of physical and technological capitals, the participatory features of the projects supported processes which enhanced social capital. Attributes of social capital enhanced adaptive capacity of the farming communities but in ways which had not been anticipated by the project facilitators. As such, the unexpected and indirect outcomes of enhanced adaptive capacity and implications for sustainable agricultural livelihoods were not always identified by the project facilitators.

### 8.2.2 Indicators and Outcomes of Enhanced Adaptive Capacity

In this research, a range of indicators were used to identify enhanced adaptive capacity, as understood in the framework in Section 2.7, within the farming communities which participated with the Trax and CODE-WA Projects. These indicators broadly fell into two categories: those which were features of social capital, such as collaborative governance and collective learning, and those which were physical and technological capital, such as experimentation and innovation. Presence of these

indicators also demonstrated the ways in which project outcomes had been impacted by enhanced adaptive capacity.

Features of social capital which served as indicators of enhanced adaptive capacity were evident in both case studies, and more prevalent in the evidence than features of physical and technological capital (Section 6.2). The size and diversity of social networks, collaborative governance, and collective learning activated feedback loops enhancing adaptive capacity through increased empowerment, agency and autonomy of farming communities. The positive feedback loops further strengthened social capital and enhanced adaptive capacity, resulting in autochthonous action and development.

Increased diversification of farming practices, crop varieties, and livelihood sources functioned as indicators of enhanced adaptive capacity. The Trax and CODE-WA Projects both relied on diversification as a means to enhance adaptive capacity within the participating farming communities. Diversification was anticipated to be increased through experimentation and innovation among farmers. Those three characteristics of physical and technological capital all functioned as indicators of enhanced adaptive capacity (Section 6.2.5).

Although both case studies focused on the physical features of enhanced adaptive capacity, evidence suggests that social capital had a greater impact on adaptive capacity and project outcomes (Section 6.3). Analysis suggests that adaptive capacity of farming communities was enhanced by both the Trax and CODE-WA Projects, although often this was due to unexpected and/or indirect impacts of the project activities. In the case of Trax, the communities, which had engaged with the project activities up to 20 years ago, demonstrated evidence of sustained adaptive capacity and increased sustainability of their agricultural livelihoods resulting from the project. Although the CODE-WA Project ended more recently, there was evidence that the participating farmers continue to have enhanced adaptive capacity compared to before the project. Enhanced adaptive capacity had a positive impact on project outcomes, despite the intended increase in diversity of crop varieties being unsuccessful in enhancing adaptive capacity.

### 8.2.3 Implications for Sustainable Agricultural Livelihoods in Development Interventions

In the context of agricultural livelihoods in Northern Ghana, the indicators of enhanced adaptive capacity discussed above also indicated increased sustainability, as understood in this research. Indicators of enhanced adaptive capacity were evident among farming communities which had ceased participation in the respective project some years previously. In addition, in these communities farmers referred to features of collaborative governance and empowerment when describing the sustainability of their agricultural livelihoods. There was evidence of collaborative governance and empowerment being sustained in both projects (Section 7.2), and these features of enhanced adaptive capacity acted as indicators for sustainability. Features of physical and technological capital also functioned as indicators of sustainability in conjunction with social capital indicators. However, this study was limited in scope and thus it was not possible to capture the potential impacts of multiple or severe shocks to compromise sustainability despite enhanced adaptive capacity (Section 7.2.3).

Farmers associated with the Trax and CODE-WA Projects reported that the interventions had positive impacts on the sustainability of their agricultural livelihoods, although this did not preclude negative impacts to occur as well. The sustainability identified in the associated farming communities was responsive to changing social, economic, political, and environmental conditions due to the influence of the enhanced adaptive capacity (Section 7.3). The participatory nature of the two projects had important impacts on features of social capital for enhancing adaptive capacity, in turn influencing the adaptive nature of increased sustainability.

The concept of complex adaptive systems provided a useful analytical tool for identifying non-linear and diverse outcomes resulting from enhanced adaptive capacity within the two projects. Furthermore, Section 7.5 identified features of complex adaptive systems in framings of sustainable agricultural livelihoods. Thus, diverse, non-linear, and emergent characteristics of complex adaptive systems may provide a useful approach when planning and implementing future agricultural development interventions which aim to enhance adaptive capacity and increase sustainability. There is scope for these characteristics of complex adaptive systems to be built into a framework to inform the policy, planning and evaluation of such interventions.



The preceding three sections have summarised the key findings associated with the Trax and CODE-WA Projects. These findings are pertinent beyond only these two case studies and there are wider lessons which can be taken from this discussion. Firstly, there are many diverse ways in which the concept of adaptive capacity can be understood (Sections 5.4 and 5.8). This may incorporate features which are social, physical, or technological in nature. Adaptive capacity may be framed in relation to adaptation, resilience, and/or sustainability. Although the findings here relate the multiple identified understandings to agricultural development interventions, this is relevant more widely as efforts to enhance adaptive capacity are taken up in a range of sectors and interventions.

Secondly, there are a range of indicators of enhanced adaptive capacity. Although different stakeholders within single interventions may use different terminology to describe the same indicator (Section 6.4), the identified indicators are features of social capital and physical and technological capital. These indicators may be effective for identifying enhanced adaptive capacity in other contexts and beyond agricultural development interventions.

Thirdly, evidence of adaptive capacity resulting in beneficial outcomes for farming communities has been discussed. This has positive consequences for the sustainability of agricultural livelihoods. In a wider context, the processes associated with outcomes and sustainability resulting from enhanced adaptive capacity may also be relevant in other contexts. Although this study focused on agricultural livelihoods, adaptive capacity may be increasing sustainability in other ways. These wider lessons from the findings outlined above will be discussed further in Sections 8.4, 8.6, and 8.7 in relation to the contributions this research has made.

### 8.3 Reviewing Research Hypotheses and the Framework of Adaptive Capacity

Data analysis and discussion in the three preceding chapters referred to the framework of adaptive capacity outlined in Section 2.7. This framework drew on relevant literature to identify possible characteristics of adaptive capacity to be tested through examination of the case studies. From the framework of adaptive capacity, the research questions and hypotheses to be tested through this study were outlined (Section

2.8). This section will reflect on the framework of adaptive capacity and propose a revised framework derived from the data analysis.

### 8.3.1 Review of Research Hypotheses

Four hypotheses were tested through this research. Contextual assumptions which formed the basis of the research questions and the framework of adaptive capacity were outlined in Section 2.7.1. The assumption that farming communities in Northern Ghana were heterogeneous was appropriate and the diversity of responses to, and outcomes from, the Trax and CODE-WA Projects reflects this. In addition, the importance of social capital for enhancing adaptive capacity and increasing sustainability has been established. Thus, those assumptions which informed the hypotheses were suitable for this research. However, it is possible that these underlying assumptions have influenced the research process and findings to some degree.

Each of the four hypotheses outlined in Section 2.8.1 will now be considered in relation to the research findings.

Hypothesis 1: There are multiple understandings of ‘adaptive capacity’ being applied within and among different agricultural development interventions.

There were informal and two formal understandings of adaptive capacity held by different actors in both of the Trax and CODE-WA Projects. As such, there were multiple and diverse understandings of adaptive capacity in and among agricultural development interventions. In both of the interventions, there was not one associated individual or institution which recognised all the understandings of adaptive capacity or actual outcomes identified in Tables 6.1 and 6.2. Consequently, the stakeholders at different levels and roles in the interventions were working towards different variations of the objective to enhance adaptive capacity and increase the sustainability of agricultural livelihoods. Therefore, hypothesis 1 has been demonstrated to have been correct in those particular contexts.

Hypothesis 2: The influences on how ‘adaptive capacity’ is understood within agricultural development interventions are multiple, vary between interventions, and are variable in time and space.

International development objectives, political economy of funding and governance institutions, and local social and cultural traditions were found to have influenced the understandings of adaptive capacity within both case studies. Formal understandings of

adaptive capacity in the Trax and CODE-WA Projects have evolved over time and changed according to external influences. International institutions had different understandings to the local project facilitators and farming communities, resulting in spatial diversity of understandings. Those diverse understandings reflected differing approaches to enhancing adaptive capacity and increasing sustainability of agricultural livelihoods, and also reflected differences in the scope of the respective institutions which held the understandings. Therefore, the findings concur with this hypothesis; there were multiple influences on understandings of adaptive capacity which varied in time and space.

However, although the specific influences were different between the two case studies, the general influences and priorities of international development agencies, the political economy of funding institutions, and socio-cultural traditions were similarly evident in both. Thus, hypothesis 2 was partly correct, but there was insufficient evidence to support all of the components of this hypothesis. In order fully to assess whether the influences on understandings of adaptive capacity vary between interventions, it would have been necessary to study a greater number of interventions. This will be discussed further in Section 8.8.

Hypothesis 3: The way adaptive capacity is understood within an agricultural development intervention influences the nature of formal intervention activities and the potential for impact on associated sustainable agricultural livelihoods. Both the Trax and CODE-WA Projects had formal understandings of adaptive capacity which incorporated the need to diversify crop varieties and/or livelihood sources. The physical and technological capacity, which these formal understandings included, were manifested in the projects' activities. Using introduced crop varieties, farming practices, and livelihood sources, the projects sought to enhance adaptive capacity through diversification, requiring features of experimentation and innovation. This indicated that the formal understanding of adaptive capacity within both projects contributed to determining the project activities. This analysis confirms hypothesis 3.

Examination of evidence in Chapter 6 highlighted that formal understandings of adaptive capacity, which incorporated physical and technological capital were not the only influence on the project activities, or on the potential for enhancing adaptive capacity as project outcomes. Due to complexities of multiple formal and informal understandings of adaptive capacity in both case studies, and the social and cultural

dynamics at the local levels, the impact of project activities on sustainable agricultural livelihoods were in some cases non-linear and unexpected. Outcomes of adaptive sustainability resulted due to feedbacks and emergent behaviours among the farming communities. Therefore, the way in which adaptive capacity was understood was not the only, or even the dominant, factor influencing project outcomes of enhanced adaptive capacity and sustainable agricultural livelihoods. As such, hypothesis 3 was only partly correct and the findings of this research provide a more nuanced understanding of the ways in which understandings of adaptive capacity can inform and interact with project activities and project outcomes.

Hypothesis 4: If agricultural development interventions focus on enhancing features of social capital there are opportunities for outcomes of adaptive capacity to support the sustainability of agricultural livelihoods.

The evidence examined in Section 6.2 demonstrated that features of social capital were suitable indicators of enhanced adaptive capacity. These indicators were then used to identify ways in which enhanced adaptive capacity had impacted on project outcomes. Although features of physical and technological capital, including diversification, experimentation and innovation, were also found to contribute to enhanced adaptive capacity, social capital was dominant. Diverse types of interactions, collaborative governance, and collective learning all had positive impacts on project outcomes in the projects. Empowerment, agency, and autonomy also had important roles in enhancing adaptive capacity and triggering feedbacks which supported beneficial project outcomes.

In addition, the features of social capital, which acted as indicators of enhanced adaptive capacity, were also found to impact on project outcomes for sustainable agricultural livelihoods. The role of participatory activities in both projects initiated processes of collaboration and collective action which contributed to adaptive sustainability. This analysis confirms hypothesis 4 and has important implications for similar ongoing and future agricultural development interventions, which will be discussed further in Section 8.7.

### 8.3.2 Revised Framework of Adaptive Capacity

This research drew on two underlying assumptions that, firstly, in some regions, agricultural livelihoods are currently unsustainable, and secondly, that becoming more

sustainable would be beneficial to farmers and could have positive global impacts. The framework of adaptive capacity proposed in Section 2.7 conceptualises smallholder agricultural systems within the concept of complex adaptive systems. Dynamic and non-linear pathways to sustainability incorporate enduring flexibility and adaptability. As such, the framework considered that adaptive capacity, and any resulting adaptations, could contribute towards the sustainability of smallholder agricultural livelihoods. Discussion of pertinent theoretical literature in Chapter 2 suggests that adaptive capacity contributes towards sustainability in combination with other characteristics such as resilience, stability, transformation or transition, and mitigation actions. While acknowledging that there were other characteristics of a system which can increase sustainability, this research focused only on adaptive capacity in order to thoroughly examine the dynamics of this concept within two case studies.

Discussion of the implications of the Trax and CODE-WA Project outcomes for sustainable agricultural livelihoods (Section 7.3) suggests that enhanced adaptive capacity contributed to social, economic, and environmental sustainability of the participating farming communities. This concurs with the framework of adaptive capacity proposed in this research and confirms the assumptions which informed the research questions.

Building on discourse from theory and practice, a range of components and characteristics which may contribute to enhanced adaptive capacity were summarised in the framework in Figure 2.3. In testing the hypotheses reviewed above, this research examined whether the components of social capital and physical and technological capital acted as suitable indicators of enhanced adaptive capacity as proposed in the framework for this research. The framework proposed in Section 2.7 identified social networks, a diversity of types of interactions, collaborative governance, collective learning and anticipation as features of social capital which are potential indicators of enhanced adaptive capacity. In addition, the framework envisaged that experimentation, innovation, and a diversity of agricultural livelihoods were potentially indicators of enhanced adaptive capacity which require physical and technological capital.

Section 6.4 provided a summary of the indicators of enhanced adaptive capacity which were identified and how these impacted on the project outcomes. Each of the indicators of adaptive capacity, which were proposed in the framework, were identified among the farming communities which participated with the projects. However,

additional indicators were identified which had not been proposed in the framework of adaptive capacity being tested in this research. In both case studies, the role of empowerment, agency and autonomy had important impacts on beneficial outcomes from the project activities and the sustainability of those benefits. As such, it is appropriate to revise the framework of adaptive capacity to incorporate these additional features of social capital which have been found to contribute to enhanced adaptive capacity (Figure 8.1).

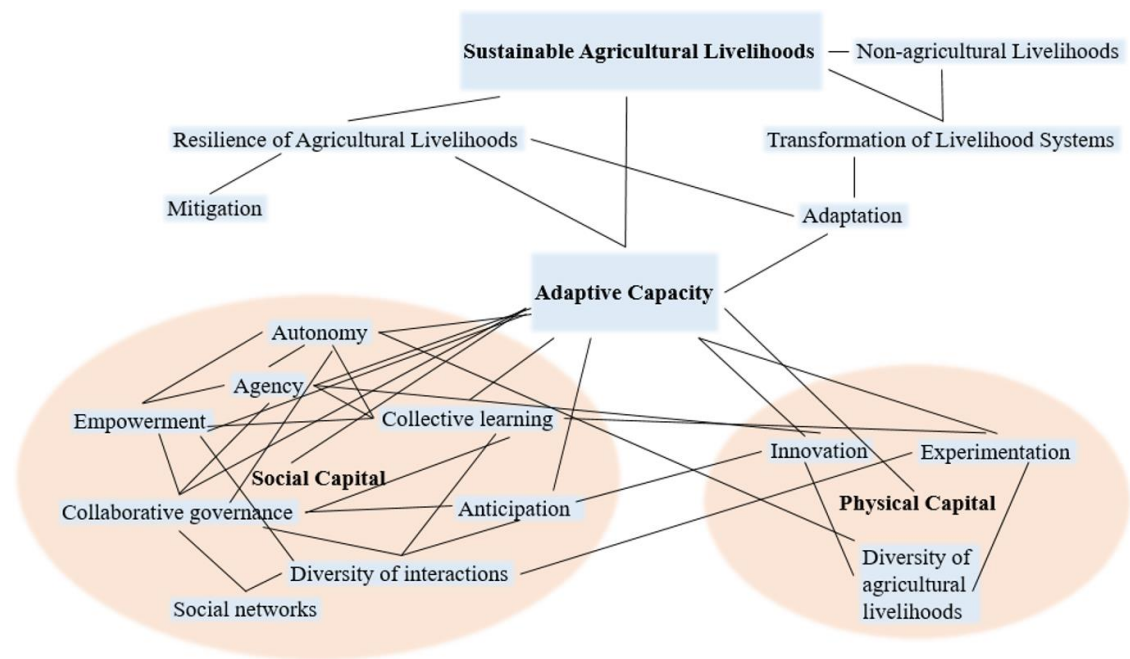


Figure 8.1. Revised framework of adaptive capacity incorporating the indicators which emerged through this research.

In light of this review of the research hypotheses and the framework of adaptive capacity, and the insights obtained through the research findings, the following sections consider the contributions this research has for theory, methodology, policy and practice, and its implications for ongoing and future agricultural development interventions and further research.

#### 8.4 Contributions to Theory

By examining the different understandings of adaptive capacity within the two agricultural development interventions, this research identified two distinct approaches

to the what, why and how of enhancing adaptive capacity (what ‘adaptive capacity’ is or means; why it is desirable; how it can be enhanced). Formal understandings were informed by top-down political-economic processes and framed the agricultural system in terms of production for economic sustainability. This framing assumed a need for environmental sustainability to allow continued or enhanced production, so understandings of adaptive capacity responded to perceived risks of environmental changes. The informal understandings of farming communities and field staff were informed by socio-cultural tradition and dynamics and frame agriculture in terms of social and cultural sustainability. In the context of the informal understandings, the social and cultural interactions were intrinsically tied to the local environment and, therefore, the sustainability of certain environmental characteristics was embedded within this.

There was widespread acknowledgement among development practitioners and sustainability theorists that there are numerous understandings of the term ‘sustainability’ and it is used in many specific and generic ways. There has also been discussion of multiple understandings of the term ‘resilience’ and how this relates to both sustainability and adaptation or adaptive capacity. To date, there has not been a thorough examination of the diverse understandings of adaptive capacity despite the frequency of use in development literature. This research contributed an investigation of how the term ‘adaptive capacity’ is understood within development practices. There were multiple, diverse understandings of ‘adaptive capacity’ being adopted at the same time within single interventions. Different stakeholders within agricultural development interventions simultaneously used multiple, diverse understandings of what ‘adaptive capacity’ means, why it is a desirable trait, and how it could be enhanced.

The findings of this research also contribute to theoretical discussion about indicators of adaptive capacity and how these relate to sustainability and agricultural livelihoods in a developing country context. The prominence of features of social capital within the findings builds on previous work on the subjects of adaptive management (e.g. Foxon et al, 2009) and collaborative governance (e.g. Borrini-Feyerabend et al, 2007). The additional indicators of enhanced adaptive capacity identified in this research contribute to this discourse by highlighting the role of social characteristics in systems, such as empowerment and autonomy, and demonstrating the ways in which this supports sustainable agricultural livelihoods. This contributes to

discourse surrounding adaptive capacity by explaining additional processes through which adaptive capacity, and subsequently sustainability, may be enhanced.

### 8.5 Contributions to Methodological Discourse

This research used ethnography, interviews, and evaluation as the primary methods for data collection. The evaluative component of the data analysis drew on the collaborative process of developmental evaluation (Patton, 2011), although not fully implementing the reflexive and adaptive processes due to time constraints (Section 4.3). Patton (2011) suggested that, using a framing of complex adaptive systems, developmental evaluation can help to identify and incorporate complex interactions and capitalise on unexpected outcomes. This research contributes further to this methodological approach through the use of characteristics of complex adaptive systems as an analytical tool. The research found complex adaptive systems traits including non-linearity, diversity, dynamics, emergent behaviour, and feedbacks. The incorporation of non-linearity, feedbacks, and emergent behaviour into the methodological approach for policy and programme evaluation may be particularly useful. However, this would require a longitudinal study of the evolution of policies and programmes which was not possible in this study.

The ethnographic approach to data collection, reflection, and analysis was supported by the realist constructivist epistemology discussed in Section 4.1. This benefitted the understanding of the types of interactions in the farming communities and how they engaged with the Trax and CODE-WA Projects and their broader social networks. These data would not have been so clearly evidenced had other research methods been used. As such, the research findings support the use of ethnography as a methodological approach to data collection when seeking to examine the processes of how understandings of terminology evolve and are co-constructed.

In addition, the use of visual ethnography and the participatory involvement of the farming communities and project field staff in data collection was beneficial (see Section 4.4.2). Those methods provided insights into the ways understandings were co-constructed among the farming communities and helped build rapport amongst those participating in the study and facilitated co-construction of research data. Although



these methods did not contribute the most significant data from which the findings emerged, they provided useful contextual and background information.

## 8.6 Contributions for Policy

The research findings may contribute to policy debates relating to agricultural development interventions, adaptive capacity and adaptation, and sustainability by providing evidence of suitable indicators and effective approaches to policy implementation. This study corroborates an approach to policy which focuses only on adaptive capacity as a way to achieve sustainability objectives, but contradicts approaches which focus on physical and technological attributes as the means to enhance adaptive capacity. Therefore, the key findings are useful for consideration in future iterations of relevant governance and policy interventions.

The need to recognise that there is not one common understanding of adaptive capacity contributes to policy discourse at national and international levels. For example, the UNFCCC does not acknowledge that there are different understandings of adaptive capacity. The findings of this study suggest that policies acknowledge that there may be a diversity of understandings at any one time and then explicitly state the understanding of adaptive capacity adopted within the specific policy in question. This suggestion relates to policies which are associated with adaptation and adaptive capacity at any level, from interventions, to governmental policy, to international bodies such as the United Nations. Thus, this research contributes to policy discourse at an international level.

This research sought to test the utility of other indicators of enhanced adaptive capacity, as proposed in the framework in Section 2.7. For investigation of research question two, Chapter 6 examined the evidence of the indicators both projects identified for monitoring project activities as well as testing the potential indicators proposed in the framework of adaptive capacity. As discussed above, this framework of adaptive capacity has been revised to incorporate the additional indicators of enhanced adaptive capacity which emerged in this research.

The identified indicators of enhanced adaptive capacity could contribute to the policies of other similar ongoing and future interventions (see Section 8.7) in Ghana

because the cultural context is comparable. Recognition of the dominance of social capital indicators contributes to policy and planning at a local and governmental level. For example, governmental policy concerning agricultural development (see Section 3.2) focuses on physical and technological capital through infrastructure and improved inputs. The findings of this research could contribute to future iterations of these national policies by shifting the dominant focus to social capital which has been found to have a greater beneficial impact on farming communities.

The indicators of enhanced adaptive capacity and recognition of outcomes for sustainable agricultural livelihoods examined in Chapter 6 could also contribute to the policies of ongoing and future interventions with similar objectives beyond Ghana. However, it is important to note that the cultural and socio-economic context has a bearing on the indicators of adaptive capacity identified, particularly because they are mostly social in nature. Additionally, in other contexts it is possible that different terminology or conceptualisations of indicators may be used so the indicators outlined in this research may not be directly applicable.

## 8.7 Contributions for Practice

There were intended and unexpected, direct and indirect outcomes of enhanced adaptive capacity within the two agricultural development interventions. The interventions did not recognise the full extent of enhanced adaptive capacity resulting from their activities because they were not looking for the full range of potential impacts. Unexpected and indirect outcomes of projects, programmes, or activities have previously been acknowledged within the field of monitoring and evaluation. However, this research contributes to that knowledge by identifying that different stakeholders within the projects held diverse understandings of what the intervention is trying to do and why, in this case enhance adaptive capacity. Thus, different stakeholders had differing understandings of what were intended and unexpected project outcomes. Had the interventions more fully incorporated the role of features of social capital in their formal understandings of adaptive capacity, the beneficial impacts which these social attributes had on the farming communities may have been anticipated.

The contribution of participatory development interventions to enhancing social capital and increasing empowerment, agency, and autonomy is not a new concept. This

background to participation in agricultural development interventions implies that participation can, and should, be used in a social, collective context, to contribute to strengthening social capital. The demonstration that adaptive capacity can be enhanced by focusing on features of social capital through the use of participatory project activities could contribute to the planning and implementation of ongoing and future interventions with similar objectives. The significant role of empowerment, agency and autonomy in enhancing adaptive capacity among farming communities is a new finding and an important contribution to practitioners implementing initiatives which seek to enhance adaptive capacity within a social-ecological system. This finding may contribute to similar ongoing and future agricultural development interventions through the incorporation of enhanced empowerment, agency and autonomy within the project objectives.

#### 8.7.1 Recommendations for Agricultural Development Interventions

This research has been timely as initiatives and development interventions which seek to enhance adaptive capacity to meet the objective of increased sustainability of agricultural livelihoods continues to increase worldwide. As such, it is appropriate for ongoing and future interventions, which have similar objectives, to incorporate recommendations based on the findings of this research.

Interventions which seek to enhance adaptive capacity are advised to recognise that there may be multiple understandings of adaptive capacity held by different stakeholders in the project. While diverse understandings within single interventions may have the potential to increase options for beneficial outcomes, it could also cause a lack of clarity regarding what the intervention is seeking to achieve. By explicitly stating the formal understanding of adaptive capacity from the outset may help to avoid different stakeholders working towards differing outcomes. However, incorporating diverse understandings into a common understanding for application in the intervention could benefit outcomes. The co-creation of interventions and project activities in a constructivist manner may help to overcome this. In addition, the co-creation of interventions may move projects away from assumptions that project activities will only have the anticipated direct outcomes produced by simple cause-and-effect relationships. The findings have demonstrated that there have been diverse intended and unexpected outcomes from project activities, resulting from complex interactions and limited scope of formal understandings. It is recommended that interventions are co-constructed by all

stakeholders and incorporate reflexive elements of developmental evaluation throughout the project.

Importantly, interventions are recommended to incorporate the role of social capital in their understanding of adaptive capacity and thus focus on social features through participatory project activities. The empowerment, agency and autonomy identified within farming communities engaged with the Trax and CODE-WA Projects triggered positive feedbacks that resulted in the beneficial outcomes being sustained over time. Furthermore, the features of social capital contributed to enhancing features of physical and technological capital. This implies that focusing on building features of social capital is particularly beneficial for enhancing adaptive capacity and may be more cost effective within interventions by supporting longer-term sustainability of project outcomes than those which focus solely on physical and technological capital.

## 8.8 Recommendations for Further Research

The scope of this study was limited by time and resources. Just two case studies of agricultural development interventions in Northern Ghana were used. Those case studies were examined and evaluated retrospectively and relied on reporting from the different stakeholders involved. In order fully to assess the role of the multiple, diverse understandings of adaptive capacity within the case studies, it would have been beneficial to have studied the evolution of those understandings throughout the course of the interventions. Further research which incorporates a longitudinal examination of interactions among diverse understandings of adaptive capacity would benefit the theoretical, policy and practice discourses.

This research focused on farming communities in the semi-arid region of Northern Ghana. However, interventions to enhance adaptive capacity and increase sustainability occur in numerous, highly diverse contexts, and concentrate on topics beyond agricultural livelihoods. Further research testing the indicators of adaptive capacity in other types of contexts is recommended. It is possible that not all of the indicators identified through this research would be evident in other contexts, and equally possible that other indicators could emerge. Research which tests the applicability of these indicators in contexts including urban areas, environments which

are not dryland, different cultural contexts, developed countries, and in sectors beyond agriculture would contribute significantly to the discourse, policy and practice.

### 8.9 Concluding Remarks

This research set out to examine the understandings of adaptive capacity within two agricultural development interventions, identify suitable indicators of enhanced adaptive capacity, and assess the ways in which enhanced adaptive capacity contributes towards overarching objectives of sustainable agricultural livelihoods. Diverse formal and informal understandings of adaptive capacity were identified within the Trax and CODE-WA Projects. Those understandings were influenced by international development priorities and discourse, political economy of funding institutions, and social and cultural traditions of the associated farming communities.

Social capital has been found to provide a vital contribution to enhancing adaptive capacity, despite interventions focusing on features of physical and technological capital. The importance of collaborative action, empowerment, and agency in enhancing adaptive capacity and increasing the sustainability of agricultural livelihoods is captured in the remarks of a farmer which engaged with the Trax project: *“If we can’t solve our problems on our own now we can work together. If we come together we can solve our problems and we can grow, our farms can do better”* (IVT7, 23/7/14). The findings of this research contribute evidence to the farmers’ socio-cultural approach to their agricultural livelihoods.

## References

- Aalangdong, O.I., Poreku, G., Abdul-Razaq, U., and Anchiihe, A.A. (2010) Community Involvement in wildlife Conservation in Northern Ghana, In: Nanang, D.M., and Nunifu, T.K. (Eds) (2010) *Natural Resources in Ghana: Management, Policy and Economics*, Nova Science Publishers, Inc., New York, pp165-182
- ACCRA (2012) *Consultation Document: The Accra Local Adaptive Capacity Framework (LAC)*, Africa Climate Change Resilience Alliance, London, pp15
- Adams, W.M. (2009) *Green Development, 3<sup>rd</sup> Edition: Environment and sustainability in a Developing World*, Routledge, Abingdon, pp449
- Addo, H., Amin, S., Aseniero, G., Gunder Frank, A., Friberg, M., Fröbel, F., Heinrichs, J., Hettne, B., Kreye, O., and Seki, H. (1985) *Development As Social Transformation: Reflections on the Global Problematique*, The United Nations University, Tokyo, pp 281
- Adger, W.N., Agrawala, S., and Mirza, M.M.Q. (2007) Assessment of adaptation practices, options, constraints and capacity, In: Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J., and Hanson, C.E. (Eds) (2007) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK, pp717-743
- Adger, W.N., Paavola, J., and Huq, S. (2006) Toward Justice in Adaptation to Climate Change, In: Adger, W.N., Paavola, J., Huq, S., and Mace, M.J. (Eds) (2006) *Fairness in Adaptation to Climate Change*, Massachusetts Institute of Technology Press, Cambridge, MA, pp1-19
- Agrawal, A., and Gibson, C.C. (1999) Enchantment and Disenchantment: The Role of Community in Natural Resource Conservation, *World Development*, 27(4), 629-649

Akpo, E., Crane, T.A., Vissoh, P.V., and Tossou, R.C. (2015) Co-production of Knowledge in Multi- stakeholder Processes : Analyzing Joint Experimentation as Social Learning, *Journal of Agricultural Education and Extension*, 21(4), 369-388

Allen, P. (1993) Connecting the Social and the Ecological in Sustainable Agriculture, In: Allen, P. (Ed) (1993) *Food for the Future: Conditions and Contradictions of Sustainability*, John Wiley & Sons, Inc, New York, pp1-16

Alston, J.M., Dehmer, S., and Pardey, P.G. (2006) International Initiatives in Agricultural R&D: The Changing Fortunes of the CGIAR, In: Pardey, P.G., Alston, J.M., and Piggott, R.R. (Eds) (2006) *Agricultural R&D in the Developing World: Too Little, Too Late?* International Food Policy Research Institute, Washington D.C., pp313-360

Alston, J.M., and Pardey, P.G. (2006) Developing-Country Perspectives on Agricultural R&D: New Pressures for Self-Reliance, In: Pardey, P.G., Alston, J.M., and Piggott, R.R. (Eds) (2006) *Agricultural R&D in the Developing World: Too Little, Too Late?* International Food Policy Research Institute, Washington D.C., pp11-28

Altieri, M.A. (2002a) Agro-ecological Principles for Sustainable Agriculture, In: Uphoff, N. (Ed) (2002) *Agro-ecological Innovations: Increasing Food Production with Participatory Development*, Earthscan, London, pp40-46

Altieri, M.A. (2002b) Agro-ecology: the science of natural resource management for poor farmers in marginal environments, *Agriculture, Ecosystems & Environment*, 93(1-3), 1-24

Angrosino, M.V., and Mays de Pérez, K.A. (2003) Rethinking Observation: From Method to Context, In: Denzin, N.K., and Lincoln, Y.S. (Eds) (2003) *Collecting and Interpreting Qualitative Materials, Second Edition*, Sage Publications, Inc, London, pp107-154

Antwi-Agyei, P. (2012) *Vulnerability and adaptation of Ghana's food production systems and rural livelihoods to climate variability*, PhD Thesis, University of Leeds [online] <http://etheses.whiterose.ac.uk/5044/> [Accessed on 26-11-2015]

Arnstein, S.R. (1969) A Ladder of Citizen Participation, *Journal of the American Institute of Planners*, 35(4), 216-224

Arora, S. (2012) Farmers' Participation in Knowledge Circulation and the Promotion of Agro-ecological Methods in South India, *Journal of Sustainable Agriculture*, 36(2), 207-235

Ashby, J.A. (2009) Fostering Farmer First methodological innovation: organizational learning and change in international agricultural research, In; Scoones, I., and Thompson, J. (Eds) (2009) *Farmer First Revisited: Innovation for Agricultural Research and Development*, Practical Action Publishing Ltd, Rugby, pp39-45

Ashley, C. (2000) Applying Livelihood Approaches to natural Resource Management Initiative: Experiences in Namibia and Kenya, *ODI Working Paper*, 134, Overseas Development Institute, London, pp30

Asmah, A.E., Frimpong, C., and Okpattah, V. (2013) Sirigu Symbols: Traditional Communicative Images for Fashion Designedprints, *International Journal of Innovative Research and Development*, 2(8), 193-202

ASTI (Agricultural Science and Technology Indicators) (undated) *Ghana: Snapshot data* [online] <http://www.asti.cgiar.org/data/?snapshotgeo1=GHA> [Accessed on 6-2-14]

ATPS (2010) The African Manifesto for Science, Technology and Innovation, African Technology Policy Studies Network, Nairobi, pp44

Awedoba, A.K. (2006) *The Peoples of Northern Ghana*, National Commission on Culture, Accra, pp11 [online] [http://www.ghanaculture.gov.gh/modules/mod\\_pdf.php?sectionid=593](http://www.ghanaculture.gov.gh/modules/mod_pdf.php?sectionid=593) [Accessed on 24-2-2014]



Baird, J., Plummer, R., Haug, C., and Huitema, D. (2014) Learning effects of interactive decision-making processes for climate change adaptation, *Global Environmental Change*, 27(1), 51-63

Bakker, H. (2011) *Food Security in Africa and Asia: Strategies for Small-scale Agricultural Development*, CAB International, Wallingford, Oxfordshire, pp236

Béné, C., Godfrey Wood, R., Newsham, A., and Davies, M. (2012) Resilience: New Utopia or New Tyranny? Reflection about the Potentials and Limits of the Concept of Resilience in Relation to Vulnerability Reduction Programmes, *IDS Working Paper 405, CSP Working Paper 006*, Institute of Development Studies, Brighton, pp12

Berg, B.L., and Lune, H. (2014) *Qualitative Research Methods for the Social Sciences: Eighth Edition*, Pearson Education Limited, Harlow, pp416

Berkes, F., Colding, J., and Folke, C. (2003) Introduction, In: Berkes, F., Colding, J., and Folke, C. (Eds) (2003) *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*, Cambridge University Press, Cambridge, pp1-29

Bogdanski, A. (2012) Integrated food–energy systems for climate-smart agriculture, *Agriculture and Food Security*, 1(9), pp10

Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R., and Yanda, P. (2007) Africa, In: Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J., and Hanson, C.E. (Eds) (2007) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK, pp433-467

Borrini-Feyerabend, G., Pimbert, M., Farvar, M.T., Kothari, A., and Renard, Y. (2007) *Sharing Power: A Global Guide to Collaborative Management of Natural Resources*, Earthscan, London, pp473

Boyd, E., Cornforth, R.J., Lamb, P.J., Tarhule, A., Lélé, M.I. and Brouder, A. (2013) Building resilience to face recurring environmental crisis in African Sahel, *Nature Climate Change*, 3, 631-637

Brooks, N. (2003) Vulnerability, Risk and Adaptation: A Conceptual Framework, *Tyndall Centre Working Paper 38*, Tyndall Centre for Climate Change Research, University of East Anglia, Norwich, pp19

Brooks, N., and Adger, W.N. with contributions from Barnett, J., Woodward, A., and Lim, B. (2004) Assessing and Enhancing Adaptive Capacity, In: Lim, B., and Spanger-Siegfried, E. (Eds) (2004) *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*, Cambridge University Press, Cambridge, pp165-182

Brooks, S., and Loevinsohn, M. (2011) Shaping agricultural innovation systems responsive to food insecurity and climate change, *Natural Resources Forum*, 35(3), 185-200

Burayidi, M.A. (1996) Maximising Irrigation's Contribution to Sustainable Development in Africa: Lessons from the Tono Irrigation Scheme in Ghana, In: James, V.U. (Ed) (1996) *Sustainable Development in Third World Countries: Applied and Theoretical Perspectives*, Praeger Publishers, Westport, CT, pp44-61

Burns, D., and Worsley, S. (2016) *Navigating Complexity in International Development: Facilitating sustainable change at scale*, Practical Action Publishing, Rugby, pp180

CARE (2010) *Adaptation Learning Programme for Africa*, CARE International [online] <http://www.care.org/sites/default/files/documents/CC-ALP.pdf> [Accessed on 25-7-2016]

Carpenter, S., Walker, B., Anderies, J.M., and Abel, N. (2001) From Metaphor to Measurement: Resilience of What to What? *Ecosystems*, 4(8), 765-781

Casson, M.C., Della Giusta, M., and Kambhampati, U.S. (2010) Formal and Informal Institutions and Development, *World Development*, 38(2), 137-141

CCAFS and FAO (2014) *Knowledge on Climate-Smart Agriculture: Questions and Answers*, CGIAR Research Programme on Climate Change, Agriculture and Food Security and Food and Agriculture Organization of the United Nations, Rome, pp2

CDKN (2012) *Africa Climate Change Resilience Alliance (ACCRA): Helping policy-makers understand rural adaptation*, Climate & Development Knowledge Network, London, pp2

CGIAR (2011) *Achieving food security in the face of climate change: Summary for policy makers from the Commission on Sustainable Agriculture and Climate Change* [online]

[http://cgspace.cgiar.org/bitstream/handle/10568/10701/Climate\\_food\\_commission-SPM-Nov2011.pdf?sequence=6](http://cgspace.cgiar.org/bitstream/handle/10568/10701/Climate_food_commission-SPM-Nov2011.pdf?sequence=6) [Accessed on 12-10-12]

CGIAR (undated a) *CGIAR Research Programmes* [online] <http://www.cgiar.org/our-research/cgiar-research-programs/> [Accessed on 30-6-2014]

CGIAR (undated b) *Ongoing Research, The CGIAR Research Map: Ghana* [online] <http://ongoing-research.cgiar.org/countries/country-ghana/> [Accessed on 30-6-2014]

CGIAR (undated c) *Ongoing Research: The CGIAR Research Map* [online] <http://ongoing-research.cgiar.org/factsheets/community-management-of-crop-diversity-to-enhance-resilience-yield-stability-and-income-generation-in-changing-west-african-climates-1/> [Accessed on 14-2-13]

Chambers, E., (2003) Applied Ethnography, In: Denzin, N.K., and Lincoln, Y.S. (Eds) (2003) *Collecting and Interpreting Qualitative Materials, Second Edition*, Sage Publications, Inc, London, pp389-418

Chambers, R. (1983) *Rural Development: Putting the Last First*, Pearson Education Limited, Harlow, pp246

- Chambers, R., and Conway, G.R. (1992) Sustainable rural livelihoods: practical concepts for the 21<sup>st</sup> century, *IDS Discussion Paper*, 296, Institute of Development Studies, Brighton [online]  
<http://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/775/Dp296.pdf?sequence=1> [Accessed on 25-6-13]
- Chambers, R., Pacey, A., and Thrupp, L.A. (Eds) (1989) *Farmer First: Farmer innovation and agricultural research*, Intermediate Technology Publications, London, pp219
- Chandler, D., and Reid, J. (2016) *The Neoliberal Subject: Resilience, Adaptation and Vulnerability*, Rowman & Littlefield International, Ltd., London, pp224
- Chapman, K. (2016) *Complexity and Creative Capacity: Rethinking knowledge transfer, adaptive management and wicked environmental problems*, Routledge, Abingdon, pp244
- Charmaz, K. (2003) Grounded Theory: Objectivist and Constructivist Methods, In: Denzin, N.K., and Lincoln, Y.S. (Eds) (2003) *Strategies of Qualitative Inquiry, Second Edition*, Sage Publications, Inc, London, pp249-291
- Chatty, D., and Colchester, M. (2002) Introduction: Conservation and Mobile Indigenous Peoples, In: Chatty, D., and Colchester, M. (Eds) (2002) *Conservation and Mobile Indigenous Peoples: Displacement, Forced Settlement, and Sustainable Development*, Berghahn Books, Oxford, pp1-20
- Christiaensen, L., and Demery, L. (2007) *Down to Earth: Agriculture and Poverty reduction in Africa*, The World Bank, Washington, D.C., pp122
- CIARD (2011) *The Ghana Agricultural Information Network System (GAINS)* [online]  
<http://www.ciard.net/partners-checklist/ghana-agricultural-information-network-systems-gains> [Accessed on 6-12-12]

CIARD (2012) *Case Study: The Ghana Agricultural Information Network System (GAINS)* [online] <http://www.ciard.net/sites/default/files/RAF%20%28Ghana%29.pdf> [Accessed on 6-12-12]

Cilliers, P. (1998) *Complexity and Postmodernism: Understanding Complex Systems*, Routledge, Abingdon, pp168

CODE-WA (2012) *CODE-WA: Executive Summary of Results and Recommendations*, unpublished internal report

CODE-WA (undated a) *Organisation* [online] <http://codewa-icrisat.uni-hohenheim.de/Website/Organisation.html> [Accessed on 12-11-13]

CODE-WA (undated b) *Welcome to the CODE-WA homepage* [online] [http://codewa-icrisat.uni-hohenheim.de/Website/Welcome\\_to\\_the\\_CODE-WA\\_homepage.html](http://codewa-icrisat.uni-hohenheim.de/Website/Welcome_to_the_CODE-WA_homepage.html) [Accessed on 12-11-13]

Codjoe, S.N.A., Atidoh, L.K., and Burket, V. (2011) Gender and occupational perspectives on adaptation to climate extremes in the Afram Plains of Ghana, *Climatic Change*, 110(1-2), 431-454

Conway, G.R. (1987) The properties of agroecosystems, *Agricultural Systems*, 24(2), 95-117

Conway, G.R., and Barbier, E.B. (1988) After the Green Revolution: Sustainable and equitable agricultural development, *Futures*, 20(6), 651-670

Coote, A., Allen, J., and Woodhead, D. (2004) *Finding Out What Works: Building Knowledge About Complex, Community-Based Initiatives*, The King's Fund, London, pp98

Crossley, D., Barling, L., Priebe, J., Ritson, C., and Salazar, E. (2015) *From Individual to Collective Action: Exploring Business Cases for Addressing Sustainable Food Security*, World Wildlife Fund and Food Ethics Council, London, pp70

CRP on Forests, Trees and Agroforestry (2014) *Theme 4: Climate change adaptation and mitigation* [online] <http://foreststreesagroforestry.org/forests-trees-agroforestry-research-portfolio/theme-4-climate-change-adaptation-and-mitigation/2-4-1-introduction/> [Accessed on 30-6-2014]

CRP on Water, Land and Ecosystems (undated) *WLE and Resilience* [online] <http://wle.cgiar.org/blog/2014/05/03/wle-resilience/> [Accessed on 2-7-2014]

Crush, J. (1995) Introduction: Imagining Development, In: Crush, J. (Ed) (1995) *Power of Development*, Routledge, London, pp1-23

CSIR (2010-2012) *Council for Scientific and Industrial Research Ghana: All Institutes* [online] <http://www.csir.org.gh/institutes.aspx> [Accessed on 6-12-12-]

Darko, E., and Atazona, L. (2013) Literature Review of the Impact of Climate Change on Economic Development in Northern Ghana: Opportunities and Activities, Overseas Development Institute, London, pp34 [online] <http://www.odi.org/publications/8064-literature-review-economic-development-climate-change-ghana> [Accessed on 8-7-2014]

Dawson, T.P., Rounsevell, M.D., Kluvánková-Oravská, T., Chobotová, V., and Stirling, A. (2010) Dynamic properties of complex adaptive ecosystems: Implications for the sustainability of service provision, *Biodiversity and Conservation*, 19(10), 2843-2853

Denzin, N.K., and Lincoln, Y.S. (2008) Introduction: The Discipline and Practice of Qualitative Research, In: Denzin, N.K., and Lincoln, Y.S. (Eds) (2008) *Strategies of Qualitative Inquiry*, 3<sup>rd</sup> Edition, Sage Publications, Inc, London, pp1-43

Derbile, E.K. (2013) Reducing vulnerability of rain-fed agriculture to drought through indigenous knowledge systems in north-eastern Ghana, *International Journal of Climate Change Strategies and Management*, 5(1), 71-94

De Vente, J., Reed, MS., Stringer, L., Valente, S., and Newig, J. (2016) How does the context and design of participatory decision-making processes affect their outcomes ? Evidence from sustainable land management in global drylands, *Ecology and Society*, 21(2), 1-24

Dewalt, B.R. (1994) Using Indigenous Knowledge to Improve Agriculture and Natural Resource Management, *Human Organization*, 53(2), 123-131

Diao, X. (2010) *Economic Importance of Agriculture for Sustainable Development and Poverty Reduction: Findings from a Case Study of Ghana*, Organisation for Economic Co-operation for Development, Paris, pp88

Dietz, T., Ostrom, E., and Stern, P.C. (2003) The Struggle to Govern the Commons, *Science*, 302(5652), 1907-1912

Dixon, J., and Stringer, L.C. (2015) Towards a Theoretical Grounding of Climate Resilience Assessments for Smallholder Farming Systems in Sub-Saharan Africa, *Resources*, 4(1), 128-154

Dresner, S. (2008) *The Principles of Sustainability, Second Edition*, Earthscan, London, pp205

Eakin, H.C., Lemos, M.C., and Nelson, D.R. (2014) Differentiating capacities as a means to sustainable climate change adaptation, *Global Environmental Change*, 27(1), 1-8

ECOWAS (Economic Community of West African States) (2005) *Annex to Decision A/DEC.11/01/05 Relating to the Economic Community of West African States Agricultural Policy (ECOWAP)*, ECOWAS, Accra, pp18

ECOWAS (Economic Community of West African States) (2008) *Regional Agricultural Policy for West Africa: ECOWAP*, ECOWAS, Accra, pp12

Eisenhardt, K.M. (1989) Building Theories for Case Study Research, *Academy of Management Review*, 14, 532-550

Ellis, F. (2000) *Rural Livelihoods and Diversity in Developing Countries*, Oxford University Press, Oxford, pp273

Ellis, F., and Freeman, H.A. (2004) Rural Livelihoods and Poverty Reduction Strategies in Four African Countries, *The Journal of Development Studies*, 40(4), 1-30

Ensor, J. (2011) *Uncertain Futures: Adaptive development to a changing climate*, Practical Action Publishing Ltd, Rugby, pp108

EPA/UNDP (Environmental Protection Agency/United Nations Development Programme) (2010) *National Climate Change Adaptation Strategy*, Environmental Protection Agency, Accra, pp26

Ericksen, P.J. (2008) Conceptualizing food systems for global environmental change research, *Global Environmental Change*, 18(1), 234-245

Ericksen, P., Stewart, B., Dixon, J., Barling, D., Loring, P., Anderson, M., and Ingram, J. (2010) The Value of a Food Systems Approach, In: Ingram, J., Ericksen, P., and Liverman, D. (Eds) (2010) *Food Security and Global Environmental Change*, Earthscan, London, pp25-45

Escobar, A. (2001) Culture sits in places: reflections on globalism and subaltern strategies of localization, *Political Geography*, 20, 139-174

Espinosa, A., and Walker, J. (2011) *A Complexity Approach and Sustainability: Theory and Application*, Imperial College Press, London, pp361

Essegby, G.O., Amisigo, B., Nutsukpo, D., Oppong-Boadi, K.Y., and Benefo, D. (2012) *Ghana Technology Needs Assessment Report 2012*, Technology Needs Assessment Team, Ministry of Environment, Science and Technology, Accra, pp103



European Commission (2016) *Paris Agreement* [online]

[http://ec.europa.eu/clima/policies/international/negotiations/paris/index\\_en.htm](http://ec.europa.eu/clima/policies/international/negotiations/paris/index_en.htm)

[Accessed on 27-7-16]

Fairhead, J., and Leach, M. (1998) *Reframing Deforestation - Global analysis and local realities: studies in West Africa*, Routledge, London, pp265

FAO (Food and Agriculture Organization of the United Nations) (2013a) *Climate-Smart Agriculture: Sourcebook*, Food and Agriculture Organization of the United Nations, Rome, pp570

FAO (Food and Agriculture Organization of the United Nations) (2013b) *The State of Food and Agriculture 2013: Food Systems for Better Nutrition*, Food and Agriculture Organization of the United Nations, Rome, pp114

FAO (Food and Agriculture Organization of the United Nations) (2014) *What We Do: Make Agriculture, Forestry and Fisheries More Productive and Sustainable* [online] <http://www.fao.org/about/what-we-do/so2/en/> [Accessed on 2-7-2014]

FAO (Food and Agriculture Organization of the United Nations) (2015) *Ghana Country Fact Sheet on Food and Agriculture Policy Trends*, Food and Agriculture Organization of the United Nations, Rome [online] <http://www.fao.org/3/a-i4490e.pdf> [Accessed on 4-7-2016]

Fernandes, E., Pell, A., and Uphoff, N. (2002) Rethinking Agriculture for New Opportunities, In: Uphoff, N. (Ed) (2002) *Agro-ecological Innovations: Increasing Food Production with Participatory Development*, Earthscan, London, pp21-39

Flaherty, K., Essegbey, G.O., and Asare, R. (2010) *Ghana: Recent Development in Agricultural Research, Agricultural Science and Technology Indicators Country Note*, IFPRI, based at FAO, Rome, [online] <http://www.asti.cgiar.org/pdf/Ghana-Note.pdf> [Accessed on 8-12-12]

Flora, C.B., and Flora, J.L. (2005) Creating Social Capital, In: Pretty, J. (Ed) (2005) *The Earthscan Reader in Sustainable Agriculture*, Earthscan, London, pp39-46

Folke, C. (2006) Resilience: The emergence of a perspective for social-ecological systems analysis, *Global Environmental Change*, 16(3), 253-267

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C.S., Walker, B., Bengtsson, J., Berkes, F., Colding, J., Danell, K., Falkenmark, M., Gordon, L., Kasperson, R., Kautsky, N., Kinzig, A., Levin, S., Mäler, K.-G., Moberg, F., Ohlsson, L., Olsson, P., Ostrom, E., Reid, W., Rockström, J., Savenije H., and Svedin, U. (2002) *Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations*, Scientific Background Paper on Resilience for the process of The World Summit on Sustainable Development on behalf of The Environmental Advisory Council to the Swedish Government, pp73

Folke, C., Colding, J., and Berkes, F. (2003) Synthesis: building resilience and adaptive capacity in social-ecological systems, In: Berkes, F., Colding, J., and Folke, C. (Eds) (2003) *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*, Cambridge University Press, Cambridge, pp352-387

Folke, C., Hahn, T., Olsson, P., and Norberg, J. (2005) Adaptive Governance of Social-Ecological Systems, *Annual Review of Environment and Resources*, 30(1), 441-473

Foxon, T.J., Stringer, L.C., and Reed, M.S. (2009) Governing long-term social-ecological change: What can the resilience and transitions approaches learn from each other? *Environmental Policy and Governance*, 19(1), 3-20

Gallopín, G.C. (2006) Linkages between vulnerability, resilience, and adaptive capacity, *Global Environmental Change*, 16(3), 293-303

Garbarino, S., and Holland, J. (2009) *Quantitative and qualitative methods in impact evaluation and measuring results*, Governance and Social Development Resource Centre Issues Paper, Governance and Social Development Resource Centre, Birmingham, pp51

Ghana Nsem (2009) *Vital Statistics: Ghana Multiple Indicator Cluster Survey 2006*, Ghana Statistical Service and Ministry of Health, Accra [online]  
[http://www.ghanansem.org/index.php?option=com\\_content&task=view&id=34&Itemid=75#fmch](http://www.ghanansem.org/index.php?option=com_content&task=view&id=34&Itemid=75#fmch) [Accessed on 24-2-2014]

Ghana Statistical Service (2012) *2010 Population and Housing Census Summary Report of Final Results*, Ghana Statistical Service, Accra, pp117

Gibson, B. and Hartman, J. (2014) *Rediscovering Grounded Theory*, SAGE Publications Ltd, London, pp280

Gilbert, N. (2010) Inside the Hothouses of Industry, *Nature*, 466, p548-552

Glaeser, B. (2011) Agriculture between the Green Revolution and ecodevelopment: which way to go? In: Glaeser, B. (Ed) (2011) *The Green Revolution Revisited: Critique and Alternatives*, Routledge, Abingdon, pp1-7

Glatzel, K., Conway, G., and Alpert, E. (2015) *The Farms of Change: African Smallholders Responding to an Uncertain Climate Future, Montpellier Panel Report*, Agriculture for Impact, London, pp44

Gliessman, S.R. (2005) Agro-ecology and Agroecosystems, In: Pretty, J. (Ed) (2005) *The Earthscan Reader in Sustainable Agriculture*, Earthscan, London, pp104-114

González de Molina, M. (2016) Political Agro-ecology: An Essential Tool to Promote Agrarian Sustainability, In: Méndez, V.E., Bacon, C.M., Cohen, R., and Gliessman, S.R. (Eds) (2016) *Agro-ecology and a Transdisciplinary, Participatory, and Action-oriented Approach*, CRC Press, Boca Raton, pp55-71

Government of Ghana (2013) *About Ghana: Upper East* [online]  
<http://www.ghana.gov.gh/index.php/about-ghana/regions/upper-east> [Accessed on 24-2-2014]

Greene, J.C. (2003) Understanding Social Programs Through Evaluation, In: Denzin, N.K., and Lincoln, Y.S. (Eds) (2003) *Collecting and Interpreting Qualitative Materials, Second Edition*, Sage Publications, Inc, London, pp590-618

Gubbels, P. (2011) *Escaping the Hunger Cycle: Pathways to Resilience in the Sahel*, Sahel Working Group and Groundswell International, Washington, D.C., pp124

Gunderson, L., Peterson, G., and Holling, C.S. (2008) Practicing Adaptive Management in Complex Social-Ecological Systems, In: Norberg, J., and Cumming, G.S. (Eds) (2008) *Complexity Theory for a Sustainable Future*, Columbia University Press, New York, pp223-245

Guzmán, E.S., and Woodgate, G. (2016) Transformative Agro-ecology: Foundations in Agricultural Practice, Agrarian Social Thought, and Sociological Theory, In: Méndez, V.E., Bacon, C.M., Cohen, R., and Gliessman, S.R. (Eds) (2016) *Agro-ecology and a Transdisciplinary, Participatory, and Action-oriented Approach*, CRC Press, Boca Raton, pp37-54

Hahn, T., Schultz, L., Folke, C., and Olsson, P. (2008) Social Networks as Sources of Resilience in Social-Ecological Systems, In: Norberg, J., and Cumming, G.S. (Eds) (2008) *Complexity Theory for a Sustainable Future*, Columbia University Press, Chichester, pp119-148

Hall, A. (2007) Challenges to Strengthening Agricultural Innovation Systems: Where Do We Go From Here? *UNU-MERIT Working Paper 38*, United Nations University – Maastricht Economic and social Research and training centre on Innovation and Technology, Maastricht, pp26

Hall, A., and Clark, N. (2010) What do complex adaptive systems look like and what are the implications for innovation policy? *Journal of International Development*, 22, 308-324

- Hall, A., Sulaiman, R.V., Norman, C., and Yoganand, B. (2003) From measuring impact to learning institutional lessons: an innovation systems perspective on improving the management of international agricultural research, *Agricultural Systems*, 78(2), 213-241
- Hammet, D., Twyman, C., and Graham, M. (2015) *Research and Fieldwork in Development*, Routledge, Abingdon, pp335
- Harper, D. (2003) Framing Photographic Ethnography: A Case Study, *Ethnography*, 4(2), 241-266
- Herbel, D., Crowley, E., Ourabah Haddad, N., and Lee, M. (2012) *Good Practices in Building Innovative Rural Institutions to Increase Food Security*, The Food and Agricultural Organization of the United Nations (FAO), Rome, pp117
- Hirshleifer, D.A., and Welch, I. (1995) *Institutional Memory, Inertia, and Impulsiveness*, Michigan Business School Working Paper #9405-32R1, Michigan Business School, Ann Arbor, pp38
- Holland, J.H. (1995) *Hidden Order: How Adaptation Builds Complexity*, Perseus Books, Reading, MA, pp185
- Holland, J.H. (2014) *Complexity: A Very Short Introduction*, Oxford University Press, Oxford, pp95
- Holland, J., Jones, S., and Karden, A. (2015) Understanding participation in development: towards a framework, *International Development and Planning Review*, 37(1), 77-94
- Holling, C.S. (1973) Resilience and Stability of Ecological Systems, *Annual Review of Ecology and Systems*, 4, 1-23

Holling, C.S., and Gunderson, L.H. (2002) Resilience and Adaptive Cycles, In: Holling, C.S., and Gunderson, L.H. (Eds) (2002) *Panarchy: Understanding Transformations in Human and Natural Systems*, Island Press, Washington, D.C., pp25-62

Holling, C.S., Gunderson, L.H., and Peterson, G.D. (2002) Sustainability and Panarchies, In: Gunderson, L.H., and Holling, C.S. (Eds) (2002) *Panarchy: Understanding Transformations in Human and Natural Systems*, Island Press, Washington, D.C., pp63-102

House, E.R., and Howe, K.R. (1999) *Values in Evaluation and Social Research*, SAGE Publications, Inc., London, pp152

ICIPE (2011) *Climate-smart push–pull: resilient, adaptable conservation agriculture for the future*, International Centre of Insect Physiology and Ecology, Nairobi, pp8

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) (2008) *Community Management of Crop Diversity to Enhance Resilience, Yield Stability and Income Generation in Changing West African Climates*, unpublished internal report, pp22

IIED (2011) *How wide are the ripples? From local participation to international organisational learning: Participatory Learning and Action 63*, International Institute for Environment and Development, London, pp192

IFAD (International Fund for Agricultural Development) (2013) *Smallholders, food security, and the environment*, IFAD and UNEP, Rome, pp56

IRWG (Interagency Resilience Working Group) (2012) *The Characteristics of Resilience Building: A discussion paper* [online]  
<http://community.eldis.org/?233@@.5ad4406d!enclosure=.5ad4406e&ad=1> [Accessed on 8-1-2015]

Jackson, D.L. (2005) The Farm as Natural Habitat, In: Pretty, J. (Ed) (2005) *The Earthscan Reader in Sustainable Agriculture*, Earthscan, London, pp249-260

Jones, A., Breuning-Madsen, H., Brossard, M., Dampha, A., Deckers, J., Dewitte, O., Gallali, T., Hallett, S., Jones, R., Kilasara, M., Le Roux, P., Micheli, E., Montanarella, L., Spaargaren, O., Thiombiano, L., Van Ranst, E., Yemefack, M., Zougmore, R. (Eds) (2013) *Soil Atlas of Africa*, European Commission, Publications Office of the European Union, Luxembourg, pp176

Jones, K., and Eshleman, J.T. (2016) Food sovereignty: governance and exclusion in an alternative social movement, In: Kennedy, A., and Liljeblad, J. (Eds) (2016) *Food Systems Governance: Challenges for Justice, Equality and Human Rights*, Routledge, Abingdon, pp43-60

Juma, C. (2011) *The New Harvest: Agricultural Innovation in Africa*, Oxford University Press, Oxford, pp268

Jupp, D., Ali, S.I., and Barahona, C. (2010) *Measuring Empowerment? Ask Them: Quantifying qualitative outcomes from people's own analysis*, Swedish International Development Cooperation Agency (SIDA), Stockholm, pp108

Kerr, R. B. (2012). Lessons from the old Green Revolution for the new: Social, environmental and nutritional issues for agricultural change in Africa, *Progress in Development Studies*, 12(2-3), 213-229

Keynes, J.M. (1936) *The General Theory of Employment, Interest and Money*, Macmillan and Company Limited, London, pp403

Kiraly, D. (2001) Towards a constructivist approach to translator education, *Anglistik*, 6(6), 50-53

Laube, W., Schraven, B., and Awo, M. (2011) Smallholder adaptation to climate change: dynamics and limits in Northern Ghana, *Climatic Change*, 111(3-4), 753-774

Leach, M. (Ed) (2008) Re-framing Resilience: A Symposium Report, *STEPS Centre Working Paper 13*, STEPS Centre, Brighton, pp22

Leach, M., Rockström, J., Raskin, P., Scoones, I., Stirling, A., Smith, A., Thompson, J., Millstone, E., Ely, A., Arond, E., Folke, C., and Olsson, P. (2012) Transforming Innovation for Sustainability, *Ecology and Society*, 17(2), 1-12

Leach, M., Scoones, I., and Stirling, A. (2007) *Pathways to Sustainability: an overview of the STEPS Centre approach*, STEPS Approach Paper, STEPS Centre, Brighton, pp28

Leach, M., Scoones, I., and Stirling, A. (2010) *Dynamic Sustainabilities: Technology, Environment and Social Justice*, Earthscan, London, pp212

Lemos, M.C., Agrawal, A., Eakin, H., Nelson, D.R., Engle, N.L., and John, O. (2013) Building adaptive capacity to climate change, In: Asrar, G.R., and Hurrell, J.W. (Eds) (2013) *Climate Science for Serving Society: Research, Modelling and Prediction Priorities*, Springer, Dordrecht, pp437–457

Levin, S.A. (1998) Ecosystems and the Biosphere as Complex Adaptive Systems, *Ecosystems*, 1(5), 431-436

Lin, N. (1999) Building a Network Theory of Social Capital, *Connections*, 22(1), 28-51

Low, B., Ostrom, E., Simon, C., and Wilson, J. (2003) Redundancy and Diversity: Do They Influence Optimal Management? In: Berkes, F., Colding, J., and Folke, C. (Eds) (2003) *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*, Cambridge University Press, Cambridge, pp83-114

Ludi, E., and Levine, S. (2011) *Preparing for the future? Understanding the Influence of Development Interventions on Adaptive Capacity at Local Level in Ethiopia*, Africa Climate Change Resilience Alliance, London, pp64

Mace, M.J. (2006) Adaptation under the UN Framework Convention on Climate Change: The International Legal Framework, In: Adger, W.N., Paavola, J., Huq, S., and Mace, M.J. (Eds) (2006) *Fairness in Adaptation to Climate Change*, Massachusetts Institute of Technology Press, London, pp53-76



Magee, T. (2013) *A Field Guide to Community Based Adaptation*, Routledge, Abingdon, pp232

Malongza Bukari, F.I. (2013) Indigenous perceptions of soil erosion, adaptations and livelihood implications: the case of maize farmers in the Zampe community of Bole in the Northern Region of Ghana, *Journal of Natural Resources and Development*, 3, 114-120

Mansuri, G., and Rao, V. (2013) *Localizing Development: Does Participation Work?* World Bank, Washington D.C., pp324

Marshall, C., and Rossman, G. (2006) *Designing Qualitative Research: 4<sup>th</sup> Edition*, SAGE Publications, London, pp262

Masters, W.A., Webb, P., Griffiths, J.K., and Deckelbaum, R.J. (2014) Agriculture, nutrition, and health in global development: typology and metrics for integrated interventions and research, *Annals of the New York Academy of Sciences*, 1331, 258-269

McKeon, N. (2015) *Food Security Governance: Empowering communities, regulating corporations*, Routledge, Abingdon, pp246

McPherson, M., Smith-Lovin, Y., and Cook, J.M. (2001) Birds of a Feather: Homophily in Social Networks, *Annual Review of Sociology*, 27, 415-444

Méndez, V.E., Bacon, C.M., and Cohen, R. (2016) Introduction: Agro-ecology and a Transdisciplinary, Participatory, and Action-oriented Approach, In: Méndez, V.E., Bacon, C.M., Cohen, R., and Gliessman, S.R. (Eds) (2016) *Agro-ecology and a Transdisciplinary, Participatory, and Action-oriented Approach*, CRC Press, Boca Raton, pp1-21

MEST (Ministry of Environment, Science and Technology, Ghana) (2010a) *National Science, Technology and Innovation Policy* [online]  
<http://www.ghana.gov.gh/documents/stipolicy.pdf> [Accessed on 6-12-12]

MEST (Ministry of Environment, Science and Technology, Ghana) (2010b) Ghana Goes for Green Growth: National engagement on climate change Discussion document, Ministry of Environment, Science and Technology, Republic of Ghana, Accra, pp21

Michael, S. (2004) *Undermining Development: The Absence of Power Among Local NGOs in Africa*, James Currey, Oxford, pp206

Millar, D., Ayariga, R., and Anamoh, B. (1996) Grandfather's Way of Doing: Gender relations and the *yaba-itgo* system in Upper East Region, Ghana, In: Reij, C., Scoones, I., and Toulmin, C. (Eds) (1996) *Sustaining the Soil: Indigenous Soil and Water Conservation in Africa*, Earthscan, London, pp117-125

MOFA (Ministry of Food and Agriculture, Ghana) (2007) *Food and Agriculture Sector Development Policy (FASDEP II)*, Ministry of Food and Agriculture, Republic of Ghana, Accra, pp77

MOFA (Ministry of Food and Agriculture, Ghana) (2009) *Medium-term Agriculture Sector Investment Plan (METASIP) 2009-2015: Volume 2: Programme of Actions*, Ministry of Food and Agriculture, Accra, pp29

Mortimore, M., with contributions from Anderson, S., Cotula, L., Davies, J., Facer, K., Hesse, C., Morton, J., Nyangena, W., Skinner, J., and Wolfangel, C. (2009) *Dryland Opportunities: A new paradigm for people, ecosystems and development*, IUCN, Gland, Switzerland, IIED, London, UK, and UNDP/DDC, Nairobi, Kenya, ppx+86

NDPC (Government of Ghana National Development Planning Commission) (2010) *Medium-term National Development Policy Framework: Ghana Shared Growth and Development Agenda 2010-2013 - Volume 1: Policy Framework*, Government of Ghana National Development Planning Commission, Accra, pp278

Needham, C. (2008) Realising the Potential of Co-production: Negotiating Improvements in Public Services, *Social Policy and Society*, 7(2), 221-231

Neef, A., and Neubert, D. (2010) Stakeholder participation in agricultural research projects: a conceptual framework for reflection and decision-making, *Agriculture and Human Values*, 28(2), 179-194

NEPAD (New Partnership for Africa's Development) (2003) *Comprehensive Africa Agriculture Development Programme*, NEPAD, Midrand, pp116

Neufeldt, H., Jahn, M., Campbell, B.M., Beddington, J.R., DeClerck, F., De Pinto, A., Gullledge, J., Hellin, J., Herrero, M., Jarvis, A., LeZaks, D., Meinke, H., Rosenstock, T., Scholes, M., Scholes, R., Vermeulen, S., Wollenberg, E., and Zougmore, R. (2013) Beyond climate-smart agriculture: toward safe operating spaces for global food systems, *Agriculture and Food Security*, 2(12), pp6

Newing, H. (2009) Unpicking 'Community' in Community Conservation: Implications of Changing Settlement Patterns and Individual Mobility for the Tamshiyacu Tahuayo Communal Reserve, Peru, In: Alexiades, M.N., (Ed) (2009) *Mobility and Migration in Indigenous Amazonia: Contemporary Ethnoecological Perspectives*, Berghahn Books, Oxford, pp97-114

Ngeleza, G.K., Owusua, R., Jimah, K., and Kolavalli, S. (2011) *Cropping Practices and Labor [sic] Requirements in Field Operations for Major Crops in Ghana: What Needs to Be Mechanized?* International Food Policy Research Institute, Washington, D.C., pp36

Niang, I., Ruppel, O.C., Abdrabo, M.A., Essel, A., Lennard, C., Padgham, J., and Urquhart, P. (2014) Africa, In: Barros, V.R., Field, C.B., Dokken, D.J., Mastrandrea, M.D., Mach, K.J., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., and White, L.L. (Eds) (2014) *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*, Cambridge University Press, Cambridge, pp1199-1265

Norberg, J., and Cumming, G.S. (2008a) Introduction, In: Norberg, J., and Cumming, G.S. (Eds) (2008) *Complexity Theory for a Sustainable Future*, Columbia University Press, New York, pp1-7

Norberg, J., and Cumming, G.S. (2008b) Complexity Theory for a Sustainable Future: Conclusions and Outlook, In: Norberg, J., and Cumming, G.S. (Eds) (2008) *Complexity Theory for a Sustainable Future*, Colombia University Press, Chichester, pp277-290

Norberg, J., Wilson, J., Walker, B., and Ostrom, E. (2008) Diversity and Resilience of Social-Ecological Systems, In: Norberg, J., and Cumming, G.S. (Eds) (2008) *Complexity Theory for a Sustainable Future*, Columbia University Press, New York, pp46-79

Nyantakni-Frimpong, H. (2013) Indigenous Knowledge and Climate Adaptation Policy in Ghana, *Africa Portal Backgrounder Series, Number 48*, pp10 [online]  
<http://www.africaportal.org/sites/default/files/Africa%20Portal%20Backgrounder%20No.%2048.pdf> [Accessed on 21-6-2013]

Oasa, E.K. (2011) The political economy of international agricultural research: a review of the CGIAR's response to criticisms of the 'Green Revolution', In: Glaeser, B. (Ed) (2011) *The Green Revolution Revisited: Critique and Alternatives*, Routledge, Abingdon, pp9-41

O'Brien, K., and Leichenko, R. (2008) *Human security, vulnerability, and sustainable adaptation*, *Human Development Report 2007/2008*, United Nations Development Programme, New York City, pp47

Okali, C., Sumberg, J., and Farrington, J. (1994) *Farmer Participatory Research: Rhetoric and Reality*, Intermediate Technology Publications, London, pp159

Oppenheimer, M., Campos, M., Warren, R., Birkmann, J., Luber, G., O'Neill, B., and Takahashi, K. (2014) Emergent risks and key vulnerabilities. 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 (Eds) (2014) *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*, Cambridge University Press, Cambridge, pp1039-1099

Osborne, H., Twyman, C., Adger, W.N., and Thomas, D.S.G. (2010) Evaluating Successful Livelihood Adaptation to Climate Variability and Change in Southern Africa, *Ecology and Society*, 15(2), pp27

Osei-Tutu, P., Pregernig, M., and Pokorny, B. (2015) Interactions between formal and informal institutions in community, private and state forest contexts in Ghana, *Forest Policy and Economics*, 54(1), 26-35

Ostrom, E. (1990) *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge University Press, Cambridge, pp298

Owusu, E.H., and Ekpe, E.K. (2011) An evaluation of forest conservation perceptions after a decade of community conservation in Afadjato-Agumatsa, Ghana, *International Journal of Environmental Science*, 2(2), pp441-451

Özgediz, S. (2012) *The CGIAR at 40: Institutional Evolution of the World's Premier Agricultural Research Network* [online]  
[http://library.cgiar.org/bitstream/handle/10947/2761/cgi40yrs\\_book\\_final\\_sept2012.pdf?sequence=1](http://library.cgiar.org/bitstream/handle/10947/2761/cgi40yrs_book_final_sept2012.pdf?sequence=1) [Accessed on 6-11-12]

Paavola, J. (2006) Justice in Adaptation to Climate Change in Tanzania, In: Adger, W.N., Paavola, J., Huq, S., and Mace, M.J. (Eds) (2006) *Fairness in Adaptation to Climate Change*, Massachusetts Institute of Technology Press, London, pp200-222

Patton, M.Q. (2011) *Developmental Evaluation: Applying Complexity Concepts to Enhance Innovation and Use*, The Guildford Press, New York, pp375

Pelling, M. (2011) *Adaptation to Climate Change: From resilience to transformation*, Routledge, Abingdon, pp203

Pimbert, M., and Pretty, J. (1995) Parks, People and Professionals: Putting 'Participation' into Protected Area Management, *Discussion Paper 57 UNRISD*, United Nations Research Institute for Social Development, Geneva, pp65

Pink, S. (2013) *Doing Visual Ethnography, 3<sup>rd</sup> Edition*, SAGE Publications Ltd, London, pp248

Pinstrup-Anderson, P., and Watson II, D.D. (2011) *Food Policy for Developing Countries: The Role of Government in Global, National and Local Food Systems*, Cornell University Press, Ithaca, pp400

Portes, A. (1998) Social Capital: Its Origins and Applications in Modern Sociology, *Annual Review of Sociology*, 24(1), 1-24

Poulton, C., Berhanu, K., Chinsinga, B., Cooksey, B., Golooba-Mutebi, F., and Loada, A. (2014) The Comprehensive Africa Agriculture Development Programme (CAADP): Political Incentives, Value Added and Ways Forward, *Future Agricultures Consortium Working Paper 77*, Future Agricultures Consortium, Brighton, pp18

Pretty, J. (2002a) *Agri-Culture: Reconnecting People, Land and Nature*, Earthscan, London, pp261

Pretty, J. (2002b) Social and Human Capital for Sustainable Agriculture, In: Uphoff, N. (Ed) (2002) *Agro-ecological Innovations: Increasing Food Production with Participatory Development*, Earthscan, London, pp47-57

Pretty, J. (2005) Social Capital and the Collective Management of Resources, In: Pretty, J. (Ed) (2005) *The Earthscan Reader in Sustainable Agriculture*, Earthscan, London, pp173-178

Pretty, J., Morison, J., and Hine, R. (2005) Reducing Food Poverty by Increasing Agricultural Sustainability in Developing Countries, In: Pretty, J. (Ed) (2005) *The Earthscan Reader in Sustainable Agriculture*, Earthscan, London, pp375-398

Rammel, C., Stagl, S., and Wilfing, H. (2007) Managing complex adaptive systems – A co-evolutionary perspective on natural resource management, *Ecological Economics*, 63(1), 9-21

Reed, M.S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C.H., and Stringer, L.C. (2009) Who's in and why? A typology of stakeholder analysis methods for natural resource management, *Journal of Environmental Management*, 90(5), 1933-1949

Reid, H., Chambwera, M., and Murray, L. (2013) *Tried and tested: Learning from farmers on adaptation to climate change*, IIED Gatekeeper Paper 153, International Institute for Environment and Development, London, pp19

Reij, C., and Waters-Bayer, A. (2001a) An initial analysis of farmer innovators and their innovations, In: Reij, C., and Waters-Bayer, A. (Eds) (2001) *Farmer Innovation in Africa: A Source of Inspiration for Agricultural Development*, Earthscan Publication Ltd, London, pp77-91

Reij, C., and Waters-Bayer, A. (2001b) Entering research and development in land husbandry through farmer innovation, In: Reij, C., and Waters-Bayer, A. (Eds) (2001) *Farmer Innovation in Africa: A Source of Inspiration for Agricultural Development*, Earthscan Publication Ltd, London, pp3-22

Ricci, L. (2016) *Reinterpreting Sub-Saharan Cities through the Concept of Adaptive Capacity: An Analysis of Autonomous Adaptation Response to Environmental Changes in Peri-Urban Areas*, Springer, London, pp211

Richards, P. (1985) *Indigenous Agricultural Revolution: Ecology and food production in West Africa*, Hutchinson & Co. Ltd, London, pp192

Robinson, L.W., and Sasu, K.A. (2013) The Role of Values in a Community-Based Conservation Initiative in Northern Ghana, *Environmental Values*, 22(5), 647-664

Sarpong, D.B. and Anyidoho, N.A. (2012) Climate Change and Agricultural Policy Processes in Ghana, *Future Agricultures Consortium Working Paper 45*, Future Agricultures Consortium, Brighton, pp21

Saunders, M., Lewis, P., and Thornhill, A. (2012) *Research Methods for Business Students, Sixth Edition*, Pearson Education Limited, Harlow, pp696

Scherr, S.J., Shames, S., and Friedman, R. (2012) From climate-smart agriculture to climate-smart landscapes, *Agriculture and Food Security*, 1(12), pp15

Schipper, E.L.F. (2006) Conceptual History of Adaptation in the UNFCCC Process, *Reicel*, 15(1), 82-92

Scoones, I. (1998) Sustainable Rural Livelihoods: A Framework for Analysis, *IDS Working Paper*, 72, Institute of Development Studies, Brighton, [online]  
<http://www.ids.ac.uk/files/dmfile/Wp72.pdf> [Accessed on 25-6-13]

Scoones, I. (2007) Sustainability, *Development in Practice*, 17(4-5), 589-596

Scoones, I. (2009) Livelihoods perspectives and rural development, *Journal of Peasant Studies*, 36(1), 1-26

Scoones, I., Leach, M., Smith, A., Stagl, S., Stirling, A., and Thompson, J. (2007) Dynamic Systems and the Challenge of Sustainability, *STEPS Centre Working Paper 1*, STEPS Centre, Brighton, pp76



Scoones, I., and Thompson, J. (2009) Farmer First revisited: innovation for agricultural research and development, In: Scoones, I., and Thompson, J. (Eds) (2009) *Farmer First Revisited: Innovation for Agricultural Research and Development*, Practical Action Publishing Ltd, Rugby, pp3-30

Self Help Africa (undated a) *Climate Adaptation: Ghana* [online]  
<http://www.selfhelpafrica.com/selfhelp/Main/PR-UKWA-ClimateAdapt.asp> [Accessed on 12-12-13]

Self Help Africa (undated b) *Poverty reduction in Northern Ghana through sustainable agriculture interventions and enterprise development* [online]  
<http://www.selfhelpafrica.org/uk/west-africa/climate-change-adaptation> [Accessed on 3-3-2015]

Sen, A. (1999) *Development as Freedom*, Oxford University Press, Oxford, pp366

Serres, M. (2007) *The Parasite*, Translated by Lawrence R. Schere, University of Minnesota Press, Minneapolis, pp255

Shackleton, S., Ziervogel, G., Sallu, S., Gill, T., and Tschakert, P. (2015) Why is socially-just climate change adaptation in sub-Saharan Africa so challenging? A review of barriers identified from empirical cases, *Wiley Interdisciplinary Reviews: Climate Change*, 6(3), 321-344

Simon, H.A. (1962) The Architecture of Complexity, *Proceedings of the American Philosophical Society*, 106(6), 467-482

Sluka, J.A., and Robben, A.C.G.M. (2007) Fieldwork in Cultural Anthropology: An Introduction, In: Robben, A.C.G.M., and Sluka, J.A. (Eds) (2007) *Ethnographic Fieldwork: An Anthropological Reader*, Blackwell Publishing, Oxford, pp1-28

Smit, B., Burton, I., Klein, R.J.T., and Wandel, J. (2009) An Anatomy of Adaptation to Climate Change and Variability, In: Schipper, E.L.F., and Burton, I. (Eds) (2009) *The Earthscan Reader on Adaptation to Climate Change*, Earthscan, Abingdon, pp63-87

Smit, B., and Wandel, J. (2006) Adaptation, adaptive capacity and vulnerability, *Global Environmental Change*, 16(3), 282-292

Sperling, L., Ashby, J.A., Smith, M.E., Weltzien, E., and Mcguire, S. (2001) A framework for analyzing participatory plant breeding approaches and results, *Euphytica*, 122, 439-450

Stads, G.-J., and Gogo, J.O. (2004) *Agricultural Science and Technology Indicators: Ghana*, ASTI Country Brief No. 13, IFPRI, Washington D.C. [online] [http://www.asti.cgiar.org/pdf/Ghana\\_CB13.pdf](http://www.asti.cgiar.org/pdf/Ghana_CB13.pdf) [Accessed on 8-12-12]

Stake, R.E. (2003) Case Studies, In: Denzin, N.K., and Lincoln, Y.S. (Eds) (2003) *Strategies of Qualitative Inquiry, Second Edition*, Sage Publications, Inc, London, pp134-164

Stanturf, J.A., Warren Jr, M.L., Charnley, S., Polasky, S.C., Goodrick, S.L., Armah, F., and Nyako, Y.A. (2011) *Ghana Climate Change Vulnerability and Adaptation Assessment*, United States Agency for International Development, Washington D.C., pp258

STEPS Centre (2010) *Innovation, Sustainability, Development: A New Manifesto*, STEPS Centre, Brighton [online] [http://anewmanifesto.org/wp-content/uploads/steps-manifesto\\_small-file.pdf](http://anewmanifesto.org/wp-content/uploads/steps-manifesto_small-file.pdf) [Accessed on 24-6-13]

Stirling, A. (2007) "Opening Up" and "Closing Down": Power, Participation, and Pluralism in the Social Appraisal of Technology, *Science, Technology & Human Values*, 33(2), 262-294

Stirling, A. (2014) *From Sustainability to Transformation: Dynamics and diversity in reflexive governance of vulnerability*, SPRU Working Paper 2014-06, Science Policy Research Unit, Brighton, pp29

Sultana, F. (2007) Reflexivity, Positionality and Participatory Ethics: Negotiating Fieldwork Dilemmas in International Research, *ACME*, 6(3), 374-385

Sumberg, J., Okali, C., and Reece, D. (2003) Agricultural research in the face of diversity, local knowledge and the participation imperative: theoretical considerations, *Agricultural Systems*, 76(2), 739-753

Sumberg, J., Thompson, J., and Woodhouse, P. (2012) Contested Agronomy: Agricultural research in a changing world, In: Sumberg, J., and Thompson, J. (Eds) (2012) *Contested Agronomy: Agricultural Research in a Changing World*, Routledge, Abingdon, pp1-21

Sumberg, J., Thompson, J., and Woodhouse, P. (2013) Why agronomy in the developing world has become contentious, *Agriculture and Human Values*, 30(1), 71-83

Taylor, T.A. (1991) *Organization and Structure of National Agricultural Research Systems in Anglophone sub-Saharan Africa*, International Service for National Agricultural Research [online] [http://pdf.usaid.gov/pdf\\_docs/PNABH497.pdf](http://pdf.usaid.gov/pdf_docs/PNABH497.pdf) [Accessed on 19-11-12]

Temple, B., and Edwards, R. (2002) Interpreters/translators and cross-language research: reflexivity and border crossings, *International Journal of Qualitative Methods*, 1(2), 1-22

The World Bank (2007) *Enhancing Agricultural Innovation: How to Go Beyond the Strengthening of Research Systems*, The World Bank, Washington, D.C., pp157

The World Bank (2011) *Republic of Ghana: Tackling Poverty in Northern Ghana*, Report No. 53991-GH, The World Bank, Washington, D.C., pp124

The World Bank (2012a) *Agricultural Innovation Systems: An Investment Sourcebook*, The World Bank, Washington, D.C., pp684

The World Bank (2012b) *Impact and Adaptation to Climate Change* [online]  
<http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTPROGRAMS/EXTIE/0,,contentMDK:22370855~menuPK:546938~pagePK:64168182~piPK:64168060~theSitePK:475520~isCURL:Y~isCURL:Y,00.html> [Accessed on 7-7-2014]

The World Bank (2016) *Foster Climate-Smart Agriculture* [online]  
<https://www.worldbank.org/en/topic/agriculture/brief/foster-climate-smart-agriculture>  
 [Accessed on 14-2-2017]

Thomas, D.S.G., and Twyman, C. (2006) Adaptation and Equity in Resource Dependent Societies, In: Adger, W.N., Paavola, J., Huq, S., and Mace, M.J. (Eds) (2006) *Fairness in Adaptation to Climate Change*, The MIT Press, Cambridge, MA, pp223-228

Thornton, P.K., Jones, P.G., Owiyo, T., Kruska, R.L., Herrero, M., Kristjanson, P., Notenbaert, A., Bekele, N., and Omolo, A. (2006). *Mapping climate vulnerability and poverty in Africa, Report to the Department for International Development*, International Livestock Research Institute, Nairobi, pp171

Trax (undated a) *Trax Ghana* [online] <https://traxghana.com/> [Accessed on 14-11-14]

Trax (undated b) *About* [online] <https://traxghana.com/about/> [Accessed on 14-11-14]

Trax (undated c) *Our Values and Approach* [online] <https://traxghana.com/our-values-and-approach/> [Accessed on 14-11-14]

Trax (undated d) *Sustainable Agriculture* [online] <https://traxghana.com/what-we-do/sustainable-agriculture/> [Accessed on 14-11-14]

Tschakert, P., and Dietrich, K.A. (2010) Anticipatory Learning for Climate Change Adaptation and Resilience, *Ecology and Society*, 15(2), pp23

Turnbull, M., Sterrett, C.L., and Hilleboe, A. (2013) *Toward Resilience: A Guide to Disaster Risk Reduction and Climate Change Adaptation*, Practical Action Publishing Ltd, Rugby, pp180

UNFCCC (2011) *Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010*, United Nations Framework Convention on Climate Change [online]  
<http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=4> [Accessed on 7-7-2014]

UNFCCC (2014a) *Fast Facts and Figures* [online]  
[http://unfccc.int/essential\\_background/basic\\_facts\\_figures/items/6246.php](http://unfccc.int/essential_background/basic_facts_figures/items/6246.php) [Accessed on 23-9-2014]

UNFCCC (2014b) *FOCUS: Adaptation* [online]  
<http://unfccc.int/focus/adaptation/items/6999.php> [Accessed on 28-6-2014]

UNFCCC (2014c) *Capacity-building Portal* [online]  
[http://unfccc.int/cooperation\\_and\\_support/capacity\\_building/items/7204.php](http://unfccc.int/cooperation_and_support/capacity_building/items/7204.php) [Accessed on 28-6-2014]

United Nations (2013) *A New Global Partnership: Eradicate Poverty and Transform Economies Through Sustainable Development, The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda*, United Nations, New York, pp84

United Nations (2015) *Transforming Our World: The 2030 Agenda for Sustainable Development*, United Nations, New York [online]  
<https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf> [Accessed on 26-7-2016]

Uphoff, N. (2002) The Agricultural Development Challenges We Face, In: Uphoff, N. (Ed) (2002) *Agro-ecological Innovations: Increasing Food Production with Participatory Development*, Earthscan, London, pp3-20

- Van Aalst, M.K., Cannon, T., and Burton, I. (2008) Community level adaptation to climate change: The potential role of participatory community risk assessment, *Global Environmental Change*, 18(1), 165-179
- Van Zwanenberg, P., and Millstone, M. (2000) Beyond skeptical relativism: evaluating the social constructions of expert risk assessments, *Science Technology and Human Values*, 25(3), 259-282
- Vandermeer, J. (1995) The Ecological Basis for Alternative Agriculture, *Annual Review of Ecology and Systems*, 26, 201-224
- Vermeulen, S.J., Challinor, A.J., Thornton, P.K., Campbel, B.M., Eriyagama, N., Vervoort, J.M., Kinyangi, J., Jarvis, A., Läderach, P., Ramirez-Villagas, J., Nicklin, K.J., Hawkins, E., Smith, D.R. (2013) Addressing uncertainty in adaptation planning for agriculture, *Proceedings of the National Academy of Sciences of the United States of America*, 110(21), 8357-8362
- Walker, B., Carpenter, S., Anderies, J., Abel, N., Cumming, G., Janssen, M., Lebel, L., Norberg, J., Peterson, G.D., and Pritchard, R. (2002) Resilience management in social-ecological systems: a working hypothesis for a participatory approach, *Conservation Ecology*, 16(1), pp17
- Walker, B., Holling, C.S., Carpenter, S.R., and Kinzig, A. (2004) Resilience, Adaptability and Transformability in Social-Ecological Systems, *Ecology and Society*, 9(2), pp9
- Walker, B., and Salt, D. (2006) *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*, Island Press, Washington, D.C., pp174
- WCED (World Commission on Environment and Development) (1987) *Our Common Future*, Oxford University Press, Oxford, pp400

Weiss, C.H. (1983) Evaluation Research in the Political Context, In: Struening, E.L., and Brewer, M.B. (Eds) (1983) *The Handbook of Evaluation Research*, Sage Publications, Inc., London, pp31-45

Wells, J. (2013) *Complexity and Sustainability*, Routledge, Abingdon, pp350

Westley, F., Tj, O., Schultz, L., Olsson, P., Folke, C., Bodin, O., and Crona, B. (2013) A Theory of Transformative Agency in Linked Social-Ecological Systems, *Ecology and Society*, 18(3), pp27

Wheeler, S.M. (2012) *Climate Change and Social Ecology: A New Perspective on the Climate Challenge*, Routledge, Abingdon, pp192

Wheeler, T., and von Braun, J. (2013) Climate Change Impacts and Global Food Security, *Science*, 341(6145), 508-513

White, H. (2008) The measurement of poverty, In: Desai, V., and Potter, R.B. (Eds) (2008) *The Companion to Development Studies: Second Edition*, Hodder Education, London, pp25-30

Whitfield, S. (2016) *Adapting to Climate Uncertainty in African Agriculture*, Routledge, Abingdon, pp190

Williams, C., Fenton, A., and Huq, S. (2015) Knowledge and Adaptive Capacity, *Nature Climate Change*, 5(2), 82-83

Yaro, J. (2002) The poor peasant: One label, different lives. The dynamics of rural livelihood strategies in the Gia-Kajelo community, Northern Ghana, *Norwegian Journal of Geography*, 56(1), 10-20

Yaro, J.A. (2010) *The Social Dimensions of Adaptation to Climate Change in Ghana*, The World Bank, Washington D.C., pp104

Yiran, G.A.B., Kusimi, J.M., and Kufogbe, S.K. 2012. A synthesis of remote sensing and local knowledge approaches in land degradation assessment in the Bawku East District, Ghana, *International Journal of Applied Earth Observation and Geoinformation*, 14(1): 204-213

Yitshaki, R., and Kropp, F. (2016) Motivations and Opportunity Recognition of Social Entrepreneurs, *Journal of Small Business Management*, 54(2), 546-565



Appendix A - Certificate of Ethical Approval



<b>Social Sciences &amp; Arts Cross-School Research Ethics Committee</b> <b>CERTIFICATE OF APPROVAL</b>	
<b>Reference Number:</b>	ER/RT223/1
<b>School:</b>	BMed/SPRU
<b>Title of Project</b>	Investigating Participatory Approaches in Agricultural Research and Development Initiatives for Enhancing Adaptive Capacity
<b>Principal Investigator:</b>	Rachael Taylor (Marshall)
<b>Expected Start Date:*</b>	01/01/2014
<p>*NB. If the <u>actual</u> project start date is delayed beyond 12 months of the <u>expected</u> start date, this Certificate of Approval will lapse and the project will need to be reviewed again to take account of changed circumstances such as legislation, sponsor requirements and University procedures</p>	
<p><b>This project has been given ethical approval by the Social Sciences/Arts Research Ethics Committee (C-REC). Please note the following requirements for approved submissions:</b></p> <p><b>Amendments to research proposal</b> - Any changes or amendments to the approved proposal, which have ethical implications, must be submitted to the committee for authorisation prior to implementation.</p> <p><b>Feedback regarding any adverse and unexpected events</b> - Any adverse (undesirable and unintended) and unexpected events that occur during the implementation of the project must be reported to the Chair of the Social Sciences C-REC. In the event of a serious adverse event, research must be stopped immediately and the Chair alerted within 24 hours of the occurrence.</p>	
<b>Authorised Signature</b>	
<b>Name of Authorised Signatory (C-REC Chair or nominated deputy)</b>	Professor Stephen Shute 17/12/2013

### Appendix B - List of Research Participants

List of constituencies of groups which participated in Focus Groups, Participatory Methods, and Visual Ethnography with location, dates of data collection, and group identifier

<b>Identifier</b>	<b>Location</b>	<b>Number of Males</b>	<b>Number of Females</b>	<b>Dates</b>
FGT1	Kabusgo	18	13	11/2/14, 21/7/14, 9/10/14
FGT2	Kabusgo	13	15	11/2/14, 24/7/14, 9/10/14
FGT3	Kabusgo	14	13	13/2/14, 31/7/14, 8/10/14
FGT4	Pelungu	1	3	14/2/14, 23/7/14, 13/10/14
FGT5	Dachio	0	13	13/2/14
FGT6	Pelungu	0	39	15/2/14, 26/7/14, 17/10/14
FGT7	Pelungu	3	0	15/2/14, 26/7/14, 14/10/14
FGT8	Pelungu	4	9	3/3/14, 21/7/14, 13/10/14
FGT9	Nakpalig	2	6	26/2/14, 4/8/14, 7/10/14
FGT10	Beo-Tankoo	2	4	6/3/14

Identifier	Location	Number of Males	Number of Females	Dates
FGT11	Pelungu	3	11	27/2/14, 31/7/14, 15/10/14
FGT12	Yakort	2	5	13/10/14
FGC1	Jonga	0	14	15/3/14, 15/9/14, 22/9/14, 3/10/14
FGC2	Doodiyiri	3	8	22/3/14, 16/9/14, 3/10/14

List of participants who took part in Semi-Structured and Key Informant Interviews with location, dates of interviews, and participant identifiers

Identifier	Location	Male or Female	Interview Dates
IVT1	Kabusgo	M	11/2/14, 23/7/14, 11/10/14
IVT2	Kabusgo	M	11/2/14, 29/7/14
IVT3	Kabusgo	M	11/2/14, 29/7/14
IVT4	Kabusgo	F	11/2/14, 21/7/14
IVT5	Kabusgo	F	11/2/14
IVT6	Kabusgo	M	11/2/14, 23/7/14, 11/10/14
IVT7	Kabusgo	F	11/2/14, 23/7/14
IVT8	Kabusgo	F	11/2/14, 29/7/14
IVT9	Kabusgo	F	11/2/14, 29/7/14
IVT10	Pelungu	M	12/2/14, 28/6/14
IVT11	Pelungu	F	12/2/14, 28/6/14
IVT12	Pelungu	M	13/2/14
IVT13	Pelungu	F	13/2/14, 22/7/14

Identifier	Location	Male or Female	Interview Dates
IVT14	Pelungu	M	13/2/14, 21/7/14, 8/10/14
IVT15	Dachio	F	14/2/14
IVT16	Dachio	F	14/2/14
IVT17	Dachio	F	14/2/14
IVT18	Dachio	F	14/2/14
IVT19	Pelungu	F	18/2/14, 30/7/14
IVT20	Pelungu	F	18/2/14
IVT21	Pelungu	F	18/2/14
IVT22	Pelungu	M	18/2/14, 22/7/14
IVT23	Pelungu	M	21/2/14, 22/7/14
IVT24	Pelungu	F	21/2/14, 30/7/14
IVT25	Pelungu	M	24/2/14
IVT26	Pelungu	F	24/2/14, 31/7/14
IVT27	Pelungu	F	28/2/14
IVT28	Kabusgo	M	28/2/14
IVT29	Kabusgo	M	28/2/14, 23/7/14
IVT30	Kabusgo	F	3/3/14, 29/7/14
IVT31	Kabusgo	F	3/3/14, 29/7/14
IVT32	Kabusgo	F	3/3/14, 29/7/14
IVT33	Kabusgo	F	3/3/14
IVT34	Nakpalig	M	26/2/14
IVT35	Nakpalig	F	26/2/14
IVT36	Nakpalig	F	26/2/14
IVT37	Nakpalig	F	26/2/14
IVT38	Nakpalig	F	27/2/14
IVT39	Nakpalig	M	27/2/14
IVT40	Nakpalig	F	27/2/14
IVT41	Nakpalig	F	27/2/14
IVT42	Pelungu	M	4/3/14, 27/7/14
IVT43	Pelungu	M	4/3/14, 27/7/14
IVT44	Pelungu	F	4/3/14, 27/7/14

Identifier	Location	Male or Female	Interview Dates
IVT45	Beo-Tankoo	M	7/3/14
IVT46	Beo-Tankoo	M	7/3/14
IVT47	Beo-Tankoo	M	7/3/14
IVT48	Beo-Tankoo	F	7/3/14
IVT49	Yakort	M	13/10/14
IVT50	Yakort	F	13/10/14
IVT51	Yakort	F	14/10/14
IVT52	Yakort	F	14/10/14
IVT53	Yakort	F	14/10/14
IVT54	Yakort	F	14/10/14
IVT55	Yakort	M	15/10/14
IVC1	Jonga	F	17/3/14, 16/9/14
IVC2	Jonga	F	17/3/14, 16/9/14
IVC3	Jonga	F	17/3/14, 17/9/14
IVC4	Jonga	F	17/3/14, 17/9/14
IVC5	Jonga	F	17/3/14, 17/9/14
IVC6	Jonga	F	17/3/14, 17/9/14
IVC7	Jonga	F	17/3/14, 17/9/14
IVC8	Jonga	F	17/3/14, 18/9/14
IVC9	Jonga	F	18/3/14, 18/9/14
IVC10	Jonga	F	18/3/14, 18/9/14
IVC11	Jonga	F	18/3/14, 18/9/14
IVC12	Jonga	F	18/3/14, 18/9/14
IVC13	Jonga	F	18/3/14, 18/9/14
IVC14	Jonga	F	18/3/14, 18/9/14
IVC15	Doodiyiri	M	29/3/14, 20/9/14
IVC16	Doodiyiri	F	29/3/14, 22/9/14
IVC17	Doodiyiri	F	29/3/14, 22/9/14
IVC18	Doodiyiri	F	29/3/14, 22/9/14
IVC19	Doodiyiri	F	29/3/14, 20/9/14
IVC20	Doodiyiri	F	29/3/14, 22/9/14
IVC21	Doodiyiri	F	29/3/14, 22/9/14

Identifier	Location	Male or Female	Interview Dates
IVC22	Doodiyiri	F	29/3/14, 22/9/14
IVC23	Doodiyiri	F	29/3/14, 20/9/14
IVC24	Doodiyiri	M	29/3/14, 20/9/14
IVC25	Doodiyiri	M	29/3/14, 22/9/14
KI1	Bolgatanga	M	25/2/14, 21/7/14
KI2	Bolgatanga	F	26/2/14
KI3	Bolgatanga	M	28/2/14, 25/7/14
KI4	Bolgatanga	M	28/2/14
KI5	Bolgatanga	F	28/2/14
KI6	Bolgatanga	M	3/3/14
KI7	Bolgatanga	M	7/3/14, 25/7/14
KI8	Wa	M	12/3/14
KI9	Wa	M	14/3/14
KI10	Wa	M	18/3/14
KI11	Wa	M	18/3/14
KI12	Wa	F	24/3/14
KI13	Wa	M	26/3/14
KI14	Bolgatanga	F	29/7/14
KI15	Bolgatanga	M	29/7/14
KI16	Bolgatanga	M	4/8/14
KI17	Bolgatanga	F	4/8/14
KI18	Bolgatanga	M	4/8/14
KI19	Bolgatanga	M	4/8/14
KI20	Bolgatanga	M	1/10/14
KI21	Wa	M	26/9/14
KI22	Online via Skype	M	9/11/14
KI23	Online via Skype	F	12/11/14
KI24	Online via Skype	M	25/3/15

### Appendix C - Sample Transcript

#### Interview KI1 on 25-2-2014

RT – Researcher

TD – Key informant

RT: I just have some questions regarding the Trax perspective rather than the farmers perspective, and also understanding how this project came to develop as it is. Because it's been going for such a long time and Self Help Africa have only been funding for 7 years or so, since 2005/6.

TD: Yeah, 2005. It was approved in 2005 and started in 2006.

RT: Okay. So, before that, the project was much the same?

TD: Umm, yeah. We've not shifted our focus on our most central project orientation, in turns of food security. That has been our main focus, working with farmer to achieve food security. So all that we do, the design of the project is aimed towards food security.

RT: So what did change when Self Help Africa became involved?

TD: We sort of tried to continue the project but moving from some project areas to other areas. Because, as we indicated with our induction programme, we work in an area, a project zone, for some number of years and then they will wean off and we move to another area. So supporting this means we are dipping in our focus in one area and spreading to other areas. So basically they [SHA] have come to help us to assess the need and move to cover more areas.

RT: Do you think that's working?

TD: Yes. Also, one thing that we've not been doing in the past was really looking at what you call enterprise development or value chain, community value chain, which we started looking at last year in terms of Self Help Africa. In the past, though we work with farmers, geared towards food security, they actually see some gains in terms of increase in production. Basically, that has been more or less confined in their local community in terms of sales. But this time we are thinking about beyond that and see how best we can develop the market chain for them to, if possibly, just go beyond their

local community themselves to local, even regional and national, or if possible, hehe, with time, we can think international. That is what led us to the orange-fleshed sweet potato project which we started with a pilot last year. We will be deepening the number of participants this year in terms of our coverage. Last year we started with 50 farmers, this year we will be developing 100 additional farmers. And then they also be able to train them in other areas towards a more business-like madate and also see how we can add value to the orange-fleshed sweet potato. So it's something we've not been proactively doing in the past. So with this new commodity, Self Help Africa is the first organisation that we've partnered with that is helping us to work towards that dream.

RT: Are CIP funding the orange-fleshed sweet potato project or are Self Help Africa funding that s well.

TD: No, Self Help Africa fund it. The partners are CIP and then also SARI. Because possibly there is some element of research which is where SARI comes in. And also CIP also helping and training, and also value chain education, and the same partners are all coming with these things to continue the activities.

RT: So I know that the time you spend in each project zone got shorter some years ago. Is that just so that you cover more areas?

TD: Not precisely. We realised that in the past, if you look at the project cycle in the past it was about 7 years. There was a review. We strategically gathered together the farmers and all the stakeholders and we tried to revisit the different activities we do on yearly basis. Year one, what do we do, we start with the needs assessment, identify the key issues, maybe moving to trainings, and so on so forth. We realised that we could be able to do all those processes within 5 years. By the time we enter, train them in different techniques and help to put in place grassroots structures, a minimum of, we could be looking to do it in under 5 years period. That allowed us to scale down from 7 years to 5 years. So it was a participatory assessment, carried out with all the stakeholders, with key people, all the beneficiaries who are the farmers, we realised that we don't need 7 years in a project zone, 5 years will suffice.

RT: It means you can reach more people.

TD: Yes, exactly, exactly. It means we can be done before and then extend our service to another place.



RT: So I guess the project largely as it is now was in place before you were even with TRAX?

TD: Yes.

RT: So the same activities, the same focus, the same participatory approach?

TD: Yes. Exactly.

RT: Since it began in [19]89?

TD: Exactly.

RT: Right, okay. And the project hasn't changed too much since then, just different focuses depending on the funder. For example, Self Help Africa bringing in the orange-fleshed sweet potato.

TD: Yes. We believe it is the beneficiaries who can tell their own story. So we don't start implementing any project or designing any project if the people are not actively involved. So before we start anything there should participatory needs assessment to allow farmers themselves to define their problems, if possibly be involved in suggesting solutions to problems. So that always has been the basis of any design of the project. As I've already indicated, over the years the peculiar problems cut across, being land degradation, being problems with animals, being maybe issues with water and so and so forth. So it seems to be the key issues are irrespective of the new areas and keep reoccurring.

RT: So what historically was the main incentive for this project, and for Trax as an organisation?

TD: The main reason why Trax is into this is because broadly, the majority of people in this area are farmers. Farming is their occupation, but there is a challenge. The challenge here is the soil, the land, which is the base of their livelihood, is not very good, it is very deficient in nutrients. So if there is a base and there is a problem with the base, of course that has a negative effect on their livelihood. What that means is that when they grow their crops over the years, they are seeing that they have very low yields, and that translates into very low incomes, because you should have enough to eat, to sell to make some income from their crops for their homes. So because of that situation you see a cycle of poverty - low yield, low food, low sales, low income, deprivation, and so on and so forth. So we feel that to be able to tackle that problem, we need to see how best, sustainably, the land, the soil could be managed to keep crop

growth but very sustainably, to enable them to increase their yield, increase their food availability, and then also that they have enough to eat, they could have enough to sell, could have some money in their pocket to take for their house. So that was the drive of Trax just because people were farmers.

RT: And so where did other aspects such as the livestock revolving scheme and village saving and loans associations come in? Are they newer or quite old in the project cycle as well?

TD: It came along in the older project. But, as information, if you talk about agric, you talk about crop yield. But again, if you look at Northern Ghana, there are some challenges. For instance they have only one rainfall regime and we were also thinking about, apart from the soil, they need inputs and how can they get money to buy the inputs. We also feel that as we support them to get money we could be able to training them to build their capacity to mobilise their own resources. Instead of going to banks which have high interest rates. So that led to some interventions along the line, like bringing on board the village savings and loan association scheme where we encourage them to make their own savings because, obviously, we work with them in groups, so when they make some money they can make contribution towards the group and learn for themselves. So that meant some of the programmes along the line come on board, based on, as we roll out, we see some related problems are identified so it helps in shaping the entire focus and we bring them into the project cycle.

RT: So you've got some quite short-term goals on an annual basis in terms of having a good yield that year, enough food and income each year, and then also some long-term goals in terms of sustainability and the sustainability of the project once Trax leave the area and also just socio-economic development indicators in terms of feeding into the income they've got and what they have for their livelihoods and household. Do you think project is achieving short-term and long-term goals? Are there differences between the two and how the project is functioning?

TD: I think we are achieving the short-term and long-term goals. The main reason of the soil and water conservation, the LEISA techniques, to take care of the soil, is to increase production and as many as who are adopting those technologies, we see that there has been a significant improvement in the soils, which translates into increased yield. So in areas where the harvest was very, very poor, you go there and see that they are having

bumper harvest. Which also means that the hunger gap is closed in those areas. There are some areas where in the past they used to have about seven months without food. Now that closes to about two / three months that they don't have food throughout the year. So that in a way, we see that we achieve the goals, immediately, where the condition of the soils improves, which can translate in the village to food crops with better yields, which can translate to them selling to have some income to take care of their basic needs. So if you interview some farmers they will tell you that because of increased yields they are now able to take care of their basic needs - pay school fees, pay national health insurance premium, buy school uniform for their kids, and so on so forth. People really tested things. So, to me, we are making some progress.

RT: So, do you think the project is helping farmers to achieve positive outcomes for themselves beyond just what Trax facilitate?

TD: Yes, because in the past some of them will tell you they don't know even how to sit together as a group, as people, and discuss issues. But now, by virtue of we coming in and building their capacity, they sit freely to really discuss their own developmental issues in the community beyond even the just the farming issues we are talking about such as soil and water conservation. We think about how do we even approach somebody to come to our aid or how do we go about sourcing for some help. So it goes beyond just engaging them to now giving them that capacity to freely talk among themselves, to freely know what they are really about in terms of developmental issues. So, it gives them that positive edge so they can do more things than when we began the project.

RT: So it kind of initiates a process but they then self-mobilise further?

TD: Exactly, exactly. And like I was sharing the other day, to me we see a significant change in the way they manage, particularly the women especially, now, could sit among their men counterpart and also contribute towards discussions, contribute towards the issues that bothers their development. That was the situation in most communities that we started with in the past, but now, because of the kind of capacity building trainings that has gone on.

RT: So do you think there's potential for the same kind of positive impacts for communities who are not engaging with Trax, those neighbouring communities or those outside of the Trax project?

TD: Of course. People who have seen what is happening in terms of our direct beneficiaries. Some of them either learn or come to their place for some level of explanation or support. Or they still seek Trax intervention, yes. And that to me has been one of our major challenges, when a lot of communities keep coming to Trax needing our interventions. Again that goes with our ability to sustain and keep basically that. So I will tell you that a lot of people need our support beyond the people who are current beneficiaries, the people we are working with.

RT: So do you think with the community trainers they could train other communities completely? Do you think if Trax never got to this particular community who have asked for your help, would the community trainers that you have trained be able to support them?

TD: Yes, with doubt. Because, beyond the training we give to all the farmers, they are given additional training which gives them that edge to lead the process and also go out and support other farmers. So in areas or places where Trax cannot reach, the community trainers could be able to train and carry out those functions very perfectly.

RT: A main goal of Trax is towards food security and sustainable crop yields. You've referred to it already, but do you think these activities can relate to other development goals more broadly? So if you look at the Millennium Development Goals for example, they address a lot of different things and environment and hunger are only small parts. Do you think Trax addresses other areas as well?

TD: Yeah. One of them is environmental sustainability, which Trax is also in because one of our key areas we believe in making sure that the soil its nutrient value so that so that we start soil sustainability. And we give training and give support on tree growing, on bunding, training people on environmental management, fire fighting, and all these things we train them. And also another area is gender equality is also another thing we are working with and work towards. As I earlier mentioned, one of our areas of capacity building is to ensure that both men and women see themselves as equal partners in development. Not one person dominate. That is what has led to the free age or the capacity of both now sitting down to discuss and then bring out suggestions of how best

they could now push forward. In the area, though I've mentioned that our area is food security notwithstanding, we also look at basic education. We partner with other organisations like British School of Brussels to be able to extend such services to some basic schools. We always start with some partners and then with some time we can see we will be able to expand to cover more areas. So we are quite mindful about the Millennium Development Goals and work in a broader sense towards achieving those goals. I also realise that in some of our past projects, one of the Millennium Development Goals is towards health and also education of malaria and some diseases, we work in the past with some family health intervention where the focus has been on the area of HIV/AIDS prevention and also providing education on how people can lead very responsible lives, promotion of condoms and all those things, were some of the things we did in the past. So again, that fits into our perspective about the Millennium Development Goals. And also nutrition with the sweet potato and soya beans.

RT: The last topic. I just want clarification of three terms and what Trax perceive the understanding of these terms are: participation, adaptation and sustainability. Can you define what those three things mean to you?

TD: Okay. To me, participation in development means the people's active involvement in all the processes leading to defining their goals and also being involved in carrying out processes that will lead to their development. So to me, it means that people are more or less not sidelined. They play a key role in making sure that every decision that is taken, they help in defining that decision. We find that that ultimately allures to their benefits. Any thing that they are involved in that allures to their benefits, to me is a kind of participation. The second one is?

RT: Adaptation or adaptive capacity

TD: Adaptive capacity, yes. To me, adaptive capacity has to do with any intervention that more or less tries to adjust to, either to what you call the status quo, what has been the status quo and now there has been a shift in what is the status quo. So any action or any intervention that tries to adjust to suit or to fit into the status quo, to me, they are trying to adapt to that change in situation. The last but not the least?

RT: Sustainability

TD: To me, sustainability means any, again, action or intervention or project that cannot go beyond its project phase, or in other words that the participants themselves could not be able to carry out independently beyond the support that they achieve currently, that to me is not sustainable. Anything that is sustainable should be geared towards people beneficiaries, be able to carry it out independently of the initial people who entered or engaged them in the process. So anything beyond that to me is not sustainable. Any maybe to go further, for it to be sustainable the focus must be within, looking at within the environment, what is already existing and not importing or bring on board any foreign material or foreign resources because that would be costly for the people to carry alone. So anything within their environment which they could be trained or their capacity built to make use of during the project phase, that is sustainable. Capacity building.

## Appendix D - Details of Trax Sustainable Agriculture Project Activities

All information in this Appendix is drawn from notes taken during the fieldwork period with Trax in 2014 and from the Trax Staff Induction Pack (Trax, 2014, unpublished internal document).

The Trax Sustainable Agriculture Project runs alongside other projects which Trax facilitate with farming communities. The agricultural intervention comes under the Sustainable Livelihoods Programme and is cross-cutting with the Community Empowerment Programme. Through other projects Trax support environmental conservation through activities which fit with the objective to enhance the sustainability of agricultural livelihoods. Trax also support an education project with local schools, providing resources and scholarships.

Trax work in four areas of Northern Ghana at a time, two in Northern Region and two in Upper East Region. All of the features of their projects are supported in each area they work in, except for the education project which is only implemented in Upper East Region.

### Trax's Sustainable Agriculture Project

The agricultural project activities within and Sustainable Livelihoods Programme is dominant in Trax's intervention and features in the activities with each community and farmer group they work with. The Sustainable Agriculture Project consists of trainings, the provision of agricultural inputs, establishing connections between farmers and extension services and all other services offered by Trax. This project also incorporates the development of supplementary livelihoods alongside the main farming activities.

After facilitating a participatory needs assessment with the community, Trax will support the farmers to organize into groups of 25 to 30 people. Trax will then work with six of the farmer groups in the first year of the five-year project cycle, adding an additional six groups each year in years two, three and four.

Depending on the farmer responses during the participatory needs assessment, Trax will select the appropriate soil and water conservation techniques for the community. Trax offers trainings in:

- Contour identification – using spirit level/A-frame/Water tube
- Bunding (terracing) along identified contours – using stones of Clay
- Grass stripping (vegetative strips) along identified contours – using vetiver grass
- Gully rehabilitation
- Water spreading weirs
- Crop residue management
- Zai pocket
- Tree growing – agro forestry, woodlot
- Natural regeneration (enclosures) and enrichment planting
- Composting
- Mulching
- Construction of energy saving mudstoves
- Crop rotation
- Cover cropping
- Intercropping with legumes
- Alley cropping
- Construction of improved animal pen
- Improved grazing/pasture land systems – paddock
- Pasture/rangeland enrichment
- Fire protection

The following outlines Trax's project activities in each of the years of the five-year project facilitation period.

#### Year 1

- Community entry & participatory needs assessment
- Facilitate formation of farmers groups
- Provide one-off tools pack to farmers groups
- Conduct video shows on sustainable ecological farming practices/outreach including anti-bush fire campaign & cross-cutting issues
- Carry out farmer-to-farmer exchange visits and skills/knowledge share
- Formulate participatory simple monitoring indicators (project assessment)
- Carry out capacity building in appropriate technology – LEISA



- Carry out capacity building and support in sustainable livestock management & fodder resources
- Link farmers groups to veterinary services
- Train selected farmers in out-growers scheme and inputs
- Facilitate selection of farmer group executives
- Facilitate development of farmer group constitution
- Train farmers groups, especially women in nutrition & food processing
- Collaborate with other institutions & create linkages
- Create linkages between beneficiary community and other partners/institutions for support
- Carry out participatory Project Monitoring

## Year 2

- Facilitate formation of six additional farmers groups
- Carry out Year 1 activities (except the needs assessment), especially with new farmers groups & refresher training with Year 1 groups
- Establish community based learning/demonstration farms & farmer field days
- Train farmers groups on numeracy & simple book keeping
- Identify alternative income generating activities & conduct feasibility study
- Train and support farmer groups in alternate income generating activities
- Identify & train community livestock worker and support with first aid kits
- Facilitate identification of specific commodities for chain development
- Map-out existing/new producer groups around identified commodity
- Facilitate restructure of farmer's producer groups around identified specific commodities
- Train producer groups on group cohesion management and business acumen
- Introduce producer groups to Village Savings and Loan Association (VSLA) concept
- Facilitate criteria for identification of Community Trainers (CTs)
- Conduct CTs needs assessment
- Collaborate with other institutions & create linkages –
- Create linkages between beneficiary community and other partners/institutions for support

- Carry out participatory Project Monitoring

### Year 3

- Facilitate formation of six additional farmers groups
- Carry out Year 1 activities (in green), especially with new farmers groups & refresher trainings with Year 1 & 2 groups
- Establish community based learning/demonstration farms & farmer field days
- Train new farmers groups on Numeracy & simple book keeping
- Link farmers groups to financial institutions
- Train and support farmers/groups in alternate income generating activities
- Identify & train community livestock workers and support with first aid kits
- Facilitate restructure of new farmer's producer groups around identified specific commodities
- Carry out improved technical capacity of new producer groups to increase quantity and meet standards
- Link producer groups to markets
- Introduce new groups to Village Savings and Loan Association (VSLA) concept
- Facilitate Village Savings and Loan Association involving new groups
- Develop CTs training modules and train CTs
- Facilitate intervening role for trained CTs & provide support
- Collaborate with other institutions & create linkages
- Create linkages between beneficiary community and other partners/institutions for support
- Carry out participatory Project Monitoring & impact assessment (mid-year)

### Year 4

- Facilitate formation of six additional farmers groups
- Carry out Year 1 LEISA activities intensively involving new farmers groups & refresher training for year 3 groups
- Train new farmers groups on numeracy & simple book keeping
- Link new farmers groups to financial institutions
- Train and support new farmers/groups in alternate income generating activities

- Identify & train community livestock worker and support with first aid kits
- Facilitate restructure of new farmer's producer groups around identified specific commodities (link new groups to cluster associations)
- Carry out improved technical capacity of new producer groups to increase quantity and meet standards
- Link producer groups to markets
- Introduce new groups to Village Savings and Loan Association (VSLA) concept
- Facilitate Village Savings and Loan Association involving new groups
- Facilitate identification of new CTs
- Conduct training for new CTs, refresher course for old CTs (year 3)
- Facilitate intervening role for newly trained CTs & provide support
- Collaborate with other institutions & create linkages
- Create linkages between beneficiary community and other partners/institutions for support
- Carry out participatory Project Monitoring & impact assessment (mid-year)
- Develop wean-off/exit strategy

#### Year 5

- Carry out refresher training on Year 1 activities, especially with year 4 groups
- Train year 4 farmers groups on numeracy & simple book keeping
- Link year 4 farmers groups to financial institutions
- Train and support new farmers/groups in alternate income generating activities
- Integrate year 4 groups into identified specific commodities cluster associations
- Carry out improved technical capacity of new producer groups, especially year 4 to increase quantity and meet standards
- Link producer groups including year 4 to markets
- Introduce year 4 groups to Village Savings and Loan Association (VSLA) concept
- Facilitate Village Savings and Loan Association involving year 4 groups
- Consolidate training for CTs on selected topics, including group dynamics, leadership and conflict resolution, and management towards consolidation and wean-off

- Facilitate role of trained CTs in community development including Community-Based Organisation formation and registration
- Consolidate collaboration and linkages with other institutions for community support and independence after wean-off
- Consolidate linkages between beneficiary community and other partners/institutions for support even after Trax wean-off
- Carry out participatory Project Monitoring & project impact assessment - share results with key stakeholders
- Carry out project close-out activities, hand over project to community and wean-off