

Assessment of Smallholder Farmers Strategies and Adaptive Capacities to Climate Change:



A Case of Konia District, Liberia

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**Assessment of Smallholder Farmers Strategies and Adaptive Capacities to Climate Change: A
Case of Konia District, Liberia**

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in partial fulfilment of the requirements for the degree of Master in Management of Development,
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LIST OF ABBREVIATIONS

ADB	AFRICAN DEVELOPMENT BANK
AEZ	AGRO-ECOLOGICAL ZONES
DFID	DEPARTMENT OF INTERNATIONAL DEVELOPMENT
EPA	ENVIRONMENTAL PROTECTION AGENCY
FDA	FORESTRY DEVELOPMENT AUTHORITY
FFI	FAUNA AND FLORA INTERNATIONAL
FGD	FOCUS GROUP DISCUSSION
GHG	GREENHOUSE GAS
IFAD	INTERNATIONAL FUND FOR AGRICULTURE DEVELOPMENT
IPCC	INTERNATIONAL PANEL ON CLIMATE CHANGE
KII	KEY INFORMANT INTERVIEW
LISGIS	LIBERIA INSTITUTE FOR GEO-INFORMATION SERVICES
LVI	LIVELIHOOD VULNERABILITY INDEX
MOA	MINISTRY OF AGRICULTURE
NGO	NON-GOVERNMENTAL ORGANIZATION
SADS	SKILLS AND AGRICULTURE DEVELOPMENT SERVICES
SHF	SMALLHOLDER FARMERS
SLA	SUSTAINABLE LIVELIHOOD APPROACH
SSI	SEMI-STRUCTURE INTERVIEW
UNDP	UNITED NATION DEVELOPMENT PROGRAMME
USAID	UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

ABSTRACT

Over the last ten years, Liberia has recorded temperature increase and low rainfall (World Bank, 2018). Due to this, productivity in agriculture has drastically decreased and now Liberia imports 75% of its staple food(rice) (Schroth, et al., 2016). Liberia's agriculture segment is considered forest-based under traditional systems of subsistence farming in the upland with rigorous labour of shifting cultivation and with low technological-based production (EPA Liberia, 2018). Climate change has a damaging effect on small-scale agriculture in Konia District, causing low productivity, poor crop growth, low income, damage of crops, and shift in livelihood sources. The objective of this study is to gain insight into the agricultural strategies and adaptive capacities being employed by smallholder farmers in response to climate change in Konia District. In addition, this research aims to propose recommendations to the SADS management for the development of strategic interventions that can reduce climate change impacts and improve smallholder farmers' agriculture productivity in Konia District. The case study uses semi-structured interviews (SSI), focus group discussions (FGD), and key informants' interviews (KII) to gather primary data for the study. A desk study was also used to gather secondary data. The collected data was analysed using thematic analysis. Findings show that smallholder farmers in Konia District practice traditional methods of farming (slash and burn, bush fallowing and crop rotation). These methods are less productive and more susceptible to climate change than modern methods such as irrigation, improved seed variety, climate-smart agriculture. At the same time, the assistance from institutional structures, such as the government and NGOs, is limited. In conclusion, the study recommends that institutional partnership to generate the needed funding to support smallholder farmers training particularly on current climate-smart technology should be pursued by SADS to enhance the adaptive capacity of the smallholder farmers in Konia.

Keywords: climate change, strategy, adaptative capacity exposure, agricultural production

1. Introduction

1.1 General context

Climate change is one of the main obstacles to achieving the global Sustainable Development Goals (SDGs). Development practitioners and researchers believe that climate change could undermine the ability of all countries to achieve sustainable development. Climate change affects all aspects of the development agenda from poverty reduction to disaster risk reduction (Hallegatte and Rozenberg, 2017). Livelihoods across the globe in every continent are increasingly threatened by changes in the climate. There are forecasts that global warming will lead to shifts in weather patterns, ocean tides and probably, ecological systems (IPCC 2014). More so, rising temperatures and sea levels are predicted by scientists that precipitation will become more inconsistent, drought more widespread and prolonged. This will escalate the problem of soil erosion around the world (Segura, et al., 2014).

Even though climate change is a global phenomenon, the kind of impact (positive or negative), the degree and intensity vary across continents, countries and sectors. In some geographic regions, extreme weather events such as droughts and floods have become more frequent, adding to the problem of hunger among people all over the world caused by poverty, weak governance, conflicts and poor market access (Hallegatte and Rozenberg, 2017). Negative impacts of climate change are more severely felt by poor people and poor countries, particularly in Sub-Sahara Africa (SSA), because they highly depend on rain-fed agriculture and natural resources, and have limited capacity to cope with climate variability and extremes (Serdeczny, et al., 2017; Schroth, et al., 2016; ADB, 2003). Therefore, there is a need for significant efforts to create models of development that can mitigate and adapt to the impacts of climate change (Serdeczny, 2017).

Moreover, there is a common understanding that the agriculture sector will be the worst affected by climate change with both irrigated and rain-fed agriculture across the globe to feel the impact (Ericksen, et al., 2011; Thornton, et al., 2011). According to the 2014 IPCC report, agricultural production, poverty eradication and food security in many African countries will be negatively affected by climate change. IFPRI's crop model predicted that average rice, wheat and maize yields in Sub-Saharan Africa would decline by up to 14%, 22% and 5% respectively by 2050 because of climate change (IFPRI, 2009). Considering that on average the agricultural sector of West Africa contributes about 40% of the region's total GDP and employs over 80% of its total population (AGRA, 2014), climate change impact on the sector will significantly affect its development agenda.

In West Africa, Liberia is among the countries that are vulnerable to the impacts of climate variability and change, such as warmer temperatures and increase in the frequency of heavy rainfall events, which present challenges to the country's socio-economic development (EPA, 2018). Climate models for Liberia suggest an average increase in annual temperatures from the 1970-99 average of 0.9-2.6°C by the 2060s and of 1.4-4.7°C by the 2090s with more rapid warming in the interior than in coastal areas (EPA, 2018). An overall increase in average annual rainfall, as well as in the number of heavy rainfall events, is predicted together with a rise in sea level of 0.6-1.0m by 2100 (EPA, 2018).

Several scholars, such as Adger, et al. (2003), Vermeulen, et al. (2013) and Lobell, et al. (2008), consider adaptation and adaptive capacities as effective strategies to mitigate the negative impacts and/or enhance positive impacts of climate change. Acknowledging the detrimental impact and vulnerability of Liberia economy to the climate change, the government of Liberia through the Environmental Protection Agency of Liberia (EPA) developed a National Climate Change Policy and Response Strategy in 2018 to guide national measures of the response. The document makes adaptation to climate change a national priority. The strategy also identified remaining needs to respond to climate change and build resilience to short and long-term climate change impacts and vulnerabilities. It also highlights the financial, technological, and human resources to identify adaptation priorities, adaptive capacities and implement appropriate adaptation plans and strategies.

In a country that is in the process of recovering from decades of conflicts, Liberian smallholder farmers may not have the necessary capacity to cope with and adapt to current and future climate impacts. Mastrandrea, et al. (2010) point out the importance of adaptive capacity and adaptation research linking climate impacts studies on agricultural production with adaptation planning to better understand these issues and propose effective measures to address the impact of climate change.

1.2 Problem context

Liberia faces challenge with the impact of climate change along with many other problems such as poverty, poor infrastructure, lack of information technology and access to finance, and weak institutions and resource competition (EPA, 2018). Several anthropogenic impacts have also worsened the climate change impact at the local level. For example, 45% of the total land area of Liberia is classified as dense forest (EPA, 2018).

The agricultural activities are the major source of livelihood for Liberia's population (Schroth, et al., 2015). This sector has been very important in the recovery of the Liberian economy after the civil war. Data further reveals that more than 70% of the population rely on agriculture as their main livelihood activity (Republic of Liberia, 2010). About 330,000 householders are engaged in smallholder agriculture with rice as the main staple crop cultivated by over 74% of the household, followed by cassava with 62%. (Schroth, et al., 2015).

Natural forests in Liberia are being threatened by agricultural practices such as shifting cultivation, which uses slash and burn, as well as increase mechanized cultivation such as the use of chainsaws, indiscriminate clearing of forest for industrial and artisanal mining, increasing exploitation of mangrove forest, small-scale plantation development and small-scale alluvial mining (USDA, 2013).

The National Climate Change Policy and Response Strategy (2018) documents that the key sectors of the country's economy have low adaptive capacity. This is a consequence of low levels of human and institutional capacity, technology, infrastructure, economy amongst others. The agricultural sector in general and smallholder farmers in specific are mentioned among the most vulnerable. For example, in forest-dependent communities, extreme climate events are limiting the ability of communities to sustain themselves due to pest infestation of crops, reduction of the amount of productive land, and lack of access to clean water, medicinal products, and fuelwood among other things, which they get from the forest.

The disruption to the agricultural system resulting from changes in patterns of rainfall and higher temperatures directly affect the country. Reducing vulnerability to current climate stress requires increased adaptive capacity and resilience to climate change in Liberia.

1.3 Problem statement

Traditional subsistence farming systems, mainly situated in the upland and characterized by labour-intensive shifting cultivation, low technologies and low productivity, dominate in Liberia's agriculture (EPA, 2018). Although rice, cassava and vegetable production accounts for about 87% of cultivated land, the output of most staple foods remains below the national required output. According to the World Bank (2018), Liberia has recorded an increase in temperature and decrease in rainfall over the last decade (2008-2018). Because of low rainfall and high temperatures, agricultural productivity has decreased substantially. Currently, the country is unable to meet national food demand. Therefore, 75% of its staple food (rice) is exported to supplement local production (Schroth, et al., 2016).

Liberia is situated in the tropical rainforest belt on the West Coast of Africa with a total land area of 9.58 million hectares, of which forests cover about 4.30 million hectares or 45% of the land area. However, the forest area has decreased in recent years due to uncontrolled logging and expansion of land used for agriculture. The annual rate of deforestation is currently estimated at 12,000 hectares (NFPIS, 2006). With the expansion of agriculture in forest areas, marginal lands and mining concessions taking over the

landscape of Liberia, there is a high risk of increased climate change impact on human livelihoods in the coming years.

Konia District is one of the most negatively impacted districts by climate change events. In Konia District, it has been observed over the years that agriculture production has reduced dramatically. As a consequence, smallholder farmers source of livelihood has changed from agriculture to other sources, deforestation is increasing and poverty has increased to an unprecedented level. The need to understand the factors that contribute to these conditions faced by the population of Konia District and Liberia at large of utmost importance.

Notwithstanding the impact climate change has on the livelihood of smallholder farmers in Liberia and particularly Konia District, and the critical role enhance adaptive capacity plays in reducing the negative effects of the impact, there is current lack of insight on their adaptive capacities, and current strategies being implemented in Konia District. Climate change may present new climate hazards and require new technologies, knowledge and resources to address the problems. However, these aspects are underexplored in climate change adaptation studies, particularly in the Liberian context. Additionally, limited research has been conducted to gain insight into the institutional structures and processes to mitigate the impact of climate change on smallholder farmers' agricultural production.

1.4 The objective of the study

The objective of this study is to gain insight into the agricultural strategies and adaptive capacities currently being employed by smallholder farmers to respond to climate change.

Additionally, this study aims to propose recommendation to the SADS Management for development of strategic interventions that can reduce climate change impacts and improve smallholder farmer's agriculture productivity in Konia District, Liberia.

1.5 Research Questions

How are smallholder farmers coping with climate change impacts on their livelihood and agricultural production in Konia District, Lofa County, Liberia?

Sub-questions

1. How are smallholder farmers livelihood and agricultural production impacted by climate change-related events?
2. What agricultural strategies are employed by smallholder farmers to cope with the impacts of climate change?
3. What adaptive capacities do smallholder farmers have to cope with the impacts of climate change?
4. To what extent are smallholder farmers' agricultural strategies and adaptive capacities improving their livelihood and agricultural production?
5. Which and to what extent are currently employed institutional structures and processes assisting smallholder farmers to mitigate the impact of climate change?

1.6 The relevance of the study

Currently, there is a limited amount of research about smallholder farmers' adaptive capacities and farming strategies in response to climate change impacts in Liberia. The Liberian National Climate Change Policy and Response Strategy (2018) has recently identified a lack of data related to smallholder farmers context-specific adaptation strategies, adaptive capacities as a challenge that needs to be addressed. This study helps to fulfil this knowledge gap. This study also contributes to providing relevant data to the general climate change and adaptation literature in Liberia. It particularly provides insight about current

farming practices smallholder farmers employ to cope with climate change, and their adaptive capacity to adjust to climate change impacts in Konia District, Liberia.

Findings from this research can serve as relevant inputs to government agencies (i.e. Ministry of Agriculture, Forestry Development Authority, Environmental Protection Agency), multi-national institutions and NGOs to formulate appropriate policy interventions in support of farmers whose livelihoods are increasingly being affected by climate change.

Additionally, findings from this thesis can help the Project Commissioner to identify adaptation measures and policies that can assist in improving smallholder farmers' production and to build resilient livelihood for its projects' beneficiaries.

1.7 Limitation of the study

The COVID 19 pandemic measures prevented the researcher from travelling to the area to collect the field data in person. To address the limitation the research commissioner (SADS) under request from the researcher recruited a research assistant who is familiar with the research community, has extensive data collection experience and ability to speak the local language. This situation posed a challenge regarding the data quality that might affect the result of the research. However, the researcher has done everything in her power to prevent it by constantly staying in touch with the assistant, guiding him and providing clear instructions.

2. Literature review

2.1 Introduction

This chapter reviews related literature. It starts with an explanation of the main concepts, provides an overview and analysis of relevant literature on climate change and its impact on the agricultural production and livelihood, vulnerability, adaptive capacities and strategies used by smallholder farmers in a different context and ends with the explanation of theoretical frameworks adopted for the study.

2.2 Definition of Main Concepts

2.2.1 Smallholder farmer

The definition of smallholder farmers is different between countries and agro-ecological zones. In favourable areas of Sub-Sahara Africa with high population densities, SHF usually cultivates less than 1 ha of land, whereas they may cultivate 10 ha or more in semi-arid areas (FAO, 2008; Lowder, 2016).

2.2.2 Climate change

The IPCC (2014) defined climate change as “a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer”. There is a consensus among scholars that climate change could be a result of natural processes or external forces, or because of the composition of the atmosphere, in land use, a direct or indirect human activity which may modify the composition of the atmosphere (IPCC, 2014; Metz, et al., 2007). There are concerns that climate change may affect human activity and some of these effects are already being observed (Morton, 2007). Around 90-95% of climate change is most likely to have been caused by human activity (IPCC, 2007).

2.2.3 Climate variability

Climate variability “refers to variations in the mean state and other statistics of the climate on all spatial and temporal scales beyond that of individual weather events” (IPCC, 2014).

Natural variability of the climate system, in particular on seasonal and longer time scales, predominantly occurs with preferred spatial patterns and time scales, through the dynamical characteristics of the atmospheric circulation and through interactions with the land and ocean surfaces. Such patterns are often called regimes, modes, or teleconnections (IPCC, 2014).

2.2.4 Climate extreme

This is “the occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events are referred to collectively as climate extremes” (IPCC, 2014).

2.2.5 Coping capacity

Is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantages of opportunities, or to cope with the consequences (IPCC 2007). One of the most important factors shaping the adaptive capacity of individuals, households and communities is their access to and control over natural, social, physical and financial resources

2.2.6 Impacts

Impact refers to the “effects on natural and human systems” (IPCC, 2014).

2.3 Vulnerability

The concept of vulnerability has become more prominent in the context of climate change within climate change studies in recent decades (Canon, 1994; 2000; Wisner, et al., 2004; Ribot, 1996). Vulnerability research is broadly centred on different concepts of sustainable livelihood analysis, poverty, food security, disaster risks and adaptation/coping (Chambers and Conway, 1992; Sen, 1981; Kelly and Adger, 2000). Vulnerability is applied as a key concept in assessing who will experience the greatest impacts of climate change. Many researchers in the field have often cited Sen's entitlement approach (1981) as having built the foundations for systematically examining causality and for laying the groundwork for vulnerability analysis (Kelly and Adger 2000; Adger 1996; Ribot 1996).

Chambers (1989), in the context of livelihood security, considered vulnerability as exposure to contingencies and stress, and difficulty in coping with them. To Birkmann (2006), vulnerability most commonly includes exposure, susceptibility and capacity of response. It is viewed from various perspectives such as biophysics, human ecology, political economy, and constructivist and political ecology (McLaughlin and Dietz, 2007; Miller, et al., 2010). Climate-induced variability negatively affects livelihoods and puts rural households at risks of shocks and stresses (Prowse and Scott, 2008). Moreover, these households have inadequate assets and therefore are exposed to risks cannot cope. According to the IPCC (2014), vulnerability is the tendency to be adversely affected and vulnerability to climate change is "the degree to which an environmental or social system is susceptible to and unable to cope with, adverse effects of climate change, including climate variability and extremes".

The IPCC (2014) considers vulnerability to be a function of three factors. The first one is the types and magnitude of exposure to climate change impacts. The second one is the sensitivity of the target system to a given amount of exposure. Finally, the third factor is the coping or adaptive capacity of the target system or population. As can be seen from the abovementioned, there is no agreement among scholars on what vulnerability is. In this thesis, the IPCC definition is adopted and the emphasis is placed on the adaptive capacity components as the conceptual framework to explore the smallholder farmers' abilities to cope with climate change in Konia District.

2.4 Impact of climate change in Liberia

Liberia faces challenge with the impact of climate change along with many other problems such as poverty, poor infrastructure, lack of information, technology and access to finance, weak institutions and resource competition (EPA, 2018). The mainstay of the economy in Liberia is rain-fed agriculture that depends on the climatic pattern and thus, is vulnerable to extreme weather events. The impact of climate change has been felt in Liberia over the past few decades. Increased frequency of natural hazards such as coastal erosion, terrestrial flooding, loss of mangrove forest by sea intrusion and associated impact on fishery and wildlife are the most prominent impacts of climate change in Liberia (EPA, 2018).

Several anthropogenic impacts have also worsened the climate change impact at the local level. Among them specialists name shifting cultivation (which uses slash and burn), increase in mechanized cultivation, indiscriminate clearing of forest for industrial and artisanal mining, increasing exploitation of mangrove forest, small-scale plantation development and small-scale alluvial mining, which are occurring at the expense of natural forest (USDA, 2013). The EPA (2018) expressed worry that, unless these issues are managed soon, they will aggravate poverty and accelerate climate change.

2.5 Mitigation of climate change

Mitigation is considered as a human intervention to decrease the causes or increase the sinks of greenhouse gases (IPCC, 2014; Edenhofer, 2015). Mitigation is a response strategy to global climate

change and can be defined as measures that reduce the number of emissions (abatement) or enhance the absorption capacity of greenhouse gases (sequestration). It refers to any strategy or action taken to remove the GHGs released into the atmosphere or to reduce their amount. IPCC (2007) defines mitigation as the technological change and substitution that reduce resource inputs and emissions per unit of output.

2.6 Adaptation to climate change

The concept of adaptation has become preserved in global policies such as the 2nd article of the United Nations Framework. Despite the global climate change adaptation and, recognition until the 1990s and early 2000s, the international policy on climate focused on mitigation. However, from the early 2000s, the shift to adaptation has been documented (Pielke, et al., 2007; Parry, et al., 1998; Hulme, et al., 2007). Adaptation has been variously defined in climate change literature. Prominent among the various definition is that of the IPCC (2014), where adaptation is defined “as the process of adjustment to actual or expected and its effects to lessen or avoid harm or exploit beneficial opportunities”.

Policy-driven or planned adaptation is often interpreted as being the result of a deliberate policy decision on the part of a public agency, based on an awareness that conditions are about to change or have changed, and that action is required to minimize losses or benefit from opportunities (Pittock and Jones, 2000). This thesis acknowledges that adaptation does not simply occur independently at the field or farm level, but it is a process influenced by broader economic, political and social forces. Therefore, besides focusing on farmers’ adaptation, to understand farmers adaptation capacity, the study also looks into the institutional structures and processes to mitigate the impact of climate change on smallholder farmers, including the government (with a focus on the Ministry of Agriculture) and NGOs that run intervention programs related to agriculture.

2.7 Smallholders’ agricultural and non-agricultural adaptation strategies

According to Schroth, et al. (2015), well planned and early adaptation action reduces disaster, protects lives and increase agricultural productivity. Climate change adaptation strategies are appropriate at all levels of society, due to the harshness of climate impacts (Ford, et al., 2016). Smallholder farmers have always lived with the change in the weather pattern and have their adaptation strategies for climate uncertainty. Many of these measures are indigenous knowledge which offers advantages in terms of production (Johnston, et al., 2009).

Scholars, such as Bradshaw, et al. (2004) and Salazar-Espinoza, et al. (2015), found that in some cases a substantial share of variety of production in farming systems has risen because of adaptive responses to climate change. However, larger smallholders are likely to adapt compared to their counterparts in smaller smallholders (Gebrehiwot and van der Veen, 2013; Huang, et al., 2014). This links to theories which recommend that underlying adaptive capabilities can scale with the size of agricultural holdings (Troost, 2014). Technological management of water is important for smallholder farmers who mostly depend on rainwater for their agricultural production. For non-irrigated agriculture, water conservation, harvesting, and storage techniques serve as an important adaptation strategy (Lybbert and Sumne, 2012; Trærup and Stephan, 2015; Christiansen, et al., 2011). Conservation agriculture may assist in systems that are irrigated and rain-fed for an increase in soil organic matter to increase water retention and usage efficiency (Milder, et al., 2011).

Smallholder farmers use the change of crop varieties to respond to climate change. The smaller holders benefit because of these crops being resistant to heat, tolerating salinity, and are fast-maturing crop varieties within shorter periods (Lybbert and Sumne, 2012; Vermeulen, et al., 2012). Fafchamps and Lund (2003) found that smallholders regularly seek casual ways of sharing risks in the form of community social ties and familiarity and depend on diverse income sources in areas where agricultural production is

marginal. According to Ellis (1998), diversification within households increases income, decreases vulnerability, and helps in shielding against vulnerabilities during agricultural failure. However, it is not a guarantee for all the not all smallholders to diversify. More so, the development of new migration strategies as an adaptation is a transitional area of interest (McLeman and Smit, 2006; Tacoli, 2009; Rufino, et al., 2013). Migration can be a strategy that is temporary due seasons in new agricultural areas and regions but can also be permanent. Worldwide, conditions caused by climate change can be hostile to agriculture and therefore resulting into rural-urban migration such as a case in India where labourers move from agricultural production to manufacturing at times of the year when productivity is so low (Colmer, 2016).

2.8 Smallholders' adaptive capacities

Adaptive capacity is defined as the ability of a system to adjust to actual or expected climate stresses or to cope with the consequences. Engle (2011) believe that adaptive capacity mostly brings some positive qualities of a system that enable it to decrease the adverse impacts (vulnerability) connected with climate change. New research also indicates that perceptions of social identity by communities show a strong role in climate risk perception and adaptive ability (Frank, et al., 2011). These factors of adaptive capacity are “not independent and may function otherwise in different contexts” (Smit and Wandel, 2006). To be able to properly characterise the vulnerability of a given system, the adaptive capacity of that particular system must be recognised or exposed because every system has some inherent adaptive capacity to environmental change (Gbetibouo, et al., 2010).

Early adaptation literature characterized adaptive capacity as a dynamic concept (e.g., Eakin and Bojorquez-Tapia, 2008; Vincent, 2007). Lemos, et al. (2016) consider the adaptive capacity to include specific capacities and associated tools and skills that enable actors to foresee and effectively respond to specific threats (e.g. the ability to respond to and manage an identified climate hazards).

Recent literature on smallholder farmer climate change adaptation decisions shows that adaptation is driven by multiple stressors (Burnham & Ma, 2016). Phuong, Biesbroek, and Wals (2017) show that common components of adaptive capacity referred to in the adaptation literature in the context of climate change responsiveness and natural resource management are human, social, financial, political, and institutional capital building. Previous studies in the context of smallholder farmers' capacity indicate that adaptive capacity components should refer to the earlier mentioned objective determinants (Brooks and Adger, 2005; Smit and Pilifosova, 2001; Yohe and Tol, 2002

2.9 Components of Adaptive Capacity

2.9.1 Human Capital

Human capital is very important to adaptive capacity to climate change impact (Cinner, et al., 2018). It provides farmers with education and productive skills to cope with climate change (Lemos, et al., 2013). Siders, 2019 suggest that a well-developed human capital base can help communities adapt to a changing climate and enable climate-resilient progress which can further lead to human capital gains. Muttarak and Lutz (2014) suggest that smallholder farmers with higher human capital are more capacitated with the skills to tackle climate change issues both now and in the future as well as being critical in delivering the climate-smart solutions of tomorrow. Literature documented different elements of human capital as discussed below.

Education

Previous studies highlight the role of education as a human capital component of adaptive capacity. For example, Lemos (2013) documented that education is an important portion of the global response to climate change by enabling the understanding of climate change impact while addressing its consequences. It also boosts their adaptive capacity and thus reduces vulnerability. Deressa, et al. (2008) argues that level of literacy is completely correlated with adaptive capacity in that farmers with higher levels of education have increased potential to accept and adapt to climate change than those with a lower level of education. Some studies concluded that efforts to build farmers resilience towards climate change are more fruitful in literate farmers than their colleagues who are not literate (Wamsler, Brink and Rentala, 2012). This implies that literate farmers are more likely to grasp training skills in current adaptation practices than their illiterate counterparts (MC Lemos, 2013). This also has a positive effect on household adaptive capacities (Maddison, 2006).

Awareness and training (Knowledge)

Awareness and training broadly embody sensitization and skills acquisition. It is highly crucial to farmers' adaptive capacity, particularly to smallholder farmers, since it provides them with information related to accessing input and other things that can support them in their farming activities (Deressa, et al., 2008). Acceptance of climate change and the need to adapt is an important step to adapting to climate change and thus enhances the adaptive capacity. The use of appropriate technologies in climate change adaptation also requires some requisite training and education (Deressa, et al., 2008).

Farming experience

Defiesta and Rapera (2014) document that the number of years of experience in farming is highly correlated with the level of knowledge and skill related to adapting to climate change and climate variability using technology. According to Deressa, et al. (2009), an experienced farmer who has lived in a particular area for long has the skills and experience to adapt to climate change than an inexperienced farmer. Farmers who have spent several years in farming have more knowledge about adaptation than the less experienced ones (Deressa, et al., 2009). This experienced farmer possesses the indigenous and introduced technology compared to an inexperienced farmer.

2.9.2 Social capital

The community networks and social relations are necessary in building the adaptive capacity of people since it enables them to assist and support each other in times of disaster (Egyir, et al., 2015). Some elements of social capital documented in the literature are reviewed below.

Participation in farmer-based organisations

Participation in farmer-based organisations is considered critical to the farmers' adaptive capacity to climate stress as it enhances social networking and increases social capital (Egyir, et al., 2015). Such organizations provide chances for farmers to learn from their colleagues about some adaptation measures or methods. Some farmers also rely on farmer-based organisations for communal labour for timely executions of on-farm climate change adaptation activities such as soil conservation, weeding, planting, etc.

Access to family/household labour

Garner and Campos (2014) note that more access to family/household labour enhances the social capital of the farmers. Good ties with the family allow farmers to do more. Moreover, the household or family is not only a source of farm labour but also an avenue for sharing of critical climate information.

2.9.3 Physical capital

Physical capital, namely assets, such as infrastructure and machinery, are important and used to increase productivity (Butzer, Mundlak and Larson, 2010). A society, that has limited or no physical capital, is at risk of low productivity, which negatively affects livelihood (Butzer, Mundlak and Larson, 2010). Physical capital is vital in designing a livelihood strategy that would enhance adaptive capacity (Williges, et al., 2017). The physical capital asset also enables farmers to improve their resilience (Butzer, Mundlak and Larson, 2010).

Infrastructure

Access to infrastructures such as roads, irrigation and storages are important to the farmers' adaptive capacity. Their determination to adapt to climate change will be in vain if they cannot access roads to send their produce home or to the market (Deressa, 2008). Access to good road network enhances farmers' capacity to access markets for both their input and output (Belay and Recha, 2017). Therefore, the increasing distance of the farm to good roads is inversely related to the infrastructural capacity to adapt to climate change. Once a farmer has access to good roads, he or she can access markets to sell his/her perishable produce which cannot withstand the adverse effect of climate change. Access to the market for farmers' product also enables to gain some income that can sustain them until the next farming season (Balew, Agwata and Anyango, 2014; (Büyükcangaz, Alhassan and Nyenedio Harris, 2017).

Farmers with access to irrigation have a better capacity to adapt to drought than those with no access to irrigation. Farmers with access to irrigation infrastructure like dams can survive drought than their colleagues who cannot access such kind of facility (Farmers with access to irrigation infrastructure have a greater capacity to adapt to drought than those with no access to irrigation infrastructure. Farmers with access to irrigation infrastructure like dams can survive drought than their colleagues who cannot access such kind of infrastructure (Ahmed, Bunting and Rahman, 2014).

2.9.4 Natural Capital

According to Williamson, Hesselin and Johnston (2012), natural capital is a determining factor of adaptive capacity, and climate change can increase or decrease it. Particularly in rural communities of Sub-Saharan Africa, livelihood activities depend on land as the key natural asset (Berman, Quinn and Paavola, 2012). Agricultural sustainability depends on maintaining natural capital (Tallis, 2011). To have the adaptive capacity to cope with climate change impact, natural capital is important (Tallis, 2011).

Landholding size

Literature documents that farmers with large land stand a better chance of diversifying their farming practice to adapt to climate change than those with small landholdings. Therefore, landholding size is key to increasing crop productivity in farming communities in the process of adaptation to climate change (Balama, Augustino and Eriksen, 2013).

Water

According to Hill (2012) and Hamlet (2011), water plays a key role in the adaptive capacity of farmers to climate change. Climate variability has a large impact on water supply and protection (Conte, et al., 2012). Water scarcity problems and availability induced by climate change is negatively affecting smallholder farmers thus causing a reduction in crop productivity (Ngigi, 2009).

2.9.5 Financial Capital

The financial resource capacity of the smallholder farmer is very crucial in determining what he or she can do on the farm (Gertel and Sippel, 2016). Economic resources are the engine of the overall capacity of the

farmer since most adaptation efforts on the field depend on the financial resources at the farmer's disposal.

Savings

Savings contribute to income poverty reduction (Kwai and Urassa, 2015). Saving is important to smallholder farmers ability to cope with climate change and agricultural production (Nwaru, 2005). Farmers can rely on their savings for the purchase of farm inputs such as fertilizers, seeds and pesticides (Chingala, et al., 2017). Without savings, smallholder farmers will find it difficult to cope with farming.

Access to credit

The provision of credit is an important instrument for improving the welfare of smallholder farmers directly and for enhancing productive capacity through financing investment in their human and physical capital (Chingala, et al., 2017). One barrier to agricultural growth and development is the limited access to credits (Batista and Vicente, 2017). Smallholder farmers often struggle to save because of low farming incomes, social responsibilities and household size (Jumpah, Tetteh and Adams, 2018).

According to Frank and Penrose Buckley (2012), farmers with access to credit are more economically able to adapt to climate change than those with less access to credit. Defiesta and Rapera (2014) highlight that farmers, who engage in other occupations such as petty trading, are more likely to withstand farming-related climate shocks than those with no livelihood alternatives. Agricultural credits to smallholder farmers can help to improve their farm productivity (Candia, 2019). However, access to agricultural finance for smallholder farmers remains a big challenge, especially in Africa (Candia, 2019).

2.10 Institutions

Institutional arrangements play a serious role in the adaptive capacity assessment and resilience-building for the reason that adaptation is a collective effort (Belay and Recha, 2017). The capacity to adapt to climate change depends on critical and integrated institutional activities right from the community to the national level, which interdependently provides the right support to farmers to plan and implement on-farm adaptation activities (Belay and Recha, 2017). The livelihood strategies of the people also depend on the activities of other institutions (Dulal, et al., 2010). These activities include the laws, rules, regulations, services and policies upheld by the state, private sector, civil society organizations, the markets and agencies at local, national and international level (Dulal, et al., 2010).

Access to extension service

Extension services enhance farmers' knowledge and skills in climate change and adaptation-related practices and technologies (Frank and Penrose Buckley, 2012). Local farmers acquire current adaptation methods from the training and support they receive from agriculture extension agents. So, farmers who obtain this kind of training are more ready to change their farming practices against climate change than those who do not have access to such training at all.

Policies or Laws

Agricultural policy describes a set of legislations involving agriculture (Aryeetey and Isinika, 2010). Governments usually implement agricultural policies to accomplish a detailed outcome in the agricultural sector (Bates and Block, 2009). Agricultural policy is created by the government to control the agricultural sector in terms of subsidies, climate change and forestry (Gitau, et al., 2008). Agriculture policies concerns approach used by governments to alter the economic and social framework within which agricultural production takes place by influencing the prices of farm inputs and outputs (Zimmermann, et al., 2009). Government intervenes in the agricultural sector in different ways, such as the provision of subsidies and taxes, credit, price stabilisation programs and expenditures programs (Schmitz, 2010).

2.11 Theoretical frameworks

Climate change impacts research depend on on the theoretical perceptions of disaster risks (Wisner, et al., 2004; Wisner, 2004) and analyses of livelihoods (Chambers and Conway, 1992), food security (Watts and Bohle, 1993; Sen, 1981), and adaptation (Kelly and Adger, 2000). This study relies on the Sustainable Livelihood Framework and some elements of the IPCC vulnerability framework to explore the different adaptation options, the various capital that enhances adaptive capacity, the institutional processes that facilitate climate change adaptation and the how these impact of smallholder farmers' agricultural production.

2.12 Sustainable Livelihood Approach (SLA)

The Sustainable Livelihoods Approach is one of the most formative elements in the theoretical and practical discussion surrounding rural development. Climate change is increasingly being seen as a vital factor that affects the livelihoods of some people. The SLA provides a framework to comprehend the vulnerabilities, adaptive capacities and the strategies households might adapt in respond (Elasha, et al., 2005; Below, et al., 2012).

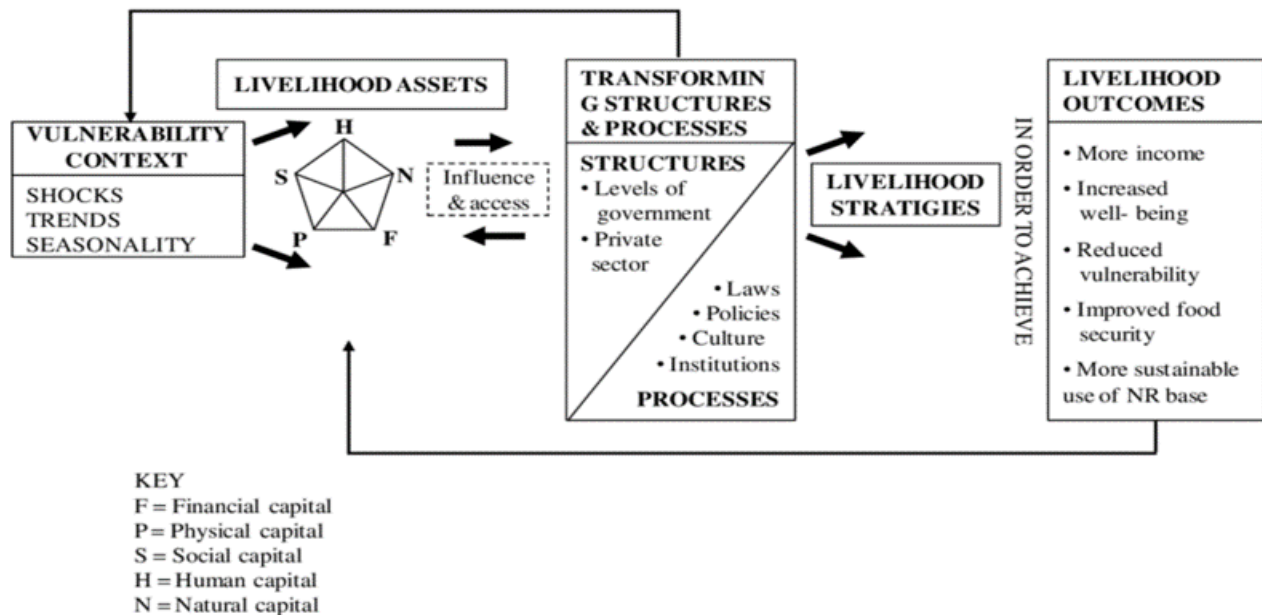
Chambers and Conway (1991) defined livelihood as “comprising the abilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable when it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term”.

The SLA has been applied by development organizations such as DFID, Oxfam and UNDP to assess the capacity of communities to withstand climate shocks. Also, SLA has been used to assess communities' capacities to withstand conflicts and other climate and non-climate stresses.

Reid and Vogel (2006) used the SLA to identify a range of stressors that either reduce adaptive capacity or increase vulnerability to climate anomalies in South Africa. The livelihood approach makes the case that agriculture-dependent households may be able to reduce their overall vulnerability to climate variability and change by diversifying the strategies within their livelihood portfolios, or specializing to take advantage of a niche (Ellis, 2000; Fraser, et al., 2005).

The key basics of the livelihood approach are the five forms of livelihood capital, including natural, physical, financial, human and social capital, the vulnerability context and the influence of the transforming structures and processes on livelihood strategies and outcomes (Chambers and Conway, 1992; Scoones, 1998). Figure 1 below illustrates the Sustainable Livelihood Framework.

Figure 1: The Sustainable Livelihood Framework



Source: DFID, 1999

SLF has two major components: livelihoods and sustainability. Livelihood assets are the touchable and untouchable assets that people use to create their livelihood outcomes. Livelihood strategies generally refer to the mixture of activities that people depend on in order to realize their livelihood outcomes (Chambers and Conway, 1992). Livelihood outcomes generally refer to the outputs (such as food security and more income) of the combination of livelihood activities (Chambers and Conway, 1992). In this regard, livelihood outcomes are greatly influenced by the vulnerability context, which refers to the external environment in which people or households exist (DFID, 1999). Within the SLF, the adaptive capacity assessment considers the endowment of the individual capital assets by a household in the context of climate change.

Of specific status in the SLA is the role of institutions and organisations that facilitate access to resources and assets by households or people to follow their livelihood results within the vulnerability context. People's access to capital assets, their livelihood strategies and outcomes are governed by the prevailing policies as well as institutions, both formal and informal (Yaro, 2004). The SLA highlights the various connections that govern households' or persons' abilities to endure shocks and stresses (Birkmann, 2006). Human capital assets can be the quality and quantity of labour. At the household level, this is mirrored in the household size and arrangement and it is characterized by educational level, training and skills levels, and household members (Rakodi, 1999; Elasha, et al., 2005). Natural capital in the form of land is a critical asset for many livelihoods and consequently can greatly influence the other capital assets (Reale and Handmer, 2011). Financial capital includes income, savings, credit and other savings in liquid form (Scoones, 1998).

Physical assets refer to non-land assets including infrastructure (e.g. markets, roads, electricity, and irrigation facilities) (Elasha, et al., 2005). It also includes the type of equipment (Scoones, 1998). The IPCC

2.13 The IPCC Livelihood Vulnerability Framework

Livelihoods Vulnerability Analysis is used in assessing the impact of hazards on livelihood resources. Several methods of vulnerability assessment have been developed over the past many decades in natural threats, food security, poverty analysis, sustainable livelihoods. This thesis adopted Livelihood Vulnerability Index (LVI) framework of ICPP (2001) and specifically the adaptive capacity component to further assess the adaptive capacities of the smallholder farmers. This framework was originally constructed to provide development organizations, policymakers and planners with a practical tool to understand contributions of demographic, social and physical issues to climate vulnerability.

Exposure to climate change

This study adopted the definition of exposure by the IPCC (2014) that describes exposure as “the existence of people; livelihoods; environmental services and incomes; infrastructure; or economic, social, or cultural assets in places that could be harmfully affected”. O'Brien, et al. (2004) considered exposure to climate change as relating to the extent to which a particular system or community may be exposed to climatic stresses. Therefore, a community or system must be first exposed to stress to be vulnerable (Ericksen, 2008).

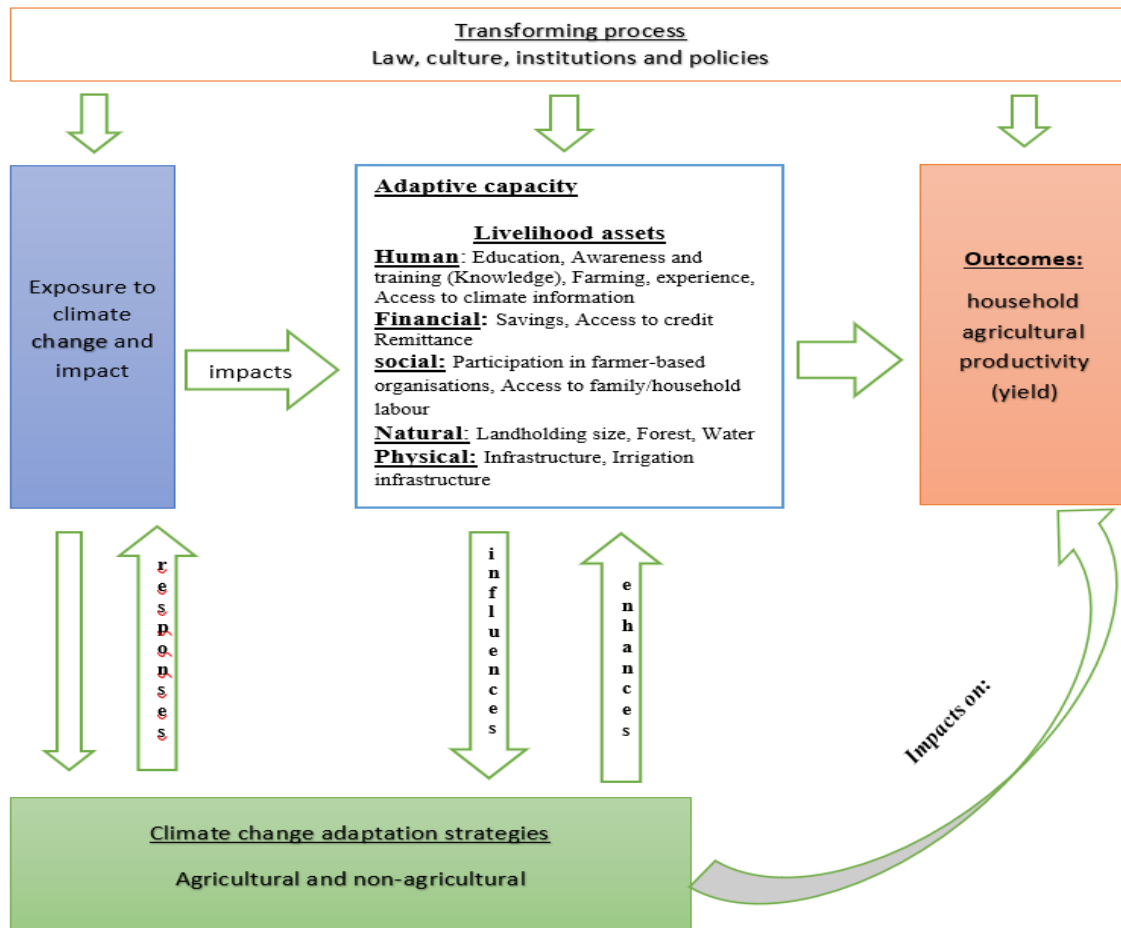
Sensitivity to climate change

Sensitivity refers to the extent to which a system will answer to a change in climate, either positively or negatively. Thus, a system that is vulnerable to climate inconsistency will prove a high sensitivity to modest climate stress and is forced in its capacity to adapt to such detrimental effects. Sensitivity controls the response of a given system to climate change and may be influenced by socioeconomic and ecological conditions of the system (IPCC, 2007). Hence, sensitivity is determined by the function of the inherent appearances of the system being exposed, as well as the extent of stress on that exact system (Smit and Wandel, 2006).

2.14 Conceptual Framework

The conceptual framework for this study as shown below in figure 2 adapted elements of the SLF and the IPCC's LVI to further explore and guide the data collection and analysis. Based on the two abovementioned theoretical frameworks, the conceptual framework for this study was developed.

Figure 2: Conceptual framework



Source: Author base on literature

The conceptual framework above illustrate the linkages between smallholder farmers exposure to climate change, their adaptive capacity, their adaptation strategies and the impact on their agricultural production. Under the transforming structure and processes part of the framework, the study focused only on the institution, not on the law, culture and policy. The study focused on the institutional structure because it has the power to influence the policy, the law and the culture of the community base on their effectiveness. The study did not assess the exposure part of the framework because it requires more time and in-depth data collection to understand how smallholder farmers are exposed to climate change, therefore it can be treated as separate research. In the context of climate change, livelihoods assets are impacted, therefore, smallholder farmers adopt different strategies to cope with the impact. The strategies adopted also enhances the various capital as well as the capital also influences the capacity to implement an adaptation strategy. Successful implementation of adaptation strategies impact on agricultural productions. At all the stages the transforming structure and processes such as laws, culture, institutions and policies shape the vulnerability context, adaptive capacity and the outcomes as in agricultural production.

3. Methodology

3.1 Introduction

This chapter outlines various strategies and methods used in the research to carry out the data collection. The specific elements relating to the procedures and techniques used by the researcher to identify, select, process and analyse the data are further explained along with the selection of the study area in this chapter. This section also contains a description of the quality concerns and limitations surrounding this study.

3.2 Study area selection

Konia District is within the upper highland tropical forest of the agro-ecological zones (AEZ) of Liberia. Konia District was selected for this study for several reasons. One of them is that the commissioner of the research implements several projects there. Konia District has been identified by the Liberian Ministry of Agriculture as vulnerable to climate change impacts (MOA, 2018). Moreover, about 90% of the residents of Konia District are smallholder farmers (GIZ, 2017).

3.3 Research approach

This study encompasses both primary and secondary data gathering procedures. The primary information was collected in Konia District. The case study was conducted through collecting data through semi-structured interviews (SSI), focus group discussions (FGD), and key informants' interviews (KII) with main stakeholders, community members, and smallholder farmers in Konia District. The secondary data was collected through desk research using reports, journals, Google Scholar, My Greeni and E-library. These sources provide information on the background of climate change impact on smallholder agriculture and farmers adaptive capacities and strategies to climate change. The secondary data helped the researcher to explore and understand these research issues.

3.4 Sampling

For the selection of participants for the SSI, a simple random sampling technique was employed. A list of smallholder farming households was compiled for the selected communities in a meeting with community opinion leaders since there was no already available list of households in the communities. Participants were then drawn through the lottery methods using the serial numbers allocated to each household. Simple random sampling is known for its ability to avoid bias and its fairness in selecting respondents and it is especially useful to minimize the consumption of time, which is beneficial to the researcher in achieving the research objectives within the given timeframe.

Purposive sampling technique was used to select respondents for the FGD and KII. This was guided by the participants in-depth understanding and specialized knowledge on the topic. A list of prominent players in the community that have to link with agriculture and climate change issue was identified by the local community leaders during the community entry stage. Six prominent players on the list were purposively selected for the KII interviewed. Purposive sampling technique is noted for improving the validity and reliability of study by generating responses from respondents that are knowledgeable of the topic, which leads to the collection of rich empirical data and reasonable findings.

3.5 Data Collection

Mixed methods were used in the collection of data for this study, involving observation, focus group discussions, semi-structured interviews, and key informant interviews. The use of the different methods enabled the researcher to acquire relevant information from a group of farmers, individual farmers and key stakeholders in the research community. In addition to the interviews conducted, the researcher conducted observation to see the reality of issues disclosed by respondents.

The different methods of data collection used (semi-structured interview and the focus group discussion) provided the farmers with the opportunity to know who the researcher was, and they were confident to share their knowledge about their agriculture practices in the midst climate change. During the semi-structured interviews, key informant interviews, focus group discussions and observation, information was collected through note-taking, video recording and photos taking. Before the collection of that information, the respondents were asked for their consent and permission was given to the researcher through the assistant.

3.5.1 Observation

The observation was employed at every point of this study. The researcher observed the facial expression, gestures and reaction of the household respondents, focus group participants and key informants during the interview or discussions via video calls and recordings. Since the interviews were conducted at the respondent's home and farm respectively, the observation disclosed the kind of cropping and irrigation practices carried out by smallholder farmers (*see image 1 and 2*). Through the observation, the researcher was able to get familiar with the farmer-to-farmer working group that exists in the research community (*see image 3*).

Image 1 & Image 2: Agricultural practices



Source: Author field data

Image 3: Farmer-to-farmer working group



Source: Author field data

3.5.2 Semi-Structured Interviews (SSI)

The SSI was used to collect information from individual households. Fifteen smallholder farmers were randomly selected from the three (quarters) sections of the Konia Township as respondents for the SSI as shown in the table below.

Table 1: Semi-structured respondent selection

Location	male	female
Section (quarter) 1	3	3
section (quarter) 2	2	3
Section (quarter) 3	2	2
TOTAL	7	8

Source: Author field data

To ensure fair representation of both male and female in the sample for the SSI, households in the list compiled were stratified into male and female households. Seven (7) households were randomly selected from the male household strata and eight households from the female strata.

The reason for selecting only 15 respondents for the study, even though this is not a substantial sample, lies in the fact that the research assistant had limited time and resources available for the field data collection. This made it impossible to deal with larger samples and should be considered as one of the limitations of the study. To focus on the research issue during the SSI, a semi-structured interview guide was developed (*see appendix 2*).

Open-ended questions were tailored to the respondents during the interview, and based on their responses, a probing question was asked. Each response was documented by taking notes and voice recording by the researcher assistant and later sent to the researcher by email. During each interview, the research assistant did a video call to the researcher to take the lead in asking probing questions based on the response of the interviewee. The video calls enabled the researcher to have direct interaction with the interviewees. Out of the fifteen interviewees, seven were available for interview only over the weekend (on Sunday); five were interviewed in the middle of the week (Wednesday and Thursday). Three of the respondents were interviewed on their farm because they could not be reached during the

weekend or in the middle of the week in the community. Each of the interviews took one hour and 10 minutes.

Image 4 & Image 5: Observation and interview



Source: Author field data

The researcher facilitated all interviews through phone and video calls while the researcher assistant was taking note, voice recording and conducting observation. If there were issues mentioned during the interview, which were not accounted for in the notes, the researcher made use of the voice recording to make use of the information. Even though written communication was sent to respondents beforehand, formal consent for the interview and recording was sought during the interview stage by the research assistant. The interview sessions were conducted in a network coverage area identified by the interviewee.

3.5.3 Focus Group Discussions (FGD)

Two sets of focus group discussions were held with the study participants in Konia Township on the topic of smallholder farmers' adaptive capacities and production strategies to adjust to climate change. The FGD was intended for the researcher to understand whether smallholder farmers can discuss and agree on the similarity of climate change impact on their agriculture production. The FGD was divided into two sections; one section was conducted with six females while the other was conducted with six males. Three of the females were randomly selected from those who participated in the SSI while the other three were randomly selected from the non-SSI participants. The same idea was applied to the male FGD. The reason for the inclusion of those who were already interviewed in the SSI in the same group with those who did not participate in the SSI was to see if the group could agree on the same issues mentioned by the interviewee during the SSI. The researcher separated the gender for the FGDs because the traditions of Konia Township mandates women not to be assertive or responsive when they are in the presence of men. To promote fair and accurate responses and to increase the reliability and validity of the study, the researcher separated the gender. The researcher also wanted to understand the female group and the male group perspective on the research issues; therefore, they were treated separately to have a gender-focused discussion.

Each session was conducted in a school building selected by the participants. During the discussion, a 1.5-meter setting distance was considered throughout as a preventive measure during COVID-19 pandemic. During the discussion, the researcher served as a facilitator through video call while the researcher assistant was monitoring and making sure all the participants are allowed to share their idea on the various topics presented in the discussion. Before the beginning of the discussion, the researcher assistant seeks the participant's consent for photo taking and voice recording. After consent was granted, the

participants were asked to set up their ground rules for a smooth discussion. Every respondent's view was highly respected and documented during the group discussion.

Image 6: FGD with men and women



Source: Author field data

3.5.4 Key informant interviews (KII)

In this study, the key informants are stakeholders who are knowledgeable about the research issues. To facilitate smooth conduct of KIIs, the researcher formulated interview questions relating to specific concerns of the study, developed a key informant's interview guide (*see appendix 4*), selected six key informants with specialized knowledge and unique perspectives on the subject. Through the researcher instruction before the beginning of the interview with the key informants, the researcher assistant sends communication informing the identified key informant about the interview. The six stakeholders identified as key informants were community chairman, Agriculture Extension Officer, NGO representative, farmer's cooperative chairman, FDA representative and Ministry of Agriculture representative (District Agriculture Officer). These stakeholders were selected based on their role to agriculture development in Konia District.

The KII guide was developed based on the main research topics (climate change, farmers' adaptive capacities, and production strategies). The interviews were conducted face-to-face with the research assistant and video call with the researcher. This strategy enables the researcher to explore new questions by probing during the interview since she was not physically present in the research community. The interview was conducted with the different stakeholders on their selected and agreed time in a specific location. Except for the community chairman, who was interviewed under his palava hut over the weekend on Sunday, the rest of the stakeholders were interviewed in their offices during their free working period.

The interview for each participant took an average of an hour and 15 minutes. To acquire all the needed information from the key informants, the researcher phrase questions carefully, use probing techniques, maintain a neutral attitude, and take adequate notes through the help of the researcher assistant. For easy analysis of the information from the KII, the researcher formatted a recording sheet and headed with each of the research sub-question and coded. The confidentiality of key informants' responses was ensured before the interview.

Table 2: Data collection plan

Sub-Research Question	Data Source	Data Collection Method	Data Collection Tools
How are smallholder farmers livelihood and agricultural production impacted by climate change-related events?	Smallholder farmers	SSI and FGD	Checklist and interview guide
What strategies are employed by smallholder farmers to cope with the impacts of climate change?	Smallholder farmers and key informants	FGD, SSI and KII	FGD and KII guide with open-ended questions and checklist
What adaptive capacities do smallholder farmers have to cope with the impacts of climate change?	Smallholder farmers and key informants	FGD, SSI and KII	Open-ended questionnaire
To what extent are smallholder farmers' strategies and adaptive capacities improving their livelihood and agricultural production?	Smallholder farmers	SSI and FGD	Open-ended questionnaire
Which and to what extent are currently employed institutional structures and processes assisting smallholder farmers to mitigate the impact of climate change?	Smallholder farmers and key informants	FGD, SSI and KII	KII discussion guide with an open-ended questionnaire

In the study, data gathered through the various methods (focus group discussions, interviews, and observations) was correlated and triangulation enabled testing responses to questions asked under different circumstances, i.e. how different would be a response to a question posed to a group from response to the same question posed to an individual in a semi-structured interview.

3.6 Data Analysis

Data was collected and analysed using qualitative data analysis method according to the different themes used in the study. The analysis process started in the field with the collection of data and verification through cross-checking, arranging and coding according to the dimensions used in the study. During this process, significant issues disclosed by respondents in line with the research sub-questions were organized and recorded into the pre-designed Microsoft excel sheet. Quotes and statements from participants were recorded during every discussion. To avoid the wrong representation of data and ensure quality data collection, information from the field was thoroughly analysed.

3.7 Coding process

The answers given by respondents during key informant interviews, focus group discussions and semi-structured interviews were coded in accordance with the relevance to each sub-research question. For

the convenience purpose, the results of the coding are placed in the Appendix. The discussion in this chapter is based on the results of the coding as well as individual quotes given by participants during the data collection process.

3.8 Ethical Considerations

During the fieldwork, the researcher adhered and took note of all ethical concerns. Consent for participation from respondents was first sought, and anonymity for the respondents was assured. Before the SSI, KII, or FGD was conducted, the researcher requested permission to record, and take photos. The researcher through the assistant informed the participants regarding the purpose of the research, which is solely academic, and that there were no rewards for participating in discussions and providing information. The researcher through the assistant committed to all cultural protocols and worked according to the rules and regulation of the research community.

4. Research context

4.1 Introduction

This chapter provides basic information about the commissioner - Skills and Agricultural Development Services (SADS).

4.2 SADS profile and approaches to program implementation

The Skills and Agricultural Development Services (SADS) is a registered not-for-profit and non-governmental organization established in March 1999 with accreditation by the Ministry of Planning and Economic Affairs (MPEA/NGO/AC#0158). SADS has worked in six counties (Lofa, Montserrado, Nimba, Grand Gedeh, Grand Cape Mount and Sinoe), and considers everyone within the borders of the Republic of Liberia as integral to the implementation of its programs.

SADS uses community participatory engagement techniques to help especially rural people to identify their problems and needs. Information gathering is focused on the environmental elements, social issues and sustainable development of the people. SADS implements a wide range of programs that are targeted toward improving the livelihoods of rural Liberians while educating them to conserve their natural environment and improve their food security. Specific areas of competencies of the organization include:

- Community enterprise and small business development
- Natural resources education and awareness
- Community empowerment and livelihoods development
- Conservation and climate-smart agriculture
- Building and strengthening local governance and community infrastructures
- Community engagement, human rights and social justice
- Research, training and strategic environmental assessments
- Norad REDD+ Project and climate change

4.3 SADS Mission and Vision

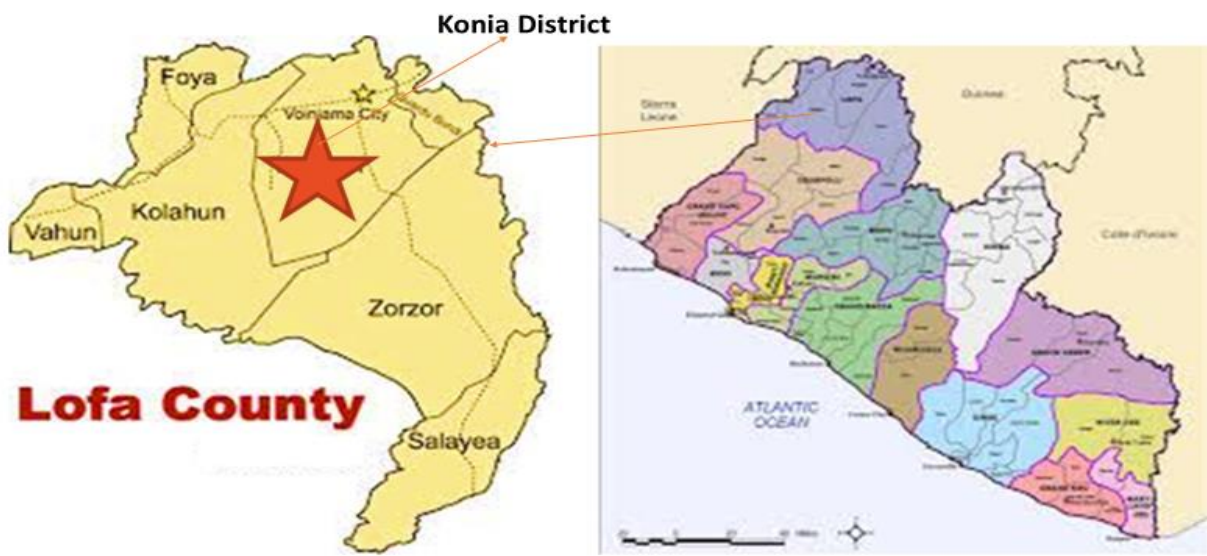
SADS's mission is to work for the empowerment and providing social services to humanity, and ensuring environmental sustainability in Liberia.

SADS vision is to seek a new Liberia in which the empowerment of local citizens will serve as the bedrock for poverty reduction and equal opportunities with a strong sense of ownership for all.

4.4 Study Area

The research was conducted in Konia District, Lofa County, Liberia. Lofa is the third-largest county in Liberia with a population of approximately 276,863 inhabitants (LISGIS, 2018). Lofa County is located in North-Western Liberia. It has borders in the North with the Republic of Guinea, in the West with Sierra Leone and to the South with Liberia's Gbarpolu and Bong Counties. Konia District is the largest district in Lofa county with the highest number of smallholder farmers according to LISGIS (201) report. The district holds one of Liberia important reserved forest (Wonegizi forest). The district is divided into 10 communities that are predominantly occupied by the Lorma ethnic tribe. The population of the district is estimated at 7,000 inhabitants. The Konia Township, which is the case study area for this research, is the most populated community within the district and is divided into three quarters (sections). The community is headed by a Township, follow by the quarter chief for each of the quarters. Below is the map of Lofa county and the study area.

Figure 3: Liberia, Lofa County and Konia District



Source: LISGIS, 2016

5. Results and findings

5.1 Introduction

This chapter provides the results and findings of this research. The results are presented according to the themes used in the research sub-question as follow: climate change impact on smallholder farmers' livelihood, smallholder farmers' strategies during climate change, smallholder farmers' adaptive capacities to cope with the impacts of climate change, climate change effect on smallholder farmers' agricultural production and institutional structures and processes in addressing climate change issues. Tables, graphs and figures are used to better understand the findings of this research.

5.2 Climate change impacts on smallholder farmers agricultural production

To better understand the impacts of climate change and change in weather patterns faced by the respondents, they were asked about what is the intensity of rainfall and sunshine, and subsequently if there are any impacts on their agricultural production and livelihood. During the semi-structured interviews on climate change impact on agricultural production, all the participants mentioned similarly how the unexpected rainfall and sunshine in the Konia District disrupt their farming activities. Under normal conditions, Liberia has six months of rainfall and six months of dry weather conditions in a year; however, this pattern has changed in the last 10 years. Sometimes the sunshine continues for more than eight months as well as rainfall, which usually disrupts the agriculture production season and productivity. This information disclosed during the SSI was confirmed during the FGD with women and men.

For example, one of the women from FDG said:

"Our agriculture activities in this district are based on the rainy and the dry season, but over ten years now the seasons have been unstable, most time the dry season exceed more than the regular six months and as a result, our crops will die because our farming system is based on regular six-month moderate rainfall and sunshine. Some of us are not able now to pay our children school fees because we depend on our agriculture activities that are not yielding to acquire food and income".

In addition, this issue was also mentioned by a key informant. When asked about the stability of rainfall and sunshine in the district, he said:

"The unstable rainfall and sunshine have been a serious problem in this district, most of the time during the dry season which we expect to last for six months, it will only go for four months and the intensive rainfall will start. Most of the time when farmers plan to start burning and cleaning their farms during the dry season, the rain will suddenly start for that whole month and disrupt the farming season mainly for lowland farmers. This change in the weather pattern has affected most of our farmers who use to cultivate crops, generate more yield and even sell some for income for their family no longer sell rice in the market".

The finding confirms that smallholder farmers' agriculture activities in the Konia district is mainly dependent on rainfall and sunshine. All respondents from the SSI and FDG also confirm that weather pattern irregularity and instability is a result of climate change.

5.3 Smallholder farmer's strategies during climate change impacts

The graph below shows the respondents' strategies to adapt to climate change according to their sex.

Figure 4: Respondents strategies amidst climate change

Respondents' strategies in the midst of climate change



Source: Author base on field data

This analysis above shows that the majority of the 15 interviewees in the SSI (12 respondents) were involved in both farming and off-farm jobs, while three out of the total 15 respondents were involved only in farming. The majority of respondents disclose that off-farm jobs provide an alternative income source to address their needs when their main livelihood activities cannot meet up with their necessities as a result of the change in weather. This statement was supported during the interview with a smallholder farmer (FGD12) who also works as a motorbike rider:

"I started farming from the time I knew myself as a man and it's been the source of my family income and food, but over the last seven years, the yield from my farming activities have not been productive due to change in the weather pattern. Besides, the cost of making farm now is expensive, so I decided to engage in this bike riding that when I don't get enough yield from my farm, my bike business will still support my family".

In addition to the Motorbike riding business strategies that were disclosed by smallholder male farmers as their coping strategies as a result of climate change effect on their farms, a female respondent ((SSI7) who was also involved in farming and off-farm job disclosed her activities during the SSI by saying:

"I started my small table business at my house after I realised that my cassava and cabbage farm that was doing to provide food for my family and generate income to send my children to school was no longer giving me much yield. Most of the time, I will invest all my effort to plant my crops during the normal planting season when there is stable rainfall but suddenly the sun will intensify and destroyed the farm yield. As a result, the yield acquired from the farm cannot maintain my family for the harvest period. Therefore, I decided to engage in the table market to give me income when my farm is not bringing enough yield. Besides there is no support from government to help us during farming, most of the NGOs that can come with support for farmers can be selective when you don't know anyone in the NGO you will not benefit much and sometimes you are not even recognized".

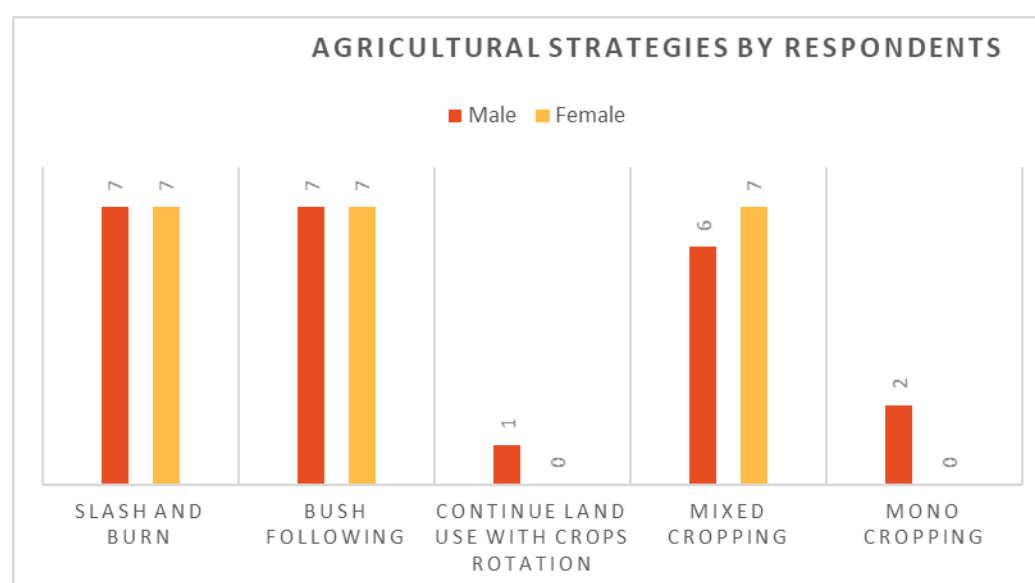
The respondents, who were only involved in farming, disclosed they did not have the experience to engage in other livelihood activities. They said that, despite the change in the weather pattern in the district, they still hold on to their farming for food and income for their family warfare. They went on to say that due to the change in the weather pattern, they are now engaged in the cultivation of different crops. Then,

even when there is intensive sunshine, not all the crops are affected, and they are still able to harvest some crop that will support their family. This statement was confirmed by a respondent (SSI14) who said: *“I don’t have formal farming knowledge but I have been farming for a long time now, and this thing of unstable sunshine and rainfall started a long time, so for me, I use to cultivate a different type of crops, no matter the sunshine or rainfall, all the crops will not die the same time, some will survive and produce a yield that can support my family”*.

5.4 Agricultural strategies

The result from the SSI shows that most smallholder farmers were involved in different cropping strategies to cope with change in the weather pattern in Konia. Some of the strategies disclosed by respondents were identified as the common strategies used by farmers for cultivation of crops in Liberia. The graph below shows the different farming strategies employed by the respondents to address the change in the weather pattern in Konia.

Figure 5: Agricultural strategies by respondents



Source: Author base on field data

The result demonstrated in the above graph shows that 14 (seven male and seven female) of the 15 respondents practice bush following with slash and burn, while only one respondent practices continue land use with crops rotation. Mixed cropping was disclosed as the major cropping system practised by the majority (13) of the respondents. Mixed cropping is considered as the major cropping strategy employed by smallholder farmers in Konia. Mixed cropping enables smallholder farmers to grow a different type of crop on the same plot of land at the same time. Mixed cropping help to reduce the loss of farm yield. This statement was confirmed by a female smallholder farmer (SSI2) who said:

“It is because of mixed cropping that I am still encouraged to continue making farm because usually during the farming season the unexpected rainfall or intensive sunshine will be experienced and most time destroyed some of my crops, but the good thing is, not all the crops are destroyed by the intensive sunshine and rainfall. Some of the crops can withstand rainfall and others also withstand sunshine, because of that I usually not lose all my farm yield, especially when I mix rice, cassava and maize on the same plot”.

This information was also verified during the observation (see image 8) conducted by the researcher through the research assistant.

Image 7, Image 8 & Image 9: Mixed cropping by smallholder farmers



Source: Author field data

From the interview conducted, the two respondents who were engaged in mono-cropping were male and they were involved in the cultivation of only cocoa. Cocoa is the major cash crops that are cultivated by the people of Konia. Cocoa grows well even during intensive rainfall and sunshine, besides, the labour requirement for cocoa, especially during maturity, is less, only thing is, the cultivator will need some level of agriculture training to maintain the crops. This information disclosed during KII was confirmed by a smallholder cocoa farmer who explained:

“I was cultivating rubber first but due to this continue sunshine that sometimes lasts for more than seven month in a year, my rubber could no longer produce much latex, so I have to cut down my rubber and replace it with cocoa which is one of the cash crops that is grown by most of my friend. The good thing about the cocoa is that it can grow well under the bigger tree and the bigger tree prevent the sunray from directly getting on the cocoa plant and it helps to reduce yield lost. To maintain the cocoa tree is challenging, but I been doing it for a long time now, so I understand it well, besides I received some agriculture training from my secondary school and also from NGOs that help me to understand the cocoa farming well”.

The finding shows that smallholder farmers did not employ new farming strategies, as it was confirmed during SSI with the majority (14) respondents. It was also confirmed during the FGD and mention twice by the key-informants that farmers are still using their traditional farming practices. The only strategy employed by the majority of farmers (12 respondent) confirmed during the SSI was diversification (engaging in off-farm jobs) during climate change impact on their farms.

5.5 Adaptive capacities to cope with the impacts of climate change

To disclose the adaptive capacities of smallholder farmers to cope with climate change impacts, the researcher took into consideration the available livelihood assets of the respondents and designed questions to analyse those assets.

Human asset

To analyse the quality of the respondent’s human asset, questions were posed taking into consideration if they have benefited from any agriculture training or have formal agriculture knowledge and the number of labour contributors they have in their household. Besides, the respondents were also asked about the types of crops grown by them as a means to probe for clarity about the method used to cultivate those crops. Table 2 below outline the responses of the smallholder farmers according to the type of crops grown, head of household, agriculture skill and the number of labour contributors in their household.

Table 3: Respondent human assets

No	Crops grown by respondents	Sex	Head of household	Received some agriculture training/ have formal agriculture knowledge	No. of labour contributors per household
1	Rice, Maize, Cassava and vegetable	F	No	Received agriculture training	3
2	Rice, Cassava and Maize	M	Yes	No training	5
3	Cocoa	M	Yes	No training	2
4	Cassava, rice and Maize	M	Yes	No training	6
5	Potato, Cassava, rice and Maize	F	Yes	No training	3
6	Cocoa-yam, maize, rice and Cassava	M	Yes	No training	4
7	Maize, rice and cassava	M	Yes	Formal agriculture Knowledge	4
8	Potato, cassava, rice and vegetable	F	No	No training	5
9	Rice, cassava and Maize	F	Yes	No training	7
10	Cassava and Maize	M	Yes	No training	5
11	Rice, vegetable and cassava	F	Yes	No training	8
12	Rice, Maize and Cassava	M	Yes	Received agriculture training	4
13	Vegetable garden and cassava farm	F	No	No training	8
14	Rice, cassava, maize and vegetable	F	No	No training	5
15	Cassava, rice and maize	M	Yes	Received agriculture training	6

Source: Author field data

The table shows that all eight male respondents were the heads of their households, while only three of the seven female respondents were identified as the heads of their households. Among the 15 respondents, only four had some form of agriculture knowledge, three of the four respondents were male while only one was female. The table also shows that nine of the fifteen respondents have more than four labour contributors in their household. The strength of smallholder farmers lies in their family labour, most smallholder farmers dependent on their family labour for their agriculture production activities. This statement was agreed and confirmed by the focus group:

“We depend on our family especially our children, most of us it is because of the number of children and family member we have who can work enables us to cultivate our farm because even government is not helping us, in other communities farmers received training from government and NGOs how to practice improved farming especially now that we don’t have stable rain and sunshine, for the majority of us from this community, we still using our traditional idea to do our farming because of no support”.

Due to the limited improved agriculture skill of most smallholder farmers and they continued the use of traditional agriculture practices for farming, their farm yield cannot sustain them until the next harvest season. This statement was back by a female smallholder farmer (SSI2) who said:

“For me, I didn’t go to school and have not sat for any farming training before, the only idea I get from my parent on farming when they were living at the time, I was young is the one I using now to make a farm. Sometimes when my children and myself make a big farm, we can get some yield, but the only thing the yield can maintain my family up to the next farming season”.

Some respondents who had benefited from agriculture training were observed to practice some level of improved agriculture and irrigation practices (figure 15).

Image 10: Farm of the respondent with formal agriculture knowledge



Source: Author field data

Types of Government or NGO Supports received by some respondent

Table 3 shows the number of respondents who received some form of supports from the government or NGOs.

Table 4: Respondents' support

Respondents represented with Letters	Sex	Received support from government or NGOs	Type of Supports
A	M	NO	
B	M	YES	Training
C	F	YES	Training
D	M	NO	
E	M	NO	
F	M	NO	
G	F	YES	Bag of fertilizer
I	F	NO	
J	F	YES	Training
K	M	YES	Training
L	F	NO	
M	F	NO	
N	M	NO	
O	F	NO	
P	M	YES	Bag of fertilizer

Source: Author field data

The table shows that only four of the fifteen respondents received some level of agriculture training from NGOs, while two respondents mentioned that only one bag of fertilizer received by them as support from one local NGO working in their community. Nine of the fifteen respondents disclosed that they have not received any help in their farming activities from NGOs of any governmental institution. According to the community leader during the KII, smallholder farmers who usually benefited from NGO's training or workshops in the community are those who had to acquire some level of primary education. He went on to say that most of the NGOs that come in their community usually select farmers with primary education to form part of their training or workshop intended for farmers. This information provided by the key informant was also confirmed by the approved statement of the focus group (FGD1):

"NGOs been conducting a workshop and some agriculture training for farmers in our community, but they can only consider farmers who can read and write in their training or workshop, so most of us have not been able to participate because we have not gone to school before, only a few people that among us that went to school can have the opportunity to form part".

In addition to the respondents who participated in training or received fertilizer from NGO, the majority of the respondents, who had not received any support for their agriculture production, indicated, that most of the support that is provided by NGOs and the Ministry of Agriculture in their community are only received by farmers who are closer to the NGOs staff or a government agriculture officer in the community. This information was confirmed by a female respondent (SSI9) who benefited from the local NGO fertilizer distribution:

"Last year during our production season, one NGO that was working in our community before came and they took our name to give us some maize and rice seeds for planting, but after some days we only hear that they had distributed the seeds and only a few people whom they knew received the seeds. So, when the local NGO was asking for to send their name so they can be given fertilizer, I didn't send my name but because my sister's son was working with them he was able to give me one bag and again some farmers who sent their names could not get".

The majority of the respondents still practice traditional agriculture with limited skills and material capacity to adapt to climate change impact. The main reason for it is the lack of agriculture training and limited material support for smallholder farmers.

Social asset

Finding from the SSI shows that 100% of the respondents were members of different farmer-to-farmers working groups. According to most of the respondents (13), some of the group contain 20 to 30 members, and each group was established with different objectives to address their farming needs. This information provided during the SSI was confirmed by a key informant (Agriculture Extension Officer) who is the resident of the community and founder and chairman of one of the farmer-to-farmer working groups. He explained:

“In our community, most of the people livelihood activities depend on farming, but the majority of the farmers cannot afford to buy seeds, fertilizer, and other farming tools, so I decided to put people who were not part of the other farmers working group to come together some we can be able to help each other during our farming season to strengthen our members farming activities”.

The same key informant also explained that when the group visit one-person’s farm, each member of their group can contribute 1000 Liberian dollar which is equivalent to 10 USD for enhancement of their member farming activities. He went on to say that the money is collected by the group and 50% is used to buy seeds, fertilizer and farming tools while the other 50% is being given in cash to the farmer. He also mentioned that besides the money and the agriculture material, the group take the whole day of the meeting to work on the visited member farm. He concluded that the farmer-to-farmer working groups are the major source of support for smallholders in their community. This information provided during the SSI and the KII about the farmers to farmers working groups was also confirmed by observation (See Image 10).

Image 11: Farmer-to-farmer working group



Source: Author field data

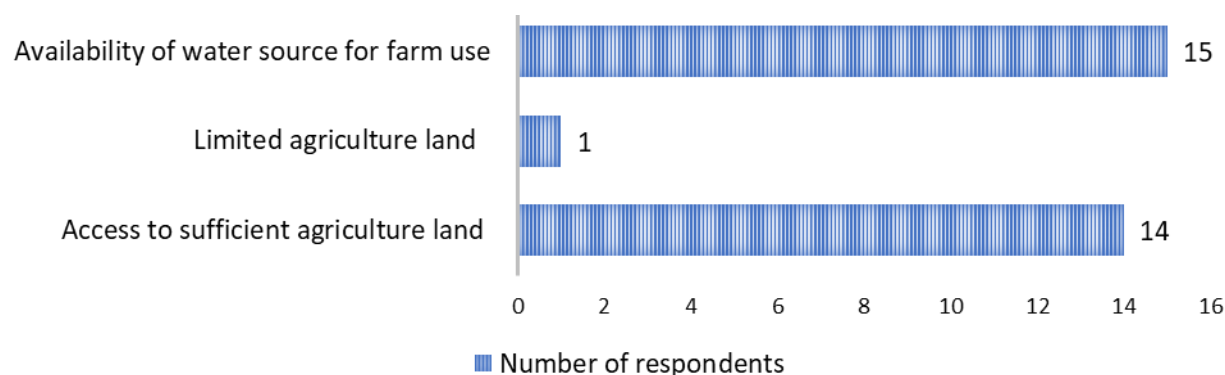
In addition to the farmer-to-farmer working groups that were disclosed as the major source of support for smallholder farmers in Konia, majority of the interviewees during the SSI (13) stated that they are also part of a farmers' cooperative group that helps them to sell their farm produces during the dry season. They stated that due to the low productivity of their farms the cooperative is not very active. This information disclosed during the SSI and the FGD was also confirmed by the key informant (district farmers' cooperative chairman) who explained:

"The Konia District has three smallholder farmers' cooperative group which I'm serving as the chairman, one of the cooperatives group is based here in the Konia Township. Those three cooperatives use to be very active and supported by government when they were established newly before the Liberian civil war, but since the war ended about 18 years ago when we reorganized this group, smallholder farmers in the district have not been receiving needed agriculture support from the government or agriculture NGOs to improve their farming activities. So, the cooperatives have not been active because the yields from farmers are the one sold by the cooperative. Besides, most of the customers that used to come to buy the few farm yields that are sold by the farmers through the cooperative are not coming again because of the bad road from the city to the community".

Natural asset (agriculture Land and water bodies)

Finding from the SSI shows that majority of the respondents can access agriculture land and water source. The figure below demonstrates the number of respondents who have access to sufficient agriculture land and accessible water source along with those who have limited agriculture land.

Figure 6: Respondents natural assets



Source: Author field data

The analysis shows that all the respondents have an available water source for their farming activities, while 14 of the 15 respondents have access to sufficient agriculture land for farming. According to the majority of respondents, agriculture land is one of the resources that they have in abundance. Some

people from different communities, who want to come and settle in the Konia community, are being given farmland whenever they request for it without paying any amount of money. This information was confirmed during the two FGD when the issue of land available for farming in the Konia community was raised. One of the FGD group explained:

"In our community, we don't sell farmland to people, rather we give land to people free whenever they want to do farming as long as they want".

The one respondent who owned limited farmland explained that the highest portion of his family land was taken by the government during the 2012 boundaries humanization for the establishment of the Wonegizi reserved forest. He further explained that the remaining portion of land is what he uses now to do continue cropping because the land is not enough to do bush fallowing as he was doing before. He went on to say that the community people are willing to give him more farmland but preferred using his small position of land because he doesn't have support to make large farm, and besides, he mentioned that his cropping method (crops rotation) is less labour intensive compared to his previous farming method (bush fallowing).

Financial asset

From the SSI, all the respondents disclosed that there is one local bank and two credit union in the Konia Township. When the respondents were asked about their relationship with the bank and the credit union groups in terms of providing loans, they explained that the bank and the credit union group give loan to farmers who can provide their land deed as collateral before any amount of money can be given, the result none of the respondents had access to the loan or credit. When the same issue of accessing the loans from the bank and the credit union was raised in the FGD, the two FGD explained that they do not have access to the loan because the land owned by them was inherited from their parent so they do not have a deed. This information provided during the SSI and the FGD was confirmed by the key-informant (Local credit Union representative) who explained:

"The credit union is meant to provide local farmers with a loan for their agriculture activities, but when the money is given to some farmers, they will escape with the money to a different community, and the credit union will become the loser. So, this time now, the union decided not to give money to any farmers who do not have land deed".

Besides the credit union and the bank, the respondents also disclosed that there exists an organization called BRAC that also give loan to farmers in Konia Township. According to the respondents, BRAC gives them the loan with a high-interest rate, and they struggle to generate the money to pay because most of their crops do not produce much yield so they can be able to sell and pay the organization back. All the respondents mentioned that they stop taking a loan from BRAC because of the high-interest rate. Besides the loan, BRAC also established small saving club for farmers to save the income from the proceeds of their farm during harvest. From the SII, only five of the 15 respondents had saving with BRAC, the majority (10) respondents did not have any form of saving. According to the five respondents, the saving helps them to purchase seed for farming the next season.

Physical asset

To disclose the type of physical assets used by smallholder farmers to cope with the impact of climate change, questions were posed to the respondents regarding the farming equipment or tools used for crops production, and the availability of farm-to-market roads in the Konia community. The finding from the semi-structured interviews showed that two of the 15 respondents' farms are accessible to the road and are located closer to Konia Township. The Township has a general market that people come from all the smaller villages to sell their farm produces every Wednesday (market day). The majority (13) of the respondents mentioned that their farms are located at a distance from the Township market and the road is very challenging, the only means to get their farm's produce to the market during harvest is through

motorbike and the transportations are very expensive. In addition to the farm-to-market roads, the majority (13) respondents also complained about the bad road between their farms and the Township market. Besides, all the respondents (15) also mentioned that the road from the Township to the city is very deplorable, as a result, most people who come from the city to buy their farm product stop coming now; therefore, when they harvest their crops and bring to the market there are no customers to buy their products and all will perish.

The issue of bad road to the Konia Township disclosed during the SSI was also mentioned by the community chairman who explained during the KII:

“The bad road from the city to this community is the one suffering farmers because they try their best to cultivate crops even during the dry season when they don’t get much yield, but the little that they harvested and bring to the market, there are no customers to come from the city to buy because of the bad road”.

The information disclosed by the respondents was also attested by the researcher assistant while on his way to the research community (see image 11).

Image 12, Image 13 & Image 14: Road network



Source: Author field data

Regarding the agriculture equipment or tools used by smallholder farmers, the finding from the SSI and the FGD show that all the respondents have no access to any modern agriculture equipment like tractors for their farming activities. All the respondents disclosed that they only have access to traditional agriculture tools like cutlasses, knife, hoes, and shovels that are used for their cultivation. The respondents also explained that it is difficult for them to get new tools because they are not getting support from the government or NGOs, and besides, the yield acquired from their farms are limited to generate income that they can buy new tools.

Summary of the respondent’s assets analysis using the asset pentagon

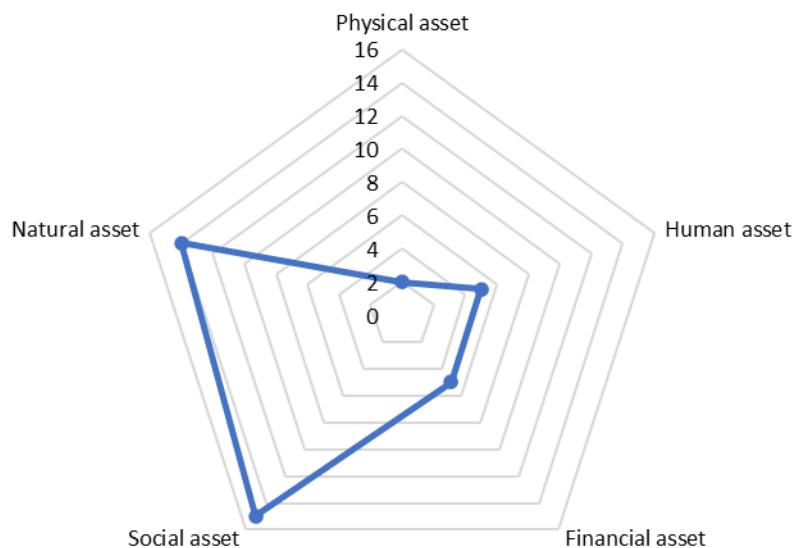
The respondents’ adaptive capacities to cope with climate change impact were analysed looking at their assets and uses. The finding relating to the variety of the respondents, the table and the asset pentagon below shows the description of the assets mention by more respondents.

Table 5: Farmers' livelihood assets

Assets	Number of Respondents	Total	Percentage
Human asset			33.30%
Formal education and agriculture training	4		
Informal agriculture training	1	5	
Physical asset			13.30%
Access to good farm road	2		
Access to improved farm equipment or tools	0	2	
Social asset			100%
Member of farmer's group or farmers cooperative	15	15	
Natural asset			93.33
Access to more agriculture land	14		
		14	93.30%
Financial asset			26.66%
Access to saving	4		
Access to loan or credit	0	4	

Source: Author field data

Figure 7: Respondents' assets pentagon



Source: Author field data

The asset pentagon was developed based on the finding on the respondent's assets. The pentagon clearly shows the highest asset disclosed by the respondents generally, the social asset followed by the natural asset. All the respondents were members of different farmer-to-farmer working groups. The poorest asset is physical as farmers have limited access to good roads and improved agriculture tools or equipment. They have no modern agriculture equipment and most of the tools they use are traditional and old, which makes the cultivation difficult. The human asset and the financial asset are shown on the pentagon as the second least assets disclosed by farmers. In the case of labour contributors, all the respondents have some number of labour contributors for their farming activities; however, the majority of them lack improved agriculture knowledge and training.

5.6 The impacts of farmer's strategies and adaptive capacities on their agriculture production

Concerning the strategies of smallholders to cope with the impact of climate change in Konia, most respondents (14) said that they are still using the traditional farming method that includes slash and burn, bush fallowing, and crop rotation. One respondent was identified to be engaged in manual irrigation (use of a watering can) as well as continue cropping. All the 14 respondents who are using the traditional farming method said that their preferred farming area is the upland. Only one respondent who was doing continues cropping with crop rotation said that his preferred farming land is lowland. The reason given by the majority of the respondents who farm on upland was that the upland is easy to cultivate and they do not need to apply fertilizer because they are doing bush fallowing. The one respondent disclosed that the lowland has easy access to water and even during intensive sunshine the crops can still be irrigated just by using the traditional irrigation system (using a watering can).

To understand the effect of those employed strategies, the respondents were asked the reasons, and fourteen (14) of them indicated the bush fallowing was the best method they knew and the one they were used to. The one respondent, who was using lowland farming, explained:

"I was initially farming on upland and doing the same bush following about ten years ago, but after gaining some agriculture knowledge from school and also received training from agriculture NGO, I decided to move to the lowland and cultivate my crops because of the understanding from the school and the training. The yield I can get now is a little bit better compared to when I was doing bush following form of farming. Although the sunray is now high because of the change in the weather pattern, I can manage to cultivate crops that can sustain my family".

When the issue of comparing the yield acquire from farming in the present condition of change in weather pattern to the yield farmers use to generate about five years ago was raised in the Male and the Female FGD, both groups similarly explained and agreed to the information disclosed by the SSI respondents that there has been decrease in their present farm yield compared to the past. For example; the female group said:

"Our only farming strategy has been the bush following, and to be truthful, it is not giving us much yield now. Like before we use to get a little much, even those it has been challenging for us but we don't have a choice, it is the only farming strategy we know. Especially now that we don't have any support, we are not getting yield again"

The finding shows that farmers have some capacities like the availability of farmland and well established social network, however, those capacities and their traditional farming strategies confirmed during the SSI and the FGD could not improve their agriculture productivities. This is due to the fact that they lack

other capacities like improved agriculture skills and training, improved agriculture tools and the lack of support also confirmed in the two FDG and the SSI.

5.7 Institutional structures and processes

This section presents the institutional structures and processes in place to mitigate the impact of climate change on smallholder farmers' agricultural production. During the interviews, the researcher sought to identify and know the opinions of respondents regarding these mitigation efforts.

Concerning the NGOs, almost all respondents admitted their presence in the region. For example, 12 out of 15 farmers said that SADS and FFI are present in the community to work with farmers but most of their activities does not cover the majority smallholders - only a few farmers who have closer relation working with those organizations can benefit from their programs. In this context, farmers' field school run by SADS was mentioned several times to be ineffective; however, the opinion of few respondents (3) was that most farmers don't attend the farmers' field school established by SADS because they claim that the school is not providing them with farming materials. The few respondents disclosed that the farmers' field school have a positive effect on their farming system while the majority of respondents disclosed that it is inefficient and lack resource for practical training. Two of 15 respondents mentioned that Solidarity is running crop maintenance program for farmers in the district, while 13 respondents disclosed that they only hear about the Solidarity organization working in the district but they have never benefited anything from the organization. All the respondents indicated that IFAD is helping farmers to rehabilitate their cocoa and coffee farms, but only considering those located near the protected area in the district. The respondents explained that the majority of the cocoa and coffee farmers do not receive help from the organization because their farms are not located closer to the protected forest. Majority respondents (14 people) also mentioned the cultural heritage law about protecting certain species of animals are in place, and further indicated that NGOs and government agency, such as FDA, MOA, EPA, FFI and SADS, focus on maintaining cultural heritage and enforcing the wildlife protection laws. They are not doing much to build the livelihood of those farmers in the district that host the protected forest. This statement was confirmed by a key informant (community chairmen), who said:

"There are so many different NGOs working in our community with the protected forest, but most of their activities we can see here is to create awareness on the protection of the animals in the forest, some claim that they are working with farmers but most of the farmers in our community have not received even a watering can from them, but they are always telling people to stop killing bush meat".

All of the participants acknowledge government presence (MOA, FDA, EPA) but they said there had been limited assistance from the government that come one after two to three years in terms of providing seeds, training, provision of fertilizers, tools and other farming inputs to help to cope with climate change and increase agricultural productivity. Government representatives confirmed that the resources for building smallholder farmers capacity are very limited to cover all the farmers at the same time, usually, the number of farmers increases to receive government support based on the increase in the Ministry of Agriculture budget. The government representative further explained that they work along with NGOs to make resources available to improve farmers' capacities. The representatives of NGOs said that their organizations do utmost best with the available resources; however, they admitted that those resources deemed insufficient to address the needs of all the smallholder farmers to combat the impact of climate change.

From the interviews, it is visible that there are some organizational structures and process in place that help to minimize the impact of climate change on smallholder farmers' agricultural production. However, this support is not sufficient and only reaches a limited number of smallholder farmers. It is also clear that farmers understand that NGOs do whatever is in their power, while most of the criticism falls on the government, which, according to the farmers, can and should do more. Findings from farmers in the semi-

structured interviews revealed that building farmers' capacity through the provision of agriculture inputs, creating effective farmers' field schools, financial support would help to enable them to cope with the changing climate.

6. Discussion of findings

6.1 Critical discussion

This chapter presents the discussion of key findings from the research. The discussion analyses how the findings of the study agreed or disagreed with other findings from the literature presented in chapter two, as well as presents an overall reflection about the findings. The discussion of the study was done in line with the research objective to gain insight on the current adaptive capacities and agricultural strategies being employed by smallholders of Konia in response to the effect's climate change, on agricultural production and livelihood. It also discusses institutional structures and processes in place to help smallholder farmers to mitigate climate change.

Farmers largely depend on agriculture for their livelihood, at the same time, they are exposed and vulnerable to the effects of climate change which affects their agricultural production and livelihood (Prowse and Scott, 2008, Harvery, 2014). Data collected in this research confirms that wet and dry periods have been irregular and inconsistent throughout the year. As a result, the farmers face challenges such as low agriculture productivity as they heavily rely on regular rain and dry season for crops production. This finding corresponds with the literature (MOA, 2016; Falco, et al., 2012) that states that smallholder farmers in Liberia are dependent on the rainy and the dry season for their agriculture activities. According to small-scale farmers interviewed in this research, the normal climatic period of six months of dry season and six months of rainy season has been seriously altered due to climate change impact in the last ten years in Konia. These findings agree with Aniah (2016), who concluded that the livelihood of smallholder farmers is greatly affected by climate change.

Based on the finding from this research, it is possible to state that climate change events such as longer period of dry season affect smallholder farmers' livelihood assets most especially their financial asset as farmer's agricultural productivity reduces because of the impact of climate change. Farmers harvest less and sell less due to poor yields caused by drought and harsh climatic conditions. Similarly, Schlenker and Lobell (2010) findings show that smallholder farmers livelihood assets are affected by climate change events that cause low agriculture productivity.

Interviews confirmed that smallholder farmers were involved in different cropping strategies to cope with climate change. Findings show that smallholder farmers use slash and burn, bush fallowing, continued land use with crop rotation, mixed cropping and monocropping. Among these adaptive strategies, slash and burn, bush fallowing and mixed cropping were the most popular farming strategies regularly used by smallholder farmers in Konia, while continued land use with crop rotation and monocropping were the least popular strategies. These findings agree with USAID (2013) report, which states that main smallholder farmers' practice in Liberia is slash and burn, and it is the major driver of deforestation that also influence the change in the weather pattern. USAID (2013) also reveals that continued land use with crop rotation and monocropping were the least popular farming strategies used by farmers because these farming practices require some level of improved agriculture skill or knowledge. Therefore, if smallholder farmers do not have some improved agriculture skill, they might find it difficult to practice.

Farmers adapt to the devastating consequences of climate change by using the abovementioned strategies to maximise agricultural yields. For example, mixed cropping ensures that farmers produce varieties of agricultural products. The idea behind it is that if one crop fails to produce substantially, the others can make up for it. This technique ensures that farmers maximize the value of their land and minimise the repercussions of climate change impact. This is a strategy to avoid the risk of relying on one crop system where climate change effect can damage the crop, thus leading to low yields and livelihood challenges (USAID, 2013). However, interviews with farmers in this research reveal that majority of respondents lacks improved agriculture knowledge to effectively employ these strategies. As a result, the strategies do not give them the best productivity. This information agrees with the study of Lemos (2013), who discloses that literate farmers are more likely to acquire skills in current adaptation practices of

improved farming strategies compared to their illiterate counterparts who might try to employ the same strategies but still realized low yield.

Findings from this study also revealed that irrigation was not being used among farmers as a climate change adaptation strategy. The reason given by farmers was that they were cultivating upland, and they could not water their entire rice farms using watering cans. This leads to the low agricultural yield, especially during the dry periods. Furthermore, findings show that some farmers get rid of underperforming agricultural products in favour of high performing and economically viable agricultural produce. For example, it was found during the primary enquiry to the study that some farmers destroyed their rubber trees because of low production in favour of cocoa plant due to their growth potentials and economic value.

In general, this research exposed farmers' lack of adequate knowledge and capacity to cope with climate change impact. According to the findings of this study, farmers have traditional methods as opposed to conventional methods of climate change adaptation. Besides the different cropping strategies are used by respondents to cope with climate change, the majority of the respondents use diversification as a coping strategy.

The majority of the farmers disclosed to have been involved in off-farm job when their farm yield is affected by the change in the weather pattern. This finding is in line with the statement made by Yamba, Appiah and Siaw (2019) that smallholder farmers involve in petty trade as a means of diversifying their income source when there is a decrease in their agriculture productivities.

The findings from this study show that majority of the respondents had no form of improved agriculture training or knowledge to cope with the impact of climate change. Most smallholders' farmers rely solely on their traditional farming knowledge for their agriculture production activities. This agrees with Harvey, et al. (2014) and Jamshidi, et al. (2020), who are saying that smallholder farmers in a developing country have both limited materials and agriculture capacity to enhance their agriculture production and, as a result, they are engaged into traditional agriculture practices. Findings also show that all the respondents had some reasonable number of labour contributors mainly their family members who help in the cultivation of their farmland. Usually, smallholder farmers who have more family members that are capable and willing to work cultivate a larger portion of farmland. This finding is also in line with the study done by Garner and Campos (2014), who concluded that smallholder farmers rely on their family labour for their farming activities.

Findings also show that one respondent who had some level of improved agriculture knowledge was engaged in the continuing land used with crops rotation and the used of overhead irrigation. Those smallholder farmers, who had received some form of agriculture training, acquire a better yield from their crops compared to those who had never received any form of agriculture training. However, all the smallholder farmers were affected by the change in weather patterns but those with agriculture skill have a better capacity to practice improved coping strategies. This shows that education has a great influence on smallholder farmers' ability to cope with the impact of climate change. This finding is also proven in the study done by Deresa, et al. (2008), who disclosed that an increase in the level of education of household increases the chances that they start adopting agriculture innovations.

Farmer-to-farmer working groups were disclosed as the major social asset used by smallholder farmers to address most of their farming activities. The farmer-to-farmer working groups were also considered as a source of income for the farmers. The farmers are dependent on these groups for seeds and other agriculture inputs to carry out their farming activities. Besides the labour and the income acquired by smallholder farmers in the farmers' working groups, farmers also learn new ideas from each other during their visit to their various farms. This finding from the study is in line with the findings in of Egyir, et al. (2015), who disclosed that participation in farmer-based organisations enhances their agriculture skill, social networking and increases social capital as well their financial capital.

In addition to the social asset, the natural asset (land) was disclosed as the second asset owned by almost all the respondents. The land is an asset frequently owned by smallholder farmers in the Konia District. The issue of land for farming is not a major problem for the smallholder farmers in the Township of Konia, but resources and skills to farm were the major issues for farmers.

Findings of this research show that the majority of the farmers who have access to a large portion of land did not show increase production then the few who have a smaller portion of land. Farmers with a lesser portion of land that have some level of agriculture skills had better yields than those with larger land plots and no formal knowledge. This finding disagrees with Balama, Augustino and Eriksen (2013), who disclose that landholding size is key to increasing crop productivity in farming communities. Balama, Augustino and Eriksen (2013) also state that farmers who have access to a larger portion of land will do better in coping with climate change effects compared to those with small farms. This statement is also arguable because authors did not consider the agriculture skill or the education level of the farmers with large land, as education play a major role in farmers' adaptive capacity.

Findings from the study show that traditional farming methods are still used as the adaptive capacity of farmers to cope with climate change in Konia District of Liberia. These traditional methods used by smallholder farmers include slash and burn, crop rotation, bush fallowing, shifting cultivation amongst others. They have shown to be ineffective in mitigating the impact of climate change among farmers in Konia District. Konia District is characterised by irregular rainfall and sunshine, unpredictable weather patterns and a longer period of drought conditions. These unfavourable and erratic weather conditions seriously affect farmers' agricultural production. In current times, it is difficult to predict weather patterns. Before farmers knew that they had six months of rain and six months of the dry season. At present, the dry season sometimes extends longer than expected just like the rainy season. These inconsistencies disrupt farmers planting calendar and yield. Most of the interviewees said they applied traditional methods as a coping mechanism. This was corroborated in the findings of the semi-structured interview where 14 out of 15 participants agreed to the above statement. These farmers applied these traditional methods because they have limited asset to conventional methods to cope with changing weather patterns, such as modern irrigation systems and climate-resistant seed varieties. Among the interviewed smallholder farmers, agricultural production was boosted thanks to the application of these traditional methods. These methods are cost-effective and easily applicable. Without the application of these methods, farmers will find it difficult to realise an increase in agricultural production.

The reduction of the effects of climate change in agricultural production is important in enabling farmers to attain their agricultural production target. The effects of climate change can be mitigated by institutional structures and processes, which can be significant in increasing resilience and adaptation of smallholder farmers. This was confirmed by Belay and Recha (2017) and Dulal, et al. (2010) who corroborated that institutional arrangements play an important role in farmers' adaptive capacity and building of resilience because adaptation is a collective effort. Respondents in the semi-structured interviews of this research acknowledged the role of these institutional structures and processes in hindering the effects of changing weather patterns in agricultural. Respondents said the role of NGOs was considered to be very significant in climate change resilience and adaptation. However, according to the respondents' views, they believe that the government's role in the adaptive capacity of smallholder farmers to climate change impact has been minimal. The government has not paid proper attention to small-scale farmers' needs with regards to climate change impact. These farmers need the support of government via policies, legislations, and infrastructures that support farmers to be able to cope with the adverse effect of climate change. According to the interviewed farmers, the government can help small-scale farmers through financial support, provision of improved seed varieties, climate-resistant seeds, irrigation systems and early warning system to easily adapt to the impact of climate change. All those aspects are important but irrigation deserves special mentioning in this context. This can be confirmed by Buyukcangaz et al. (2017), who found out that Liberia has higher irrigation potential with an area of

11.137.000 ha, and an irrigation potential area of 600.000 ha, and irrigation potential in percentage of cultivable area as 12%, but less is done when it comes to irrigation development.

Reflection

At the beginning of my thesis work, I was very excited but scared, as this was my first experience in writing a thesis even though I have heard about it from many individuals. As a young professional coming up, it has always been my passion to understand the science behind climate change, how it affects the environment, people and their livelihood. As a result, I chose to use a case study in Konia District, one of several communities in which my organization works to conduct my research. However, there some challenges faced and lessons learned during the research process which I would like to reflect upon.

My research journey began with research proposal development, which was very new to me. As a first-time research proposal developer, it was not easy to handle all the critical feedback and comments from my supervisor. Of specific reference was the development of my research questions and problem statement, which I had to revise several times to suit my perceived research idea. After many attempts, I was finally approved by my supervisor to proceed with conducting my research.

As climate change issues have always been a passion for me, and a focus area of my organization, SADS, I chose to focus my research on gaining insight on current adaptive capacities and strategies of smallholder farmers in maintaining or increasing their production during climate change. This work allowed me to speak directly with rural farmers and understand the existing problems they were confronted with from climate change impact. The conversations took place over the phone because of COVID-19 pandemic, which prevented me from travelling in person to conduct the research. However, most of the respondents, especially women, we're very excited to speak with me being a female who is advocating for the livelihood development in the midst of the current climate change challenges.

As a result of the COVID-19 restriction, I selected a research assistant with whom I worked remotely on a daily basis to achieve the research objectives. His selection was based on the fact that he has long-standing experience conducting research involving people in rural communities and has practical understanding of their traditions, culture and norms. Secondly, he has no personal relationship with the people of Konia, which might have probably influenced their responses to research questions either positively or negatively.

During the field data collection, my research assistant encountered challenges of bad road conditions in getting to the study site in the Konia District. He took three days on the road just to reach the town, which would have taken approximately seven hours from Monrovia during the dry season. The internet connections were also very poor and frustrating at times as I was always working remotely with him during the questionnaire administration. At times, I had to call like six to eight times during an interview. In most cases, the research assistant will start the interview and connect the researcher through a phone call to be fully involved with the interview in terms of probing for clarity from the interviewee because he could not understand all the sensitive issue surrounding the research. This internet connectivity issue made some of the respondents to become very restless and impatient especially the men and it was a potential stumbling block for the researcher probing for more information. Fortunately, all the respondents were willing to cooperate with the research assistant in solving the network coverage problem by moving to other locations in the community with stronger network coverage.

Also, there were difficulties in mobilizing research participants due to COVID-19 fear factor, insufficient timing and resource constraints in conducting the study. Despite all of these difficulties, the researcher had several opportunities. The smooth community entry, the experience of the research assistant in the research community, cooperation from key informants and the willingness of the town chief to mobilize study participants were opportunities that facilitated the research process.

One key limitation of the research was the sample size. The author acknowledges that the study sample is not the standard statistically derived representative number for the entire population. Therefore, this

study has a weaker basis for generalization than a study with a statistically representative number. I would have also preferred to have been in the field collecting my data and not relying on my assistant. I question myself if he probed enough or understood the questions fully, and allocated enough time for the field study. However, carrying out this research has made me to effectively communicate my ideas, analyse and critique the work of others through the development of research proposal and defence of the proposal, and development of data collection instruments. Other people's works were critique during the discussion of the results.

This research has given me hands-on experience in understanding the impacts of climate change on rural farmers' livelihoods. I have gained a deeper understanding of the scientific process of doing research, most especially qualitative research. Several skills have been acquired by engaging in this research such as time management, organizational, team working, research, negotiation, writing and communication skills. Furthermore, I now know how to work under pressure, work independently on complex projects and I have learnt to always have a plan of action when doing a project. This research has taught me to always be prepared for eventualities, disappointments and challenges; thus, the need for contingency planning to mitigate such circumstances. I have learnt how to collaborate more effectively and to know how to relate to people. Finally, the research has further developed my skill as a development worker and has taught me how to deal with people as a development expert.

7. Conclusions and recommendations

7.1 Conclusions

The study was commissioned by SADS and aimed at understanding the current agricultural strategies being employed by smallholder farmers affected by climate change, as well as their adaptive capacity to adjust to the impact of climate change. In the process to achieve the aims of the study, the researcher conducted focus group discussions, semi-structured interviews and key informants' interviews with the participation of all major stakeholders including local authorities, NGOs and smallholder farmers themselves.

The findings establish that the usual rainy (six months from May to October) and dry (six months from November to April) seasons have been irregular over the last 10 years, which negatively affects the agricultural productivity. Some of the smallholder farmers who depend on the agriculture yield for their livelihood are unable to generate sufficient income to sustain themselves. This results in some farmers to look for alternative income-generating activities like motorbike riding and table market selling. Others keep on solely relying on farming using traditional farming strategies such as slash and burn, bush fallowing and mixed cropping, which cannot be considered as effective and sustainable. The adaptive capacities of smallholder farmers to cope with climate change are also limited. They actively use their social assets and possess natural assets. However, majority of the respondents has limited formal education, agriculture skills and lack access to informal agriculture training, as well as access to proper financing.

Regarding the institution setup, the farmers admitted the presence of different NGOs working with farmers in the district of Konia. However, the respondents revealed that some of those NGOs are only focused on few farmers closer to the protected area, while others focus on creating awareness and law enforcement about the forest, and not helping to effectively build farmers' capacity in the community that host the forest. SADS established a farmers' field school in the Konia community; however, it is not very effective because it lacks resources for farmers to carry out practical training. Government's support to farmers in the Konia community is irregular, it usually comes after two to three years and it is too limited to cover all the smallholder farmers in the district affected by climate change.

Overall, the data gathered in this study allows concluding that smallholder farmers' agricultural strategies and adaptive capacities in Konia District are currently not enough in securing a sufficient agricultural production for the farmers. Climate change negatively affects their agricultural production, and farmers have neither effective strategies nor sufficient capacities to address the problem. Moreover, their current strategies to cope with the climate change effects adds to the problem as they lead to deforestation, destruction of ecosystems, risk of erosion, etc. Some farmers have already switched or are in the process of switching to other activities to sustain themselves. This situation is not desirable as the country needs and aims at increasing its agricultural productivity not to depend on exporting of vital food products.

At the same time, institutional help is very limited or restricted to a specific area. Some organizations and structures do what they deem necessary without proper engagement and consultations with other stakeholders and with smallholder farmers. Moreover, different institutions (NGOs and the government) are pursuing their own goals, without exploring opportunities of cooperation for the mutual benefit of themselves and the farmers. This can be attributed to the lack of cooperation among NGOs, NGOs interaction and alignment with the governmental aims and goals, as well as with the goals and needs of smallholder farmers in Konia District.

7.2 Recommendations

The recommendations subchapter is divided into two sections. One of them is more general in nature and provides several recommendations to all the stakeholders active in the region. The other one is more specific and is intended for the commissioner of the research.

7.2.1 General recommendations

1. As it is indicated in the conclusion chapter, the stakeholders mostly conduct activities independently, without the knowledge of what other parties do and how combined efforts can yield better results. However, in the fast-changing and developing world, such an approach is deemed ineffective. The most essential recommendation deriving from this study for all the stakeholders is to work together and to align their approaches for achieving the common goal: the increase of agricultural production along with the environment preservation. To achieve this goal can be a hard task as parties might have many reservations towards each other. For example, smallholder farmers might have mistrust to the government, and NGO's might be restricted in their abilities to help to be dependant on their national or international sponsors providing funds for the projects. At the same time, the researcher believes that it is possible to find common ground by starting from small steps and advises the government to conduct a meeting with the participation of all the stakeholders (local authorities, chief leaders, NGOs' representatives, farmers' representatives). Proven successful, such meetings can take place regularly and result in the establishment of a special commission that can align the activities of all the stakeholders.
2. The lack of financing was mentioned as one of the biggest problems. Accordingly, it can be recommended for the financial institutions to reconsider their policies towards smallholder farmers. It is necessary to admit that it is unlikely to happen; however, this is a key issue to be addressed to achieve higher agricultural production in the country and should be discussed among financial institutions, representatives of government, farmers and NGOs.
3. There is a ground to believe that farmers themselves can take a more proactive approach when it comes to agricultural and alternative strategies to sustain themselves. Key elements in this process are education and knowledge. Therefore, stakeholders should keep constant interaction with farmers to learn their aspirations and needs to be able to provide relevant information and training and adapt their strategy and services to farmers' needs.
4. Some improvement can also be done with better involvement of the government. For example, building of new roads, organization of irrigation systems, distribution seed varieties and climate-resistant seeds definitely can improve agricultural production of smallholder farmers and their livelihood in general. However, it is necessary to admit that these changes cannot take place fast in the country, which in the process of recovering from the civil war and has many other problems to address.

7.2.2 Recommendations for the commissioner

1. From the research findings, it was evident that the majority of the farmers were engaged in upland farming using bush fallowing with slash and burn as their only farming option, which is not giving them higher yield. Therefore, it is recommended for SADS to focus on training farmers in sustainable climate-smart agriculture like swamp or lowland production and the effective use of irrigation.
2. It was disclosed in the finding that SADS had established farmers' field school in the Konia District; however, it was also revealed that they lack resources to conduct effective practical training. Therefore, it is recommended for SADS to collaborate with other international partners with

resources to give farmers practical knowledge which is very important in building their adaptive capacity

3. Findings revealed that all the smallholder farmers were part of different farmer-to-farmer working groups that pulled resources together to carry out their farming. It is recommended to SADS to work along with already established farmers' groups in providing training and provision of inputs to make the group stronger in addressing most of their farming challenges.
4. Findings show that farmers lack access to loan or credit from the different financial organizations due to the lack of farmland deeds. Therefore, it is recommended to SADS to advocate on behalf of the farmers to government and financial institutions in order to achieve an approach that enables farmers to have access to affordable loans.
5. Findings revealed that farmers lack access to improve farm to market road. It is recommended that SADS lobby with government and international partners to rehabilitate the road from farms to the market and other roads that will help farmers to sell their products.
6. Exposure of the livelihood asset and smallholder farmers' perception of climate change and its impact are critical to helping farmers adapt to climate change. This study, unfortunately, did not consider this. It is hence recommended that; future studies should consider exploring the exposure of the livelihood's assets and smallholder farmers' perception in the Konia context-specific

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8. Appendices

Appendices 1: RESPONDENTS' CONSENT FORM

Dear prospective participant in this research,

Title: *Consent seeking to participate in an Academic Research on the following topic: Assessment of Smallholder Farmers Adaptive Capacities and Strategies to Climate Change: A Case of Konia District, Liberia.*

My name is Adu Boateng, I am collecting data on behalf of Charlene Venessa Talery, Charlene is a Liberian student studying in the Netherlands, She couldn't undertake this trip due to COVID-19 travel restriction and asked me to conduct this research on her behalf. The objective of this research is to gain insight into smallholder farmers current adaptive capacities and strategies to cope with the challenges of climate change. This research project is part of the requirement for the degree of Master of Science (MSc) in the Management to Development at Van Hall Larenstein University of Applied Sciences, The Netherlands.

The research will consist of open-ended questions regarding smallholder farmers' adaptive capacities and strategies to climate change. These open-ended questions will allow you to freely express your opinions, views and knowledge on the above topic. The research is foreseen to last about 1hours and 30 minutes. The anticipated questions will focus on the research objectives.

Information will be recorded in hand-written format. Audio and video recordings will also be done and where appropriate, summarized in an anonymous format, in the body of the final report. At no time will any specific comments be attributed to any individual unless specific agreement has been ordained beforehand. All documentation will be kept strictly confidential.

You are not compelled to participate in this research project. If you do choose to participate, you are free to withdraw at any time without prejudice. Similarly, if you choose not to participate in this research project, this information will also be maintained in confidence.

By signing this letter, you give free and informed consent to participate in this project.

Name: _____

Signed: _____

Date: _____

Appendices 2: Semi-Structured Interview guide

Interview number	
Interviewer Name:	
Location of Interview:	
Interview Date:	
Start Time:	

End Time :

SECTION 1: DEMOGRAPHIC INFORMATION

Name of town: _____

Age of household head: _____ Gender () M () F

Education: () never been to school () primary () junior high () senior high () tertiary

Interviewee status: _____

How long have you lived in this village? a) native b) less than 10 years c) over 10 years

Why did you move into this area? a) farming b) fishing c) others _____

Part I: Questions on climate change exposure

- What can you say about the weather conditions in the past 5-10 years?
- How has this weather condition affected your crops' yield?
- What effect does this shift in temperature have on the income of your household as a farmer?
- What kind of problems do you encounter from the weather?
- How do the problems you encounter affect the crops you cultivate?
- How do you see your yields compared to previous years?
- How has the level of rainfall or the beginning of rainy season affected your method of farming?
- Have you experienced any extreme weather conditions in recent years which led to yield damage, property loss, etc.? If 'yes', explain.
- How does this unstable weather affect your livelihood?

Part II: Questions on adaptive capacities

Financial assets

- What are the most popular financial methods (credits, loans, etc.) used by people in this community?
- Why do you think they are the most popular?
- How do you access information on these methods?

Social assets

- What are the local farmer cooperatives in this village?
- How important is the participation in these cooperatives?
- Do you receive external help from family members or friends?

Human assets

- What information do you receive concerning change in the weather pattern?
- How long have you been farming?
- What other skills do you have?

Natural assets

- How do people acquire land for farming in this community?
- What are the most important natural resources you have? Why do you consider them to be important?
- What natural resources are lacking?
- How long does it take you to get water for your farm?
- What do you think about availability and accessibility of the farming land in the community? Is the land sufficient or not?

Physical assets

- How do you harvest your crops?
- What equipment do you use?
- What do you think about the roads network?
- How long does it take you to take your produce to the market?

Part III: Strategies:

- Tell me about the type of farm you have?
- What type of crops do you grow on your farm?
- Where do you farm? Upland or lowland?
 - a) If upland, how do you irrigate your crops during the dry season?
 - b) If lowland, how do you control the water during rainy season?
- What other activities are you engaged in apart from farming?
- How would you describe as the most frequent farming methods used by people in this community?
- Have these methods changed over the last 5-10 years? If 'yes', explain how and why do you think they changed, if 'no', explain how?
- How has your yield changed over this period?
- How do you cope with climate change?

Part IV: Transforming structures and processes

- What government agency is present in this community?
- Do you receive any assistance from the government or NGOs during your farming? If 'yes', what kind of assistance is it? How does it help to enhance production?
- How have laws or policies affected your farming activities?
- How you have access to extension advice for your farming? How? Explain

Appendix 3: Focus group discussion guide

- 6 participants
- 100-120 minutes long.

I would like to note that everyone's view is valued, meaning that you do not need to come to an agreement but rather express your opinion freely. Let us also agree to be polite to each other and avoid interrupting each other, raising voice and shouting.

Time	Description
5 min	<u>Introduction (names, activities engaged)</u> <ul style="list-style-type: none"> - Please, introduce yourself and explain what farming activities you are engaged in and for how long.
20-25 min	<u>Getting familiarized with farmers' Adaptive capacity (assets)</u> <ul style="list-style-type: none"> - What are your most important assets? Name several and explain why they are important for you - What assets you need/would like to have or to have more to increase your agricultural production
20-25 min	<u>Getting familiarized with farmers' Strategies (activities)</u> <ul style="list-style-type: none"> - How do you cultivate your land? What are your farming methods/practices? - What problems do you experience? - How have your farming methods changed within the last few (5-10) years? Why do you think it happened? - What are the traditions and beliefs that affect your farming activities? - What other activities are you engaged in)?
10 min	Tea break
20-25 min	<u>Climate change effect</u> <ul style="list-style-type: none"> - What do you know about climate change? - How, in your opinion, has climate change affected your activities and your life in general?
20-25 min	<u>Institutions and structures</u> <ul style="list-style-type: none"> - What do you know about the laws and regulations, related to your activities? - How do you feel about these laws and regulations? - How does the government help you? What can it do better? - What do you know about NGOs working in your area? How helpful are they? What do you expect from them?
	List all the capital assets in the community, which members of the community draw upon to achieve their livelihoods. 2. Arrange these into the five capital assets (i.e. natural, human, physical, financial, and social assets). 3. Highlight the main climate events that have taken place in this community in the last 10 years. How have these events affected your livelihoods activities? 4. How are these assets (and livelihood activities) vulnerable to changes in climate? 5. How do the community cope with these changes in the climate in terms of drought and flood?
5 min	<u>Wrap up. Last thoughts. Anything to add.</u>

Appendix 4: Key Informants Interview Guide

Interview number & Type:
Interviewer Name:
Location of Interview:
Interview Date:
Start Time:
End Time:

SECTION 1: DEMOGRAPHIC INFORMATION

Name of village: _____

Age of household head: _____ Gender () M () F

Education: () never been to school () primary () junior high () senior high () tertiary

Interviewee status: _____

How long have you lived in this village? a) native b) less than 10 years c) over 10 years

Why did you move into this area?

Part I: Questions on climate change exposure

- Describe any extreme weather conditions in the recent years which led to farmers' yield damage, property loss, etc/ (Farmer Union Head, Communion Chairman, Agricultural extension officer, District Agricultural Officer).
- What effect does this shift in temperature have on farmer income? (Community Chairman, Farmer Union Head and Agriculture Extension Officer)
- What programs or policy is available to aid farmers during a climate change effect? (District Agricultural Officer, FDA Rep)
- How are policies on climate change implemented at the community level? (Community Chairman, Agricultural Extension Officer)

Part II: Questions on adaptive capacities

Financial assets

- What is the procedure for accessing credit or loan at any bank or credit union available in the community? (Community Chairman)
- How accessible is the market available to farmers to sell their products? (Farmer Union Head)

Social assets

- How effective are any local farmer cooperatives in the community in terms of participation? (Farmer Union Head)
- How important are the cooperatives to farmers agriculture production? (Farmer Union Head)
- Is there any farmer to farmer working group in the community? (community Chairman)
- What is the role of farmer to farmer working group and how important are there in the community? (Farmer Union Head, Community chairman).

Human assets

- What capacity development program are available for farmers in the community? (Extension worker)
- If available, then how do farmers benefit from those capacity programs? (Extension worker)

Natural assets

- How do people acquire land for farming in the community? (Community chairman)
- What do you think about availability and accessibility of the farming land in the community? Is the land sufficient or not? (Community Chairman, Extension worker)

Physical assets

- How do farmers acquire agriculture tools and equipment in the community? (Community Chairman, Farmer Union Head)
- Is there any storage facility for farmers group or cooperative? (Farmer Union Head)
- Are the irrigation infrastructure

Part III: Strategies:

- How do majority of the farmers cultivate their crops looking at low land and upland? If upland or lowland, what do you think they prefer that? (Agricultural Extension Officer, District Agricultural Officer)
- How do upland farmers irrigate their crops during the dry season? (Agricultural extension officer, Farmer Union Head)
- How do lowland farmers control the over flow of water in their field during the rainy season? (Farmer Union Head)
- What crop is mostly grown by farmers in the community? (Community Chairman, Farmer Union Head)
- What cropping method or practice is carried out in the community? (Agricultural Extension Officer, Farmer Union Head, Community Chairman)
- Have there been any change in the cropping method in the resent year? If yes, explain (Agricultural Extension Officer, Community Chairman, Farmer Union Head)
- Beside agriculture, what other activities do farmers engaged in? (Agricultural extension officer, Farmer Union Head, Community Chairman)

Part IV: Transforming structures and processes

- Which government agency or NGOs is working in the community with farmers? (NGO Rep, District Agricultural Officer)
- What is the role of the government agency or NGOs in promoting farming? (District Agricultural Officer, NGO Rep)
- What laws or policies are available for the promotion of agriculture activities in the community? (Community Chairman, District Agricultural Officer, FDA Rep)

- How are those policies or law implemented at the community level? (Community chairman, District Agricultural Officer, Agricultural Extension officer, Farmer union head).

Appendix 5: FGD Demographic Information (Female)

Respondent	Type	Status	Age	Sex	Education	Length of stay in Konia	Income Source (s)
FGD1	Farmer	Married	45	Female	Primary	17 years	Farming/ small business
FGD2	Farmer	Married	38	Female	Illiterate	11 years	Farming/ small business
FGD3	Farmer	Married	42	Female	Illiterate	native	Farming/ nurse
FGD4	Farmer	Single	37	Female	Primary	18 years	Farming/ small business
FGD5	Farmer	Married	40	Female	Illiterate	native	Farming/ small business
FGD6	Farmer	Widow	44	Female	Illiterate	native	Farming/ small business

Appendix 6: FGD Demographic Information (Male)

Respondent	Type	Status	Age	Sex	Education	Length of stay in Konia	Income Source (s)
FGD7	Farmer	Single	33	Male	Jr. high	native	Farming/ motorcycle transport
FGD8	Farmer	Married	48	Male	Illiterate	native	Farming/ tailoring
FGD9	Farmer	Married	36	Male	Primary	13 years	Farming/ motorcycle transport
FGD10	Farmer	Single	47	Male	Illiterate	native	Farming/ pit sawing
FGD11	Farmer	Married	50	Male	Primary	native	Farming/ small business
FGD12	Farmer	Single	30	Male	Illiterate	15 years	Farming/ motorcycle transport

Appendix 7: SSI Demographic Information

Respondent	Type	Status	Age	Sex	Education	Length of stay in Konia	Income Source (s)
SS1	Farmer	Married	37	Female	Illiterate	native	Farming/ small business
SS2	Farmer	Married	42	Female	Illiterate	16 years	Farming
SS3	Farmer	Single	36	Male	Illiterate	11 years	Farming/ hunting
SS4	Farmer	Single	44	Male	Illiterate	native	Farming/ motorcycle transport
SS5	Farmer	Married	33	Male	Illiterate	native	Farming/ motorcycle transport
SS6	Farmer	Married	39	Female	Primary	native	Farming
SS7	Farmer	Married	45	Female	Illiterate	14 years	Farming/ midwifery
SS8	Farmer	Married	39	Female	Jr. high	native	Farming/ small business
SS9	Farmer	Widow	41	Female	Illiterate	19 years	Farming
SS10	Farmer	Single	35	Male	Illiterate	native	Farming/ motorcycle transport
SS11	Farmer	Married	53	Male	Primary	native	Farming/ hunting
SS12	Farmer	Married	57	Male	Jr. high	native	Farming
SS13	Farmer	Married	33	Male	Jr. high	8 years	Farming/ motorcycle transport
SS14	Farmer	Married	56	Male	Illiterate	18 years	Farming/ hunting
SS15	Farmer	Single	38	Female	Sr. high	7 years	Farming/ small business