ASSESSMENT OF THE SUSTAINABLE LIVELIHOODS OF RURAL COCOA FARMERS IN THE ATWIMA MPONUA DISTRICT OF GHANA

BY

PARRY, VICTOR

10284457

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DECLARATION

I hereby certify that, except for references to others people's work which I have duly cited, this work is the result of my own original research under supervision of Dr. Rosina Kyerematen and Dr. Albert Ahenkan, that this dissertation has neither in whole or part been presented for another degree elsewhere.

..... DATE.....

Signature

PARRY VICTOR

(Student)

10284457

…… DATE.....…….

Signature

DR. ROSINA KYEREMATEN

(Supervisor)

……. DATE: ……

Signature

DR. ALBERT AHENKAN

(Co-Supervisor)

DEDICATION

This thesis is dedicated to my family and relatives especially my mother, my little brother James Kojo Acheampong Parry and sister Regina Adwoa Baaba Parry.

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COCOBOD	:	Ghana Cocoa Board
CRIG	:	Cocoa Research Institute of Ghana
DFID	:	Department for International Development
FBO	:	Farmers Base Organisation
ICCO	:	International Cocoa Organisation
IFPRI	:	International Food Policy Research Institute
IMF	:	International Monetary Fund
IPCC	:	Intergovernmental Panel on Climate Change
IPCC	:	Intergovernmental Panel on Climate Change
ISSER	:	Institute of Statistical, Social and Economic Research
MMYE	:	Ministry of Manpower, Youth and Employment
MoFA	:	Ministry of Food and Agriculture
NGO	:	Non-Governmental Organisation
OECD	:	The Organisation for Economic Co-operation and Development
SLF	:	Sustainable Livelihood Framework
UNCTAD	:	United Nations Conference on Trade and Development
WACRI	:	West Africa Cacao Research Institute
WFP	:	World Food Programme
WTO	:	World Trade Organisation
FAO	:	Food and Agriculture Organisation

ABSTRACT

Livelihoods are the ways in which people satisfy their needs, or gain a living. In Ghana, cocoa production supports the livelihoods of more than 800,000 smallholder households and many others who depend on it for a significant share of their income.

The primary objective of the study was to assess the sustainable livelihoods of rural cocoa farmers in the Atwima Mponua district in the Ashanti Region of Ghana. Mixed method approach was used and one hundred and fifty (150) cocoa farmers were sampled in three communities in the district. The results revealed that cocoa farmers perceived change in climate as reduced rainfall, increased temperature, change in rainfall patterns and weather extremes.

The study revealed that cocoa output (kg) and yield (kg/acre) had increased over the 5 seasons. Analysis showed that climatic variables (rainfall and temperature) have had no influence on cocoa production and yield over the 5 seasons. Socioeconomic factors (such as experience, labour, land size, etc) influenced cocoa output (kg) and yield (kg/acre). Socioeconomic factors (such as sex, age, household head, etc) influenced diversification from crop farming by cocoa farmers. Cocoa farmers cultivated other crops alongside cocoa. Cocoa farmers get income from farm, off farm and non-farm activities and remittances received. Income was unequally distributed among cocoa farmers in the district. The study recommended that government and other stakeholders should help subsidize inputs prices and increase price of cocoa to enhance productivity, livelihoods of cocoa farmers and development of the country.

CHAPTER ONE

INTRODUCTION

1.1 Background

Livelihood security of a person or household includes access and future claims to incomes from private and common property (Chambers and Conway, 1992). Livelihoods of households come from various sources and activities, variable over time. They consist of several different activities for each given household usually even for each working member, and even within a year (Chambers and Conway 1992). The response of households to changes and the kind of strategies they adopt depend on the flexibility of households' livelihoods. Most households adopt strategies that are diverse, versatile and complex (Chambers 1989). As rural households gain their livelihoods from diverse and different sources, it is expected that they are affected in various ways by adjustment measures (Ahmed *et al*., 1997). Thus, we examine not only the outcomes, but also the institutional mechanisms by which adjustment measures are translated into production and investment decisions by poor rural households (Ahmed *et al*., 1997).

Livelihoods are the ways in which people satisfy their needs, or gain a living (Chambers and Conway 1992). A 'livelihood' is a set of flows of income, from hired employment, self-employment, and remittances or (usually in developing rural areas) from a seasonally and annually variable combination of all these (Ahmed *et al*., 1997). A livelihood should be sufficient to avoid poverty, and preferably, increase well-being for a typical worker plus dependants. Well-being (Squire 1991) 'is the product of a range of factors, including adequate consumption of goods and services, health, status, achievement, and security.'

About 75% of the world's poor live in rural areas thus making them a large habour of poverty. Though urban poverty is rising, the correlation between poverty and remoteness from urban centres is strong in most countries and it is expected to remain so until at least the second decade of the century (Carney, 1999). Rural people are not only isolated from economic opportunities, they also tend to have less access to social services such as health, sanitation and education; for example, it is estimated that around 1 billion rural households in developing countries lack access to safe water supplies. Moreover, knowledge of rights and information about the way governments function is notably lacking in rural areas. This makes it hard for rural people to exert pressure for change in systems which have often actively discriminated against them both in the allocation of resources and in pricing policies for their produce (Carney, 1999).

Agriculture remains a centrally important part of the West African economy, providing 30–50% of GDP in most countries, the major source of income and livelihoods for 70–80% of the population, food supplies and revenue from export of cash crops (Fafchamps *et al*., 2001). While the economies and peoples of the region are diversifying into a range of other activities, farming is likely to remain of central significance to incomes and livelihoods for the foreseeable future (Fafchamps, *et al*., 2001). Despite the importance of farming to rural livelihoods according to World Bank (2007) staple food yields in Sub-Saharan Africa are poor due to low adoption of productivity enhancing inputs. In Ghana, agriculture provides livelihood for over 60 per cent of the population (MoFA, 2011). Beyond these, agriculture is also recognized to have a greater impact on vulnerability and poverty reduction than any other sector in developing countries (IFPRI, 2004).

Cocoa which belongs to the family Steruliacaea and genus Theobroma was discovered in18th century at the Amazon basin and later spread to other tropical areas of South and Central

America, and West Africa (Opeke 1987). The importance of cocoa to Ghana's economy cannot be overstated. Cocoa production supports the livelihoods of more than 800,000 smallholder households (Anim-Kwapong and Frimpong, 2004) and many others who depend on it for a significant share of their income (World Bank, 2011). Ghana is the world's second largest producer of cocoa, responsible for producing around 20 per cent of the world's bulk cocoa in 2005-2006 (ICCO, 2006). Cocoa is Ghana's dominant cash crop and single most important export product. In 2006, exports of cocoa butter, powder, beans, paste, and waste totaled US$1,241 million, equivalent to more than 33% of Ghana's merchandise exports (WTO, 2008). Cocoa production and marketing accounted for 32.2 percent of export earnings (ISSER, 2008) and 8.5% of Gross Domestic Product in 2006, up from 4.9% in 1998 with the European Community being the main export destination for cocoa produced in Ghana (IMF, 2007).

According to the United Nations Conference on Trade and Development, UNCTAD, (2004), cocoa is a highly competitive and lucrative economic cash crop ranked highest in terms of income generation amongst other agricultural activities in the global markets. The nutritional value of cocoa to man (health supportive) with regards to its constituent elements like butter (54%), protein (11%), cellulose (9%), pentosan (7.5%), tannin (6%), water (5%), theobromin (1.2%), sugar (11%) and caffeine (0.2%) have made it a more dependable cash crop which is encouraged worldwide. Millions of people around the world enjoy consuming chocolate whether as part of a snack, drink or dessert (International Cocoa Organisation, ICCO, 2001). West Africa with a total cultivated area of 420,000 hectares accounts for over 70% of world production (ICCO, 2001). Moreover, there are several studies which have shown the putative cardio-protective action of cocoa. These studies give an indication of the health benefits obtained from the consumption of cocoa and cocoa products, specifically, a reduction in hypertension and its

related diseases (Buijsse *et al.*, 2006; Hodgon and Kelvin, 2006; Polarity *et al*., 2006). Cocoa by-products are also an important feed in animal production.

In Ghana, agriculture production is mainly rain fed. As a result, production is erratic and vacillating between scarcity, sufficiency and glut depending on the vagaries of the weather (World Bank, 2010). This introduces an element of risk in agricultural production since decisions are made in the face of uncertainty and risk. As a result, rural farmers who produce crops have limited access to credit relative to the middlemen and processors who are at the extreme end of the value chain. Farmers therefore rely on indigenous resources and undertake small-scale operations. Nationally, more than 90 per cent of farm holdings are less than 2 hectares in size and are subsistence farms (WFP, 2009; MoFA, 2011). This renders farmers vulnerable to poverty and hunger due to limited income. The Ghana Statistical Service (2008) stress that more than 55 per cent of the poor in Ghana live in households with farming as their main activity and women farmers being the dominant group.

The exposure to risk and the inability to prevent or mitigate and cope with the impact of shocks, trends and seasonality decreases the income and well-being of households. Thus, income is an important outcome of livelihood and a major determinant of well-being of farmers. Since farming is the main economic activity in rural areas, poor farmers seek ways of supplementing or smoothing their farm income (mainstream income) which is usually subject to risks arising from the vagaries of weather and fluctuation in market prices (Ellis, 1998). To cope with increasing risk of the agricultural industry, many poor farming households resort to diversification. Livelihood diversification is the process by which rural households construct an increasingly diverse portfolio and assets allocation or engage in multiple livelihood activities in order to survive and improve their standard of living (Ellis, 2000a; Barret and Reardon, 2000). Barret and

Reardon (2000) add that diversification is born of desperation, sometimes of opportunity or risk management and requires stocks of productive factors that yield a stream of cash or in-kind returns referred to as assets. Yet, the flexibility of farmers in responding to diversification opportunities is in most cases constrained by factors such as size of markets, price risks, soil suitability, quality of irrigation infrastructure, availability and cost of labour (Ellis, 2000).

1.2 Problem Statement

Agriculture is a source of livelihoods for an estimated 86 percent of rural people worldwide. It provides jobs for 1.3 billion smallholders and landless workers, farm-financed social welfare when there are urban shocks and a foundation for viable rural communities (World Bank, 2006). Of the developing world's 5.5 billion people, 3 billion live in rural areas, nearly half of humanity. Of these rural inhabitants an estimated 2.5 billion are in households involved in agriculture, and 1.5 billion are in smallholder households (World Bank, 2007). It has been revealed by Narayan *et al.* (2000) that in rural areas much hardship is linked to reduced access to land, bad soils, adverse weather, lack of fertilizer and other inputs, deficiencies of transport and marketing, and overexploitation of common resources such as fish, pastureland and forests. Rural communities in Ghana are prone to erratic conditions of both climatic and environmental nature. Poverty is widespread in rural areas of Ghana, with the magnitude and incidence of poverty increases food insecurity manifesting in low consumption and high malnutrition and mortality rates is a widespread phenomenon (Nyanteng and Asuming-Brempong, 2003). With erratic rainfall and only marginal soil fertility, feeding the growing population is a major challenge and a prerequisite to rural development. Declining soil fertility resulting from continuous cropping and mono-cropping has led to declining yields of maize, sorghum, and groundnut (Abatania and Albert, 1993). In a study sponsored by the World Bank and conducted

in 23 countries worldwide including Ghana in 1999, it was revealed that uncertainty of livelihood sources in general was serious for the poor in rural areas in particular. Insecurity from lack of assets and money was often mentioned, but more often implied. For many their body is the main or only asset. Housing and shelter are also found as sources of discomfort and distress for the rural poor. The physical ill-being of hunger and sickness, and the pain, stress and suffering they bring are a common theme in rural areas. (Narayan *et al.*, 2000).

The cocoa sector in Ghana employs over 800,000 smallholder farm families (Anim-Kwapong and Frimpong, 2004). The number of cocoa farm owners is estimated at 350,000 and cocoa farm sizes are relatively small ranging from 0.4 to 4.0 hectare with an estimated total cultivation area of about 1.45 million hectares (COCOBOD, 2004). For smallholder cocoa farmers, cocoa contributes about 70-100% of their annual household incomes. In addition other stakeholders like chemical companies, input distributors and licensed cocoa buying companies also depend largely on cocoa for markets for their products, employment and income (Asamoah and Baah, 2002). Sales of cocoa beans have been one of the major foreign exchange earners to Ghana throughout the years. In 2002, cocoa made up for 22.4 per cent (463 million US $) of the total foreign exchange earnings (ISSER, 2003). The share of cocoa in Ghana's GDP is 8.2% and about 23% of foreign exchange earnings (ICCO, 2012). Cocoa is mostly produced by smallholder rural farmers and like all agricultural sectors in Africa, production is constrained by several factors. Surveys conducted on cocoa farms show that about 25% of current cocoa-tree stocks are over 30 years old. In addition, over 60% of cocoa farmers are currently over 50 years old, and unwilling to take extra risk in investing in yield improvement strategies due to perceived high cost of input relative to producer price (Ministry of Finance, 1999). Hence, cocoa cultivation just like most agricultural activity in Ghana is still a low input venture undertaken on

small farms using rudimentary technology with very little purchased input (Asenso-Okyere, 2001). It has been observed that there is a minimum farm size which sustains farmer interest in cocoa farming and the requisite investment in labour and other resources for a viable economic enterprise (COCOBOD, 1998). When farm sizes are small like those observed in the present survey, farmers are not encouraged to invest in inputs since the ultimate income is limited by farm size.

Rural livelihoods engage in mixed activities often based primarily on agriculture but increasingly combined with non-farm activities (Ellis, 2000). Cocoa farmers like other farmers in Africa have limited opportunities for earning cash income. Family farms in West Africa according to Toulmin and Gueye (2003) face distinct problems which include a growing shortage of land (particularly in peri-urban areas), illiteracy and poor access to schooling (which hinder access to new technologies and innovative practices), low value accorded to the status of agricultural smallholder, poorly developed organisation of smallholder agricultural production, inheritance and fragmentation of land holdings.

1.3 Justification

Livelihoods in rural areas are complex and diverse, affected in different ways by policies to promote agricultural growth (OECD, 2007). Policies for effective poverty reduction need to be informed not just by the evidence of agriculture‘s contribution to pro-poor growth but by a good understanding of the realities and dynamics of both the agricultural sector and rural livelihoods and of how poor rural households are constrained or supported by policies and institutions (DFID, 2000).

Ghana is the world's 2nd largest producer of cocoa: more than 1.000.000 MT in 2011, produced by approximately 1 million cocoa producers, predominantly smallholders, being male and female farmers, owners and sharecroppers (ICCO, 2011). In Ghana, the cocoa sector forms the economic backbone of the country (Kolavalli and Vigneri, 2011). Cocoa contributes significantly to GDP, is a major earner of foreign exchange and provides employment for hundreds of thousands of people throughout the cocoa supply chain (Kolavalli and Vigneri, 2011). Like elsewhere, smallholder farmers in Ghana are the backbone of the cocoa supply chain. Their primary activity is year-round production of cocoa, an activity that supports the entire supply chain, upon which millions of Ghanaians depend for income (ICCO, 2007). In the Southern Forest Belt, where cocoa is produced, aggregate figures suggest that through the 1990s, cocoa-farming households, along with those engaged in mining or timber (the other predominantly export-oriented activities) and other commercial activities, experienced improvements in their living conditions compared with food crop farmers (McKay and Coulombe, 2003). Poverty reduction among cocoa farmers is clear. Household surveys indicate that poverty among cocoa-producing households dropped to 23.9 percent in 2005, down from 60.1 percent at the beginning of the 1990s (World Bank, 2007b). It is therefore important to know what shocks and stresses that influence cocoa production, assets needed and strategies that will help improve the quality of cocoa and cocoa farmers livelihoods as this will help increase crop yield, economic growth, reduce poverty and enhance national development.

The study will help government agencies and institutions identify socio economic factors or characteristics that influence cocoa yield. This will give a better understanding of processes that affect livelihoods of cocoa farmers and how stakeholders can contribute to improve the livelihoods of farmers and thus cocoa yield. The study will help stakeholders know the

livelihood assets needed by farmers to improve their lives and how these assets can be made readily available to them. The study will also identify factors that influence livelihood diversification of farmers. Diversification helps to reduce income risks and vulnerability. Thus the findings of this study will help policy makers initiate programmes that will help generate employment opportunities and income for the cocoa farmers and reduce poverty. This will also help reduce income disparity among cocoa farmers.

Finally, the study will help government agencies and stakeholders know the climatic variables that affect cocoa farmers and initiate programmes to help farmers cope and adapt to the changes in the climate which will help increase cocoa yield, economic growth and enhance national development.

1.4 Objectives

The general objective of the study was to assess the sustainable livelihood of rural cocoa farmers using Atwima Mponua District as a case study.

Specifically, the study sought:

- To assess the perceptions of the population about climate change and how it affects their livelihoods.
- To determine the livelihood assets of rural cocoa farmers in the district.
- To determine the factors influencing cocoa output and yield in the district.
- To examine alternative livelihoods of rural cocoa farmers and factors influencing diversification of livelihoods in the district.

- To determine the income distribution of rural cocoa farmers in the district.

1.5 Research Questions

- In the view of rural farmers, what climatic conditions are they faced with?
- What assets are available for farmers to rely on to deal with shocks and stresses that influence their livelihoods?
- What are the factors influencing cocoa output and yield in the district?
- What are the alternative livelihood sources of cocoa farmers in the district?
- How is income distributed among cocoa farmers?

1.6 Hypothesis

1. Ho: Climatic variables (rainfall and temperature) have no significant effect on cocoa output and yield.

   Ha: Climatic variables (rainfall and temperature) have significant effect on cocoa output and yield.

2. Ho: Socioeconomic factors have no significant effect on cocoa output and yield of farmers.

   Ha: Socioeconomic factors have significant effect on cocoa output and yield of farmers.

3. Ho: Socioeconomic factors have no significant effect on livelihood diversification of cocoa farmers.

Ha: Socioeconomic factors have significant effect on livelihood diversification of cocoa farmers.

4. Ho: Income in the Atwima Mponua district is equally distributed among the farm households.

   Ha: Income in the Atwima Mponua district is unequally distributed among the farm households.

1.7 Organisation of the Thesis

The study has been organized into six chapters. The first chapter, the introduction consist of the background to the entire research, the problem statement, objectives of study, justification of the study as well as the organization of the rest of the study.

The second chapter contains the literature review which is an academic collection of findings that are related to the study.

Chapter three involves the methodology which is a systematic analysis of the methods applied to the study.

Chapter four represents the results of the research.

Chapter five consists of discussing of results and findings that have implications on the sustainable livelihoods of cocoa farmers.

The final chapter, chapter six presents the summary, conclusions and policy recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents literature on various concepts of assessing livelihood of rural cocoa farmers.

2.2 Rural Communities and their Characteristics

Rural areas can be defined by settlement size, population density and distance to metropolitan areas, administrative division, and importance of the agricultural sector (OECD, 2006)

This also means that national definitions of rural can have quite different meanings in different countries. The Organisation for Economic Co-operation and Development (OECD) uses population density of 150 people per square kilometre to define rural. Differences in population density and distance to market towns imply very different challenges for infrastructure, service delivery, and rural development. High population density makes it cheaper to provide public goods, such as roads. Low population density increases the cost of such investments but eases constraints of land resources. Rural communities by definition are less densely populated and are mostly homogeneous in contrast to the heterogeneous nature of modern towns. OECD (2006) considers five categories of rural households, or rural worlds:

Rural World 1: Large-scale commercial agricultural households and enterprises.

Rural World 2: Traditional land holders and enterprises, not internationally competitive.

Rural World 3: Subsistence agricultural households and micro-enterprises.

Rural World 4: Landless rural households and micro-enterprises.

Rural World 5: Chronically poor rural households, many no longer economically active.

2.3 Cocoa and Development

Cocoa which belongs to the family Steruliacaea and genus Theobroma was discovered in18th century at the Amazon basin and later spread to other tropical areas of South and Central America, and West Africa (Opeke 1987). Cocoa, *Theobroma cacao,* is an important cash crop in the world economy. In West Africa, cocoa is essentially a smallholder crop, cultivated on 1.2 to 1.5 million farms ranging in size from 1.2 to 2.8 hectares and employing about 10 million people (Padi and Owusu, 1998). Cocoa is a tree crop that provides livelihoods for millions of smallholder farmers in over 50 countries across Africa, Latin America, the Caribbean and Asia (International Cocoa Organization, 2006). It grows best in humid, tropical zones located roughly 10 degrees north and south of the equator.

Cocoa cultivation in Ghana is mainly done in the forest lands of the six cocoa regions where rainfall is between 1100mm and 3000mm per annum. Extremely wet and swampy lands are not suitable as well as rocky places (Cocoa Research Institute of Ghana, 1987). There are six cocoa growing regions in Ghana namely Ashanti, Brong-Ahafo, Central, Eastern, Western, and Volta regions. No other country comes to mind more than Ghana when one speaks of cocoa. Likewise, one cannot think of Ghana without thinking of its cocoa sector, which offers livelihoods for over 800,000 farmers in the southern tropical belt of the country (Kolavalli and Vigneri, 2011). Cocoa holds a unique position in Ghana's economy. It has long played a crucial role in Ghana's economic development and remains an important source of rural employment. It also remains the country's most important agricultural export crop. Cocoa contributes significantly to GDP, is a major earner of foreign exchange and provides employment for hundreds of thousands of people throughout the chain (Kolavalli and Vigneri, 2011). Africa has firmly established itself as the leading cocoa supplier. Since 2000/2001, Africa's production has expanded at an average annual

rate of 2.7%, according to the International Cocoa Organization (ICCO, 2010). Much of this growth has come from Ghana, which achieved the largest increase in output (up by 269,000 tons). In 2009-10, Ghana was the second biggest producer after Cote d'Ivoire, representing 21% of global production (World Cocoa Foundation, 2010).

Cocoa production supports the livelihoods of more than 800,000 smallholder households (Anim-Kwapong and Frimpong, 2004) and many others who depend on it for a significant share of their income. Poverty reduction among cocoa farmers is clear. Household surveys indicate that poverty among cocoa-producing households dropped to 23.9 percent in 2005, down from 60.1 percent at the beginning of the 1990s (World Bank 2007b).

For smallholder cocoa farmers, cocoa contributes about 70-100% of their annual household incomes. In addition other stakeholders like chemical companies, input distributors and licensed cocoa buying companies (LCB's) also depend largely on cocoa for markets for their products, employment and income (Asamoah and Baah, 2002). Sales of cocoa beans have been one of the major foreign exchange earners to Ghana throughout the years. In 2002 for instance, cocoa made up for 22.4 per cent (463 million US $) of the total foreign exchange earnings. Cocoa constituted 63% of the foreign export earnings from the agricultural sector, compared to 25% and 12% contribute by timber and the non-traditional export sectors (ISSER, 2003).

2.4 Sustainable Livelihood Framework (SLF)

The sustainable livelihood concept has gained wide acceptance as a valuable tool to understanding factors that influence the well-being of the poor and non-poor in developing countries. The Sustainable Livelihood Framework (SLF) provides means of assessing the status of access, endowment and utilization of capital assets based on local people's understanding and perceptions (Neely *et al.*, 2004; Solesbury, 2003). Although, the framework emphasized

understanding of the context within which rural lives take place and the assets available for them but it is a complex approach for understanding the way the poor and non-poor live, especially the way various resource endowments are employed, the various livelihood strategies are chosen and the intended or expected outcomes. The livelihoods framework (Figure 1) is intended as an analytical/operational structure for coming to grips with the complexity of livelihoods, understanding influences on poverty and identifying where interventions can best be made. The framework addresses vulnerability context by strengthening and increasing capacity of individual and collective to withstand shocks and increase resilience through asset creation, income and consumption smoothing, and provision of emergency assistance (Sudan, 2007). The major components presented in the framework (Figure 1) include the vulnerability context, livelihood assets, transforming structures and processes, livelihood strategies and livelihood outcomes.

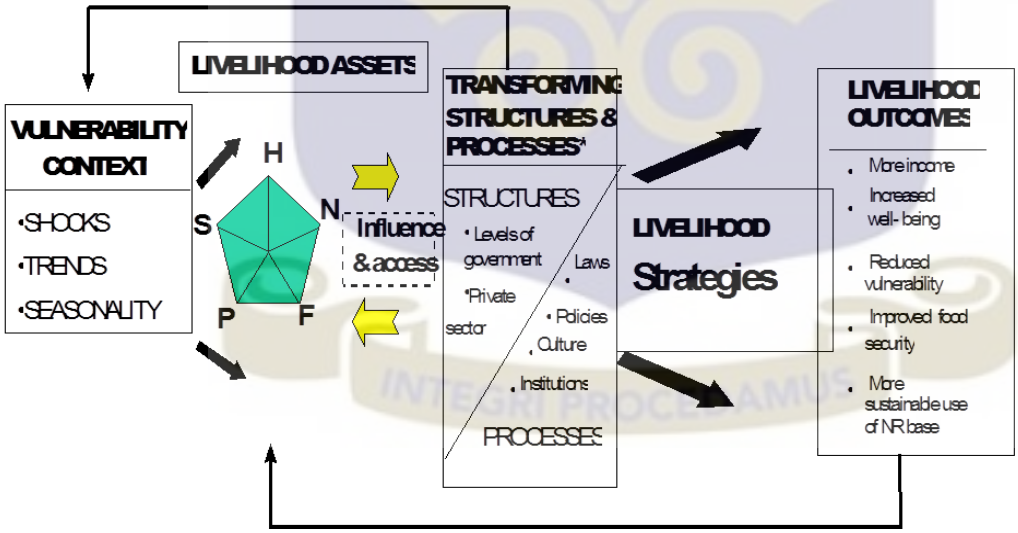

Figure 1: Sustainable Livelihood Framework

As observed by Solesbury (2003) and Carney *et al*. (2000), sustainable livelihood comprises of capabilities, assets (including both material and social resources) for a means of living. Thus, livelihood is said to be sustainable if it can cope with and recover from stresses, trends and

shocks and preserve or enhance its capabilities and assets both now and in the future, without undermining the natural resource base (Department for International Development, DFID, 1999; Solesbury, 2003; Neely *et al*, 2004). Sustainable livelihood can only become a viable pathway if some basic conditions are made available to rural households through the provision of access to reasonable start-up capital, that may comprehend natural and financial assets etc.; supportive structures and processes and access to well-developed market for steady supply of inputs, food and other consumption commodities and an outlet to enterprise outputs; and marketing information and other vertical integration opportunities among others (Sudan, 2007).

A livelihood strategy not only encompasses activities that generate income, but many other kinds of elements including cultural and social choices (Ellis, 1999, 2000a; Bryceson 2000). The major influence for people's choice of livelihood strategies is their access to assets and the prevailing policies, processes and institutions that affect their ability to use these assets; hence, any threats to these assets base constitute significant threats to rural livelihoods and poverty (Ellis 2000). Therefore, the issue for attention should be on the availability and accessibility of the resources and the kind of activities that are developed with these resources to produce a desired outcome.

2.4.1 Vulnerability Contexts

According to DFID (1999), the Vulnerability Context frames the external environment in which people exist. People's livelihoods and the wider availability of assets are fundamentally affected by critical trends as well as by shocks and seasonality over which they have limited or no control. The factors that make up the vulnerability context are important because they have a direct impact upon people's asset status and the options that are open to them in pursuit of beneficial livelihood outcomes. Shocks can destroy assets directly (in the case of floods, storms, civil conflict, etc.). They can also force people to abandon their home areas and dispose of assets

(such as land) prematurely as part of coping strategies. Recent events have highlighted the impact that international economic shocks, including rapid changes in exchange rates and terms of trade, can have on the very poor. Trends may (or may not) be more benign, though they are more predictable. They have a particularly important influence on rates of return (economic or otherwise) to chosen livelihood strategies. Seasonal shifts in prices, employment opportunities and food availability are one of the greatest and most enduring sources of hardship for poor people in developing countries. Not all the trends are negative or cause vulnerability. For example, economic indicators can move in favourable directions, diseases can be eradicated and new technologies may be very valuable to poor people. People's livelihoods and the wider availability of assets are fundamentally affected by critical trends, by shocks and by seasonality over which they have limited or no control (DFID, 1999).

Drought is one of the physical factors that can constrain the yields of crops and it can affect up to 80 percent of the total crop area with dire consequences on rural livelihoods (Beets, 1990). Even minor droughts can have great impact in the humid tropics since soils are often rather poor and have limited water storage capacity. In the sub-humid and semi-arid tropics serious droughts occur often (ranging from 1:2 to 1:5 years) (Beets, 1990). Yield reductions due to less serious mid season and end of season droughts are around 20-30 % per annum (Beets, 1990).

Shocks are usually in forms such as conflict, economic shocks, health shocks (human and livestock/crop) and natural shocks such as earthquakes. Natural shocks may have more negative effects on agricultural activity than on urban employment. Vulnerability to these risks is a result of poverty and socioeconomic position, influenced by social dimensions such as income levels, asset ownership, ethnicity, age, class, and gender (DFID, 1999).

According to Mahama, Ibrahim (2003) before the 1994 ethnic conflict (Guinea Fowl War') in Northern Region which was the most widespread ever witnessed in modern Ghana there were similar less extensive ones in 1981, 1989 and 1991. The rural areas bore the brunt of the 1994 conflict with dire consequences on livelihoods.

Climate change is another area of greatest uncertainty for agriculture. According to IPCC (2007), the historical climate record for Africa shows increased warming rates since the 1960s with a warming of approximately 0.7°C over most of the continent noted during the twentieth century. Climate change will have far-reaching consequences for agriculture that will disproportionately affect the livelihoods of the poor. It will hit poor farmers the hardest and hit them unfairly because they have contributed little to its causes (World Bank, 2007). Greater risks of crop failures and livestock deaths are already imposing economic losses and undermining food security and they are likely to get far more severe as global warming continues (World Bank, 2007).

The cocoa sector for the past years has had to contend with a number of natural elements to favour its production. Climatic factors such as rainfall, temperature, sunshine, humidity, soil moisture and wind affect cocoa production. But the two major climatic parameters which are important in determining cocoa growth are temperature and rainfall (International Cocoa Organisation, ICCO, 2011). Cocoa generally requires high temperatures with a maximum annual average of 30-32ºC and a minimum average of 18-21ºC. Average daily maximum temperature exceeding 33.5°C should not be more than 1 month (International Cocoa Organisation, ICCO, 2011). Variations in the yield of cocoa trees from year to year are affected more by rainfall than by any other climatic factor. An annual rainfall level of between 1500mm and 2000mm which is

well distributed is good. Dry spells where rainfall is less than 100mm per month should not exceed three months (International Cocoa Organisation, ICCO, 2011).

Trends are slow-moving, often benign, changes in the macro-environment, the trajectory of which may be tracked with relative accuracy. These might include broader population trends, natural resource trends and/or national and international economic trends (Chambers and Conway, 1992). Trends can manifest in different forms; economic (both national and international) trends, resource trends (including conflict), governance trends (including politics) and technological trends. For example changes such as international commodity prices, will affect those who grow, process or export such commodities but have little effect on those who produce for, or trade in, the local market.

2.4.2 Livelihood Assets (Capital)

The livelihoods approach is concerned first and foremost with people. So an accurate and realistic understanding of people's strengths (here called "assets" or "capital") is crucial to analyse how they endeavour to convert their assets into positive livelihood outcomes (Bebbington, 1999). According to DFID (1999), livelihood assets are the basic building blocks from which livelihoods are generated. Household asset positions determine household productivity. More generally, household asset endowments condition livelihood strategies. Education and health status affect a person's potential to engage in high-value non-farm jobs as well as the returns on agriculture. Education might facilitate learning about new technologies, and given the physical intensity of most agricultural labour, health and nutrition can affect agricultural productivity. The existence of, and degree of access to livelihood assets is therefore important in influencing the livelihood options that people may, or may not, have. The livelihoods approach is concerned first and foremost with people. It seeks to gain an accurate and

realistic understanding of people's strengths (assets or capital endowments) and how they endeavour to convert these into positive livelihood outcomes. The approach is founded on a belief that people require a range of assets to achieve positive livelihood outcomes; no single category of assets on its own is however sufficient to yield all the many and varied livelihood outcomes that people seek. This is particularly true for poor people whose access to any given category of assets tends to be very limited. As a result they have to seek ways of nurturing and combining what assets they do have in innovative ways to ensure survival (DFID 1999). The livelihood framework which is the conceptual framework for this study identifies five core asset categories or types within which livelihoods are built. These are; natural, human, physical, financial and social assets. Sustainable livelihoods depend on the access to and control over these assets.

2.4.4 Assets and Resource Endowments of Cocoa Farmers

Assets and resource endowments serve as a bridge between vulnerability, resistance and diversification. Although, it is not certain whether risk or resource endowments compels people to diversify. According to Sen (1981), Barrett and Reardon, (2000), Barrett *et al.,* (2002) and Winters *et al.,* (2002), the asset base of a household has greater influence on vulnerability as well as the extent of diversification. The authors further argue that the capacity of a household to smooth consumption and mitigate risk depends on the household resource endowments and asset base, as households could sell or rent out their assets to meet household needs. Thus, depending on their asset endowments, a household adopts different strategies to cope with vulnerability. In the same vein, even when risk compels one to diversify, asset mix is required to diversify. Without the necessary resources and asset mix, diversification is virtually impossible. A

household's assets consist of the stock of resources used to generate well-being (Moser 1998, Siegel and Alwang 1999).

Assets include human capital including age, education and training, and family structure; natural capital (e.g., climate, water and land); physical capital (equipment, livestock, and electricity); financial assets (credit); location-specific factors (such as access to infrastructure and social services), and social, political, and institutional assets, including social and political networks, and social inclusion. In the asset-base framework, the poor are "asset-poor" because they have limited or low-productivity assets. Certain assets are effective only if combined with others, therefore asset complementarity matters. For example, access to land has different implications for well-being depending on its location relative to markets and other infrastructure, on access to credit and inputs, and on education of the landowner. Education may have markedly different implications for welfare generation depending on location and the functioning of labor markets and related institutions. Other important determinants of asset productivity include regulatory and legal systems, which determine the security and transferability of assets, and the existence of means of exclusion. These factors are part of the context. The context in which households operate helps determine the welfare-generating potential of assets and prospects for improved well-being. The political, legal, and regulatory contexts affect how assets are managed and whether successful livelihood strategies can be undertaken (Zezza and Llambi 2002). The soil quality of different farms is believed to cause important variations in the effect of farm size on agricultural production (Berry, *et al.* (1979). It has been asserted that nowhere is the lack of assets greater than in Sub-Saharan Africa where; farm sizes in many of the more densely populated areas are unsustainably small and falling, land is severely degraded, investment in

irrigation is negligible, and poor health and education limit productivity and access to better options (World Bank, 2007).

2.5 Cocoa Production

Apart from these natural factors such as rainfall and temperature, other factors such as capital, labour, cocoa prices and the number of years of farming (experience) are very essential in determining cocoa production. All these determinants have, over the years, influenced the production of cocoa (ICCO, 2011).

Peasant households depend on agriculture and related activities for whatever livelihood its members are able to echo out of their environment. Cocoa production is not only affected by natural factors, a number of socio-economic determinants of cocoa production exist and their understanding is crucial in agricultural planning. Nkamleu (2004a and 2004b) stated that cocoa productivity levels can be enhanced either by improving technical efficiency or by improving technological application. He further added that a relevant burden for agricultural policy-makers should either be to pursue a strategy directed towards technological change by bringing new technologies, or a strategy geared towards efficiency by improving the use of existing technologies.

According to Vigneri, M. (2007), cocoa production is characterised by low-technology cultivation, which requires the use of working capital mainly to hire labour for clearing and weeding the land, and to purchase the chemicals needed to spray cocoa farms for the control of pests and diseases. The young and the better educated tend to leave cocoa farming and the rural areas, to migrate to urban areas in search of better job opportunities. Data collated from various sources (various rounds of the Ghana Living standards Survey and the GCFS) suggest that a

characteristic cocoa-growing household is headed by men (80% of population) in their late 40s (average age 49 years), with primary level education (on average 6 years).

2.5.1 Factors influencing cocoa production

According to G. J. Anim-Kwapong and E. B. Frimpong (2004), the setting of the cocoa producer price each year is a key economic policy of Ghana. The price setting process take into account a number of important factors including an estimation of the farmer's cost of production, anticipated FOB price, anticipated exchange rate, COCOBOD's costs and an explicit duty determined by the government's revenue needs. Farmers respond to price by changing the intensity with which they tend their farms. If prices are not sufficient to cover normal variable costs including maintenance, the farmer's first response will be to reduce maintenance of the farm and stop new planting activities. If prices do not even cover harvesting, fermenting and drying, then harvesting will cease. Conversely, if prices cover or exceed variable costs, farmers will intensify farm management, initially through more thorough harvesting and subsequently by more frequent weeding and the application of other inputs.

The short-term price elasticity of supply is estimated at 0.3 and the price elasticity of production for period 5 and 10 years later are 0.9 and 1.8 respectively. This means that a 10% increase in real price will result in a 3% increase in production in the short term. In the longer term increases in production resulting from new plantings will be about 18% higher after 10 years (COCOBOD 1998). The significant real price increases in 1986/87/88 and 1994/95 are reflected in subsequent increases in production. 1987/88 is an exception because of severe pest attack and drought causing lower yields. Static and declining real prices between 1988/89 and 1993/94 resulted in a corresponding stagnation in production over the same period. The intervention of the state in 2001/2002 with the Cocoa Pest and Disease Control Programme (CODAPEC) and Cocoa High

Technology Project (COCOA HI-TECH) coupled with increases in FOB prices, rising from 64% in 2000 to 68% in 2004, paid to farmers have been cited as the major reasons for the unexpected high production levels achieved in 2003/4.

According to Vigneri, M. (2007), the amount of land cultivated greatly affected production a 0.5% increase in production for each 1% increase in farm area dedicated to cocoa. Labour and fertilizer use had similar size effects (0.09% and 0.07% increase in growth for each 1% increase in their input use). Of the two exogenous drivers of growth, the analysis suggests a positive and significant effect of rainfall on the crop, but no significant effect of smuggling to and from Ivory Coast (not shown), although this could be because the variable used to measure this effect is a poor proxy for smuggling. The extensive use of spraying machines had also increased production. This result was further reinforced when allowing for the cocoa acreage lost to black pod. The negative impact of the disease on production was significantly lower on farms sprayed with fungicide. Finally, there was a drop in the over-all factor productivity: when looking at total factor productivity, we see a substantial fall over the production growth period.

Ghana's cocoa production is characterized by small-scale farming with an average productive cocoa area per household of approximately 2 hectares (Barrientos *et al*., 2008). The average yield per hectare is 450 kg (MMYE, 2008), which is low compared to on-station research trials. In cocoa producing households it is estimated that the mean per capita daily income from cocoa was US$0.42 out of a total income of US$ 0.63 (Barrientos *et al.,* 2008), thus indicating a relatively high level of poverty. Hybrid cocoa varieties developed by the Cocoa Research Institute of Ghana (CRIG) have been adopted by approximately one-third of Ghanaian farmers who appreciate their high yielding nature (Padi and Owusu, 1998 and Asare, 2005). However, these systems, when not accompanied with fertilizer, can rapidly deplete soil nutrients and tend

to have shorter production cycles because of the physiological stresses of higher yields (cost benefit). Richman (2010) investigated into the determinants of technical efficiency using a balanced longitudinal (panel) data on Ghanaian cocoa farmers for the period 2001 to 2006. The panel version of stochastic frontier model was used to estimate Technical efficiency. The determinants of technical efficiency were estimated using the Random-effects Tobit Estimator and it stood on average at 44.2%. The result found demographic factors and non-labour inputs except household size and insecticides to have positive and significant impacts on technical efficiency. Controlling for demographic profile and selected non labour inputs, result suggests that farm level problems including black pod infestation, mistletoe attack, and termites and other problems, including flooding, weeds and bushfire are affecting technical efficiency among cocoa farmers. Other factors as fertilizer intensity and quality of farm maintenance had positive and significant impacts on technical efficiency. The latter suggest that providing farmers with extension service on best maintenance practices will positively impact technical efficiency. The study recommends that efforts aimed at raising productivity and efficiency must concentrate on reducing if not eliminating farm level problems and intensification of fertilizer usage and that, farmers should be given some education on maintenance practices.

Nyemeck *et al.* (2007) concluded that there is the need to promote credit institutions which specializes in savings, mobilization and credit supply to smallholders. To them, when loans are made available to cocoa farmers without much emphasis on collateral security, the problem of poor harvest will become history as smallholder cocoa farmers will be empowered to go for any chemical without concern for the cost. Their survey showed that about 54% of cocoa farmers in Nigeria have access to credit, 37% in Cameroon, while in Ghana and Ivory Coast, only a few cocoa farmers have access to credit.

Black pod disease is the most destructive of a number of diseases, which attack the developing or ripening cocoa pod worldwide. In Ghana, the disease is caused by two *Phytophthora* species: *P. palmivora* and *P. megakarya* (Opoku *et al*., 1999).

Capsid pests are sucking insects and they damage the soft, young tissues of the tree by piercing the young shoots with their mouth parts, injecting poisonous saliva and then sucking liquid food out of the wound so made. These wounds frequently become infected with a fungus. As a result, the affected shoot dies back (WACRI, 1951).

The best soils in terms of high cocoa production tend to have an average pH 5.6-7.2 in 1:2.5 water: soil, C/N ratio between 10-12, organic carbon not less than 3%, base exchange capacity of 3-15 me/100g soil available P greater than 20ppm in the 0-5 cm and 15 ppm in 0-20 cm layer (using buffered 0.002N H2SO4 extractant), exchangeable K not less than 0.25 /100g soil, (Ca + Mg) about 8-13 me/100g soil and no aluminum in the exchange complex (Ahenkorah, 1982). Adu and Mensah-Ansah (1969) have categorized soils in Ghana into cocoa suitability soils based on textural and depth analyses. The model profile of good cocoa soils are deep and characterized by well drained non-gravelly top soil over sandy clay loam layer which usually contains both iron oxide concretions and quartz gravels. This layer overlies sedentary mottled clay, which merges with the incompletely weathered parent material (Ahenkorah, 1981).

2.6 Livelihood Strategies

According to Chambers (1995), livelihoods are the means of gaining a living. This may involve combining resources such as entrepreneurial skills, financial, physical and natural resources through a well-defined strategy. Livelihood strategies therefore refers to activities undertaken by household members such as farm activities and wild collection or hunting, off farm activities or

migration resulting in outcomes such as food or income security (Ellis and Mdoe, 2003; Ellis and Freeman, 2005). These strategies may also create a sustainable livelihood. Sustainable livelihood outcomes include poverty reduction, improved well-being, improved capabilities, livelihood adaptation, and enhanced resilience to risks and shocks, and natural resources that are sustainable (Scoones, 1998).

According to Ellis (2000b), livelihood diversification is a pervasive and enduring characteristic of rural survival, reflecting the vulnerability of rural livelihoods. Diversified livelihood systems are less vulnerable than undiversified ones; and livelihood units diversify their income sources to spread risk and smooth consumption. The agricultural industry is unique compared to other industries, because production depends on climate and weather conditions, which introduces an element of risk. Agriculture production decisions are made in the face of uncertainty and risk. Diversification can either refer to an increasing multiplicity of activities (regardless of the sector), or it can refer to a shift away from traditional rural sectors such as agriculture to non-traditional activities in either rural or urban space – i.e. sectoral change.

Factors that influence livelihood diversification

These are factors that influence or bear on diversification. Studies in different locations and economies have found that the causes and consequences of diversification vary (Ellis, 1998), and thus factors found in literature to influence diversification are generally policy or community level factors or farm specific and individual or household characteristics. For example, according to Pingali, *et al.* (1997), small and marginal farmers engage in diversification of crops to increase household income and reduce risk. But the flexibility of farmers in responding to diversification opportunities in most cases are influenced by the size of markets, price risks, soil suitability,

quality of irrigation infrastructure, availability and cost of labour and the socio-economic characteristics of the farmer. Ashok and Balsubramania (2006) also showed the importance of infrastructure in explaining the extent of diversification. They observed that access to motorable road, market and irrigation determines the extent, success and profitability of diversification through high paying crops. Singh *et al*. (2006) adds that several factors can influence or affect the degree or extent of diversification in a particular locality. These include government policies that promote specific crops, development of infrastructure like roads and markets, and relative profitability of crops.

2.7 Livelihood Outcomes

Livelihood outcomes are defined as the achievements or outputs from livelihood strategies (Department for International Development, 1997). These may take the form of increased income, increased well-being, reduced vulnerability, improved food security, and/or more sustainable use of the natural resource base. According to DFID (1999) there is a close relationship between livelihood outcomes and livelihood assets, the two being linked through livelihood strategies. For example, a person may choose to reinvest most or all of any increased income in assets, with a view to catalysing a virtuous circle of asset accumulation and increased income. For survival, food and health come first (Chambers 1983).

CHAPTER THREE

METHODOLOGY

3.1 Introduction

An important feature of research is the use of scientific methods. The validity of the answers one finds to the research questions rest on how the answers were found. This chapter seeks to systematically outline the methods and materials that were employed in the study.

3.2 Conceptual Framework for Assessing Livelihoods

Presented in Figure 2 is the conceptual framework for the study. At the disposal of cocoa farmers are five main livelihood assets or capital resources. These capital resources are human (H), financial (F), social (S), natural (N) and physical (P) capitals, although political capital which shows the distribution and use of power either for supporting or frustrating efforts by women farmers in developing livelihood strategies also exist. Cocoa farmers use these capitals or asset mix at their disposal in developing their livelihood strategies which includes cocoa output and diversification. Thus, these capital resources are pull factors and serve as incentives that afford cocoa farmers the choice to participate in multiple income earning activities or to diversify its livelihood options. Resource poor cocoa farmers' level of cocoa output and livelihood diversification may be constrained by limited access to these resources as well as lack of capacity to employ these resources in useful ventures. Cocoa output and the extent of diversification of a cocoa farmer therefore depend on the capital or asset mix of the farmer.

Livelihood strategies which in turn increase the extent of livelihood diversification may intend impact on income vulnerability by reducing risk and seasonality. Thus, livelihood diversification widens cocoa farmers' options, increases resilience to risk and seasonality, increases income by encouraging diverse transactions and increases cash in circulation in rural areas. Increased

income resulting from livelihood diversification may also help reduce poverty and empower cocoa farmers to acquire more assets. Reduced poverty and income vulnerability will have a lasting effect on the overall wellbeing of cocoa farmers' livelihood (DFID, 1999).

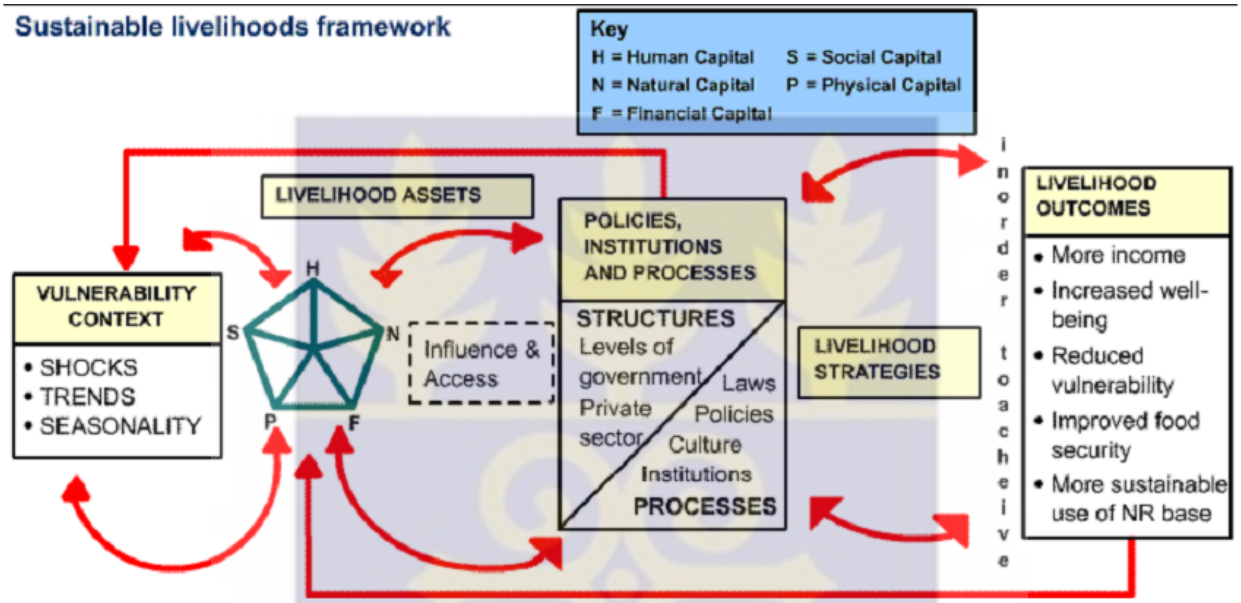

Figure 2: Conceptual Framework for Assessing the Livelihood of Cocoa Farmers

Source: The sustainable livelihoods framework (Carney 1998, Scoones 1998)

3.3 Theoretical Framework

The sustainable livelihood framework reveals assets at the disposal of cocoa farmers. Cocoa farmers develop different livelihood strategies by combining these asset mix based on different objectives. These strategies produce outcomes such as increased income, increased school enrolment of children, improved food security and health status, and reduced vulnerability. Therefore livelihood strategies are identified either from the assets endowment or from the outcome.

3.4 Research Approach

Given the all-encompassing nature of the sustainable livelihoods framework, the study required a mixed methodological approach that combined quantitative survey tools with appropriate qualitative methodologies. Thus, the research incorporated a mix of socio-economic characteristics, key informant interviews and focus group discussions. In addition, a number of secondary research sources were drawn upon.

The respondents were all cocoa farmers. It was designed to capture data at the individual level, in turn making the cocoa farmers the logical primary unit of measurement and analysis. The study was carried out in three selected communities in Atwima Mponua district aimed at capturing the micro manifestations of rural farmers' livelihoods. By the objectives of the study, it can be described as a descriptive research as it seeks to describe livelihood systems.

3.5 Research design

The Cross-sectional research design was used, since rural livelihood systems are not amenable to experimentation (that is grouping the rural people into control and experiment groups). The cross sectional design which involves observation of all of a population or a representative subset at a defined time is perhaps the predominant design employed in the social sciences. The design is often identified with survey research, a method of data collection common in many social science fields. In survey research, researchers usually ask a random sample of individuals to respond to a set of questions about their backgrounds, past experiences, attitudes, conditions and so forth.

In some cases survey research yields data that researchers use to examine relationships between properties and dispositions. In other cases the researcher is only trying to describe the pattern of

relations before any attempt at causal inference is made and this is what the researcher is seeking to do about rural livelihood systems. The property of being rural predisposes the rural people to certain livelihood systems which the researcher will investigate using questionnaires

3.6 Study Area

The study area was the Atwima Mponua District and is located in the south-western part of the Ashanti Region covering an area of approximately 894.15 square kilometers. The vegetation is basically of the semi – deciduous type. The major rainfall period begins from April to July peaking in May. The average annual rainfall for the major season is about 170 centimeters – 185 centimeters per year. The minor rainfall period begins in August tapering off in November with an average minor annual rainfall of 100 centimeters-125 centimeters per year. December to February is dry, hot and dusty. Mean annual temperatures of 27^{o}C in August and 31^{o}C in March are recorded in the district. The climate in the District is ideal for the cultivation of cash and food crops such as cocoa, cola, oil palm, maize, cocoyam, plantain, cassava, rice and all kind of vegetables. This area is dominated by farmers with 75% of the population being farmers. The soils in the district are generally suitable for agriculture. The soils in the District are deep and can support a wide range of crops; they are subject to erosion and leeching when exposed to the direct vagaries of the weather. It is almost impossible to talk about the socio-economic life of the inhabitants of Atwima Mponua District without making allusion to their main source of income is cocoa production. Cocoa feeds, cloths, shelters and takes care of the livelihood needs of the inhabitants. This cash crop thrives well within this area and is even more important because it tolerates the growing of their major staple food crops (plantains, cocoyams, yams and cassava).

Three communities in the district chosen were: Gyereso, Pasoro and Tanodumasi.

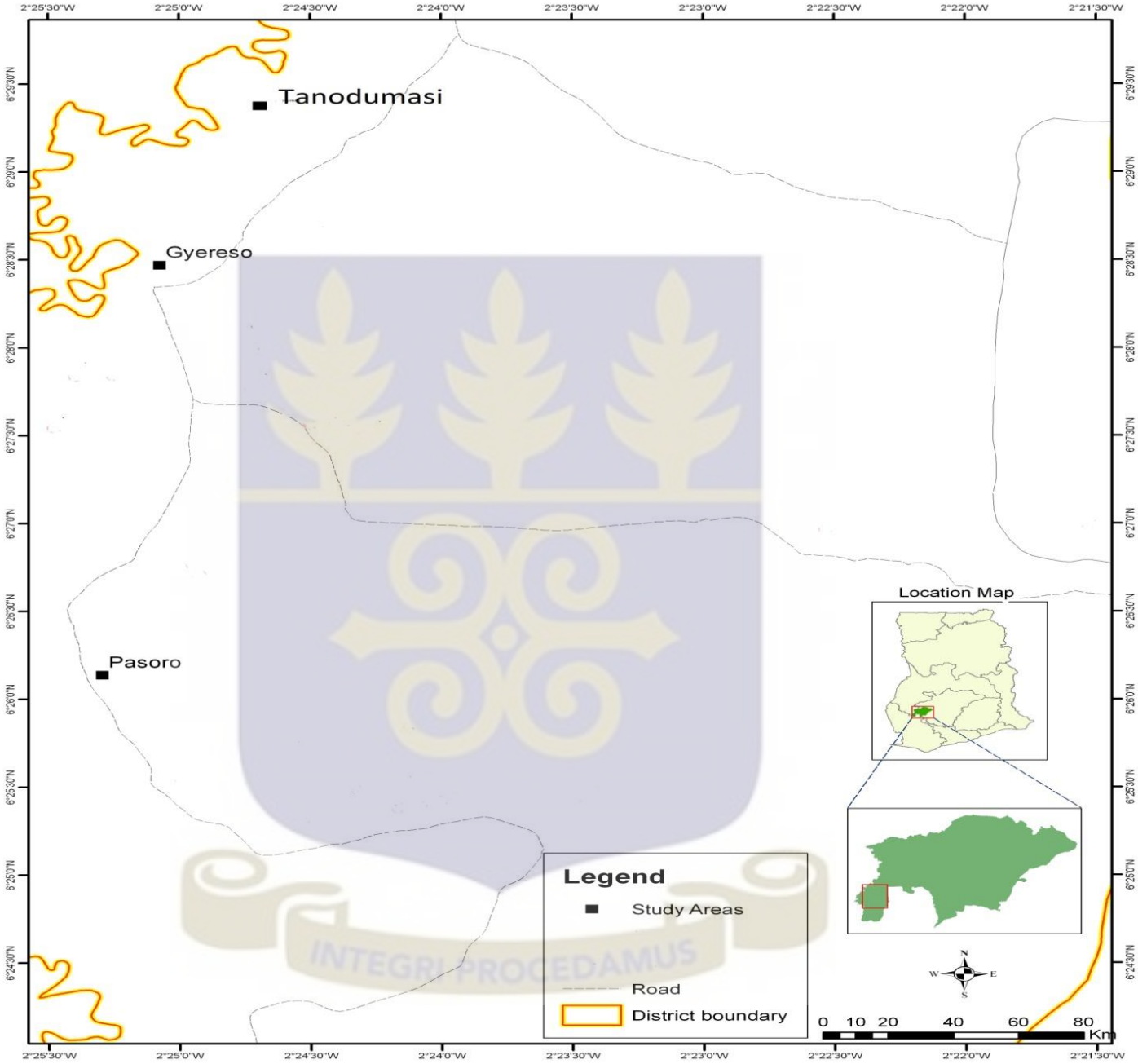

Figure 3: Map showing the study area

3.7 Study Population/Sample size

Three communities in the Atwima Mponua district were selected. A simple random sampling technique was used to select from the population of cocoa farmers in the communities:

$$n = \frac{N}{1+N(e^2)};$$

Where: n= is the sample size, N= population and e = significance level (Yamane, 1967); using e = 0.1, with a confidence level of 90 per cent. This yields a total sample size of 150. Therefore, a random sampling technique was used to select cocoa farmers from each community.

Table 1: Sample size by community

Community	No. of Questionnaires	Total Number of Respondents
Tanodumasi	65	50
Gyereso	60	50
Pasoro	55	50
Total	180	150

3.8 Sampling Techniques

Sampling is necessary because dealing with a whole population in a research process such as this is impossible in terms of time and resources. The primary goal was to get a representative sample or a small collection of units or cases from the much larger collection or population. Due to budgetary and time constraints and also geographical vastness of communities in the district, the sample frame was therefore constructed based on these characteristics as follows;

- Remoteness from the district capital
- Nearness to the district capital

Non-probability sampling was also used. Non-probability sampling selects respondents who have unequal opportunity of been selected from a population, it includes convenience, quota and purposive samplings.

Purposive sampling was used as the target population is farmers in rural communities.

3.9 Data Collection Tools

Primary data on demographic and socio economic variables such as age, level of education, household size and marital status was collected from cocoa farmers. Next, income level, livelihood assets and livelihood diversification variables such as land size, quantity of fertilizer usage, access to credit, and others was obtained from cocoa farmers in the study area.

Secondary data on cocoa yield and production of cocoa farmers was obtained from cocoa passbooks and purchasing clerks in the study area. Climatic conditions of the study area was obtained from the Ghana Meteorological Agency (GMet).

3.9 Data Management and Analytical Tools

The data management and analysis was done using various methods. To be able to see patterns and concepts in the data (what the people say), both quantitative and qualitative tools were employed in the analysis. In analyzing the data, a statistical package (Statistical Package for the Social Sciences) was used. Largely, quantitative techniques were applied to analyze the primary data collected from the use of the questionnaires. Twumasi (2001) stated that questionnaire was an efficient way to collect statistically quantifiable information.

The procedure used was not designed to make inferences about the larger rural population of Atwima Mponua district from which the communities were sampled because livelihood systems are context-specific. But differences in livelihood systems of the communities where acknowledged where appropriate in the analysis. Using cocoa farmers as respondents set out to identify and describe a range of livelihood patterns that are contained within them and the experiences of a substantial proportion of rural households. The data collected was coded and transformed into a computer readable format. This was inputted into the Statistical Package for the Social Sciences (SPSS) for analysis. By using SPSS it was possible to get the statistics in frequencies and percentages. Furthermore, it was possible with SPSS to do cross tabulations of the responses to get further information. Some of the analyzed outcome was then transferred to excel where relevant statistical diagrams were generated for the purposes of vivid visual expression of concepts and patterns.

The statistical analysis undertaken on the resulting dataset refers only to sample characteristics and gains its interest from the communities and not from a claim to represent regional or national patterns. Information gathered through group discussions, observations and in depth-interviews was also scrutinized and described qualitatively.

3.10 Equations and Explanatory Variables

Based on reviewed literature, some of the common predictors that are expected to influence cocoa farmers' livelihoods in the study area and used in the regression model as well as their direction of influence is discussed here:

Climate change variables influencing cocoa output and yield

Linear regression analysis was used to analyze the determinants of fertilizer usage by farmers. This is based on the hypothesis:

$Y = f(X_1, X_2)$

Y= Cocoa output (kg) for a season/ cocoa yield (kg/acre) for a season

X_1 = Total rainfall in a season, X_2 = Mean temperature in a season

Choice of Explanatory Variables

Rainfall: It was assumed a decrease in rainfall over the years would affect cocoa output and yield negatively.

Temperature: It was assumed an increase in mean temperature should affect cocoa output and yield negatively.

Socioeconomic factors influencing cocoa output (kg) and yield (kg/acre)

Multiple regression analysis was used to analyze the determinants of fertilizer usage by farmers. This is based on the hypothesis:

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + b_8 X_8 + b_9 X_9 + b_{10} X_{10} + b_{11} X_{11} + b_{12} X_{12} + b_{13} X_{13}$$

Y = Cocoa output (kg) for 5 seasons/ cocoa yield (kg/acre) for 5 seasons

X_1 = Hired labour (man per season), X_2 = Age of respondents (years), X_3 = Highest Educational level (1= No formal education, 2= Primary 3= JSS, 4= Secondary Education (SHS/Vocational/Technical school), 5= Diploma, 6= Bachelors, 7= Post graduate), X_4 = Number of years of cocoa farming X_5 = Family labour, X_6 = Days of farming (number of days in a week), X_7 = Hours of farming, X_8 = Number of lands used for cultivation of cocoa, X_9 = Number of FBO memberships, X_{10} = Land size for cultivation of cocoa (acres), X_{11} =Fertilizer (quantity of fertilizer use (kg)), X_{12} = Pesticide (quantity of pesticides used (kg)) and X_{13} =Sex of respondents

b_o = constant term e = Error term

Choice of Explanatory Variables

Hired labour (man/day): As number of hired labor increases, cocoa output and yield would increase.

Age: As the age of cocoa farmers increase, they may lack energy to farm thus cause decrease in cocoa output and yield.

Sex: Females tend to have less access to land, credit, labour and other farm inputs.

Highest Educational level: Education is an important capital, which could impact positively on a farmer's ability to understand and adopt technology and take good and well informed decisions on production. It is expected to increase cocoa output and yield.

Number of years of cocoa farming: Experience is expected to have a positive effect on cocoa output and yield. As years of cocoa farming increases, knowledge of cocoa farmers on practices and strategies also increases and thus expected to increase cocoa output and yield.

Hours of farming: As the hours of farming increases, it is expected to increase cocoa output and yield since increase in working hours means increase in effort and input.

Number of lands used for cultivation of cocoa: As the number of lands increases, it is expected to have a positive effect on cocoa output and yield since the acreage will increase and reduction in risk of poor soil quality of farms.

Number of FBO memberships: It was assumed that since FBO members are taught good agricultural practices and provided with farm inputs. The more FBOs a farmer joins the more

knowledge and inputs he/she gets to help increase cocoa output and yield hence a positive relationship was predicted.

Land size for cultivation of cocoa (acres): As the farm size increases, production will increase thus an increase in land/farm size is expected to increase cocoa output and yield.

Fertilizer (kg): An increase in the quantity of fertilizers used is expected to increase cocoa output and yield since fertilizers increase nutrients in soil and provide nourishment for cocoa trees.

Pesticide (kg): An increase in the quantity of pesticides used is expected to increase cocoa output and yield since pesticides reduce attacks of pests and diseases on cocoa trees.

Socioeconomic factors influencing diversification from crop farming

Logistic regression analysis was used to analyze the determinants of fertilizer usage by farmers. This is based on the hypothesis:

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + b_8 X_8 + + b_9 X_{9+} b_{10} X_{10} + + b_{11} X_{11} + b_{12} X_{12} + + b_{13} X_{13} + U$$

Y = Livelihood diversification from crop farming (1= yes, 0= no)

X_1 = Household head (1= yes, 0= no) , X_2 = Number of household members, X_3 = Household members earning income, X_4 = Age of respondents (years), X_5 = Highest Educational level (1= No formal education, 2= Primary 3= JSS, 4= Secondary Education (SHS/Vocational/Technical school), 5= Diploma, 6= Bachelors, 7= Post graduate), X_6 = Sex of respondents (1= male, 0= female), X_7 = Number of crops sold, X_8 = Land size used for cultivation of crops (acres), X_9 = Number of lands used for farming, X_{10} = Days of farming in a week, X_{11} = Income from crop

farming(Amount in Ghana cedis), X_{12} = Credit received (Amount in Ghana cedis), X_{13} =Distance to market (km)

b_o = constant term

U = Error term

Household head: As a household head, there is burden of providing the needs of household members thus a positive relationship is expected between household head and diversification from crop farming.

Number of household members (household size): As a farmer's household size increases dependency burden of the farmer also increases, hence the farmer will need to diversify to meet the needs the household and increase income. This is expected to have a positive effect on diversification from crop farming.

Age: It was assumed that as a farmer ages he or she would no longer be interested in exploring activities. A negative relationship is expected between age of cocoa farmers and diversifying from crop farming.

Highest Educational level: Education is an important capital, which could impact positively on a farmer's ability to understand and adopt technology, activities and well informed decisions on increasing income. It is expected to a positive effect on diversification from crop farming.

Sex: Females are more likely to diversify from crop farming than males. Males tend to control and access to the resources for crop farming thus females need other livelihood activities to supplement income from crop farming. It was also assumed that females will diversify more than males. A positive relationship was predicted for females.

Number of crops sold: The number of crops sold is expected to have a negative effect on diversification from crop farming as increase in number of crops sold increases income thus no need to do other livelihood activities or diversify.

Land size used for cultivation of crops: As the land size increases, the cocoa yield and output also increases thus there will be increase in income and no need to diversify. A negative relationship is expected between land size and diversification from crop farming.

Number of lands used in farming: As the number of lands increases, the cocoa yield and output also increases thus there will be increase in income and no need to diversify. A negative relationship is expected between number of lands and diversification from crop farming.

Days of farming in a week: As the number of days of farming increases, it is expected to decrease adoption of other livelihood activities since the farmer would not have the time to engage in other livelihood activities.

Income from crop farming: Income from crop farming is expected to have a negative effect on diversification from crop farming. As income from crop farming increases there is no need for a cocoa farmer to engage in other livelihood activities.

Credit received (GHS): As the amount of credit received increases there is no need for a cocoa farmer to engage in other livelihood activities to supplement income. This is expected to have a negative effect on diversification from crop farming.

Distance to market: As the distance to the market increases the risk of crop spoilage also increases thus farmers would engage in other livelihood activities to increase income. This is expected to have a positive effect on diversification from crop farming.

Income distribution among cocoa farmers in the district

Gini Coefficient was used to analyze the income inequality among cocoa farmers. This is based on the hypothesis. The Gini Coefficient was derived from a statistical formula expressed as:

$$G = 1 + 1/n - 2/n^2\,\hat{y}\,\{y^1 + 2y^2 + 3y^3 + \ldots + ny^n\}$$

G = Gini coefficient

$y^1 \ldots y^n$ = individual income in decreasing order of size

$\hat{y}$ = mean income

n = number of individual

The model shows the degree of evenness or unevenness of any set of numbers as a number between 0 and 1. A Gini Coefficient of 0 indicates equal income for all earners. A Gini Coefficient of 1 would mean that one person has all the income and nobody else has any. Thus, lower Gini Coefficients indicate more equitable distribution of income among the households, while higher Gini Coefficients mean that income is concentrated in the hands of fewer people.

3.11 Validation of Hypotheses

The F-test was used to validate the null hypothesis that bears upon the parameters of the explanatory variables in the equation: $F = (SSRr - SSR_{ur})/qSSR_{ur}/(n - (k + 1))$, where SSRr stands for the sum of the squared residuals of the restricted model and SSR_{ur} is the same for the unrestricted model. We also have that n is the number of observations, k is the number of independent variables in the unrestricted model and q is the number of restrictions (or the number of coefficients being jointly tested). The F calculated was compared with the F tabulated at a significance level and n-k degrees of freedom. If F calculated was greater than the z

tabulated at the specified degrees of freedom, then the null hypothesis (H_O) was rejected in favour of the alternate (H_a). If on the other hand, the F calculated was less than the z tabulated, then the null hypothesis (H_O) was not rejected. The software (statistical package) used for the data entering and analysis include: SPSS and Microsoft Excel.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the results of the field data. There are 9 sections in this chapter. Section one provides results of the socio-demographic conditions of survey respondents (cocoa farmers) in the study area. Section 2 provides results of perceptions of cocoa farmers on climate change. Section 3 provides results of livelihood assets of cocoa farmers. Section 4 provides results of cocoa production and yield. Section 5 provides results of institutions. Section 6 provides results of livelihood strategies of cocoa farmers. Section 7 provides results of income level of cocoa farmers. Section 8 provides results of household characteristics and Section 9 provides results of livelihood outcomes of cocoa farmers.

4.2 Frequency Distribution of Demographic Characteristics of Respondents

The demographic characteristics of respondents used in this study were sex, age distribution, educational level, marital status and household head distribution. All the demographic characteristics discussed influence the livelihood of cocoa farmers in the Atwima Mponua district.

Sex of Respondents

Eighty three (83) (55.3%) respondents were males whiles 67 (44.7%) respondents were females (Table 2).

Highest Level of Formal Education Completed

The educational level of cocoa farmers is presented in Table 1. The result reveals that 31 (20.7%) of cocoa farmers in the district have no formal education, 27 (18%) respondents had only

primary education, 28 (18.7%) respondents had JSS education, 62 (41.3%) respondents had Secondary Education (SHS/vocational/technical school) which was the highest percentage and 2 (1.3%) respondents had diploma education.

Age Distribution of Cocoa Farmers

The age of a cocoa farmer has influence on production capacity and livelihood outcomes. Other things being equal, aged cocoa farmers are more likely to be more vulnerable to shocks and stresses than young energetic farmers. As presented in table 1, none of the respondents were under 20 years old, 3 (2%) respondents were between the ages of 21-30, 21 (14%) respondents were between the ages of 31-40, 47 (31.3%) respondents were between the ages of 41-50, 49 (32.7%) respondents were between the ages of 51-60 and 30 (20%) respondents were over 60 years.

Marital Status of Respondents

Two (2) (1.3%) respondents were single, 120 (80%) respondents were married, 15 (10%) respondents were divorced or separated and 13 (8.7%) respondents were widowed.

Household head

118 (78.7%) respondents were household heads and 32 (21.3%) respondents were not.

Table 2: Socio demographic characteristics of cocoa farmers in the study area.

CHARACTERISTICS	FREQUENCY	PERCENT (%)
SEX		
Male	83	55.3
Female	67	44.7
AGE		
Under 20	0	0
21-30	3	2
31-40	21	14
41-50	47	31.3
51-60	49	32.7
61+	30	20
MARITAL STATUS		
Single	2	1.3
Married	120	80
Divorced/Separated	15	10
Widow/Widower	13	8.7
HIGHEST EDUCATIONAL LEVEL		
No formal education	31	20.7
Primary	27	18
JSS	28	18.7
Secondary Education (SHS/vocational/technical school)	62	41.3
Diploma	2	1.3
HOUSEHOLD HEAD		
Yes	118	78.7
No	32	21.3

Source: Field data (2015)

4.3 PERCEPTIONS ON CLIMATE CHANGE

Cocoa farmers were asked about their perceptions on climate change. From Table 2, 147 (98%) of respondents stated they had noticed a change in climate over the past 10 years and 3 (2%) stated they had not noticed a change in climate over the past 10 years. Fifty five (55) (37.4%) respondents stated rainfall has reduced and 32 (21.8%) respondents stated that there had been an increase in temperature and reduced rainfall (Table 3).

Table 3: Perceptions of farmers on changes in the climate

VARIABLE	FREQUENCY	PERCENT
Increased temperature only	10	6.8
Reduced rainfall only	55	37.4
Increased rainfall only	4	2.7
Change in rainfall patterns only	14	9.5
Flooding/Excessive rainfall only	5	3.4
Increased temperature and reduced rainfall only	32	21.8
Increased temperature and increased rainfall only	1	0.7
Increased temperature and change in rainfall patterns only	15	10.2
Reduced rainfall and change in rainfall patterns only	11	7.5

Source: Field data (2015)

These responses in Table 3 are supported by data from the Ghana Meteorological Agency (GMet). From Figures 4 and 5, the annual rainfall of the study area has reduced steadily after an increase of 1681.1mm in 2008 to 1254.5mm in 2014. The average temperature yearly has also increased since 2004 with temperature of 27.80^{o}C to 28.001^{o}C in 2014 with the highest temperature recorded in 2010 with a temperature of 28.2875^{o}C.

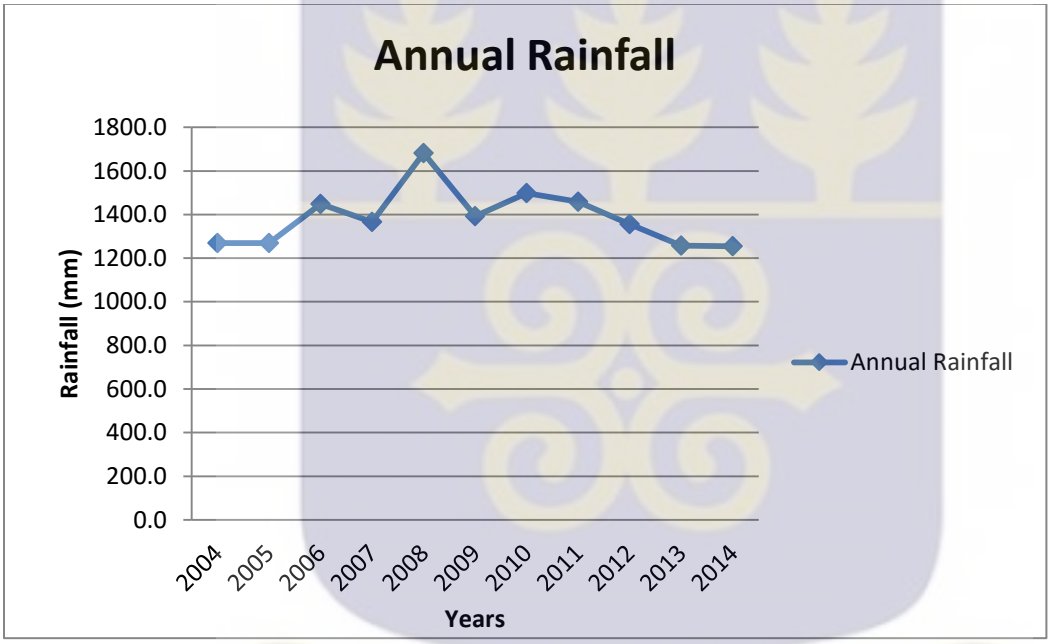

Figure 4: A graph of the annual rainfall of the district from 2004 to 2014.
Source: Ghana Meteorological Agency

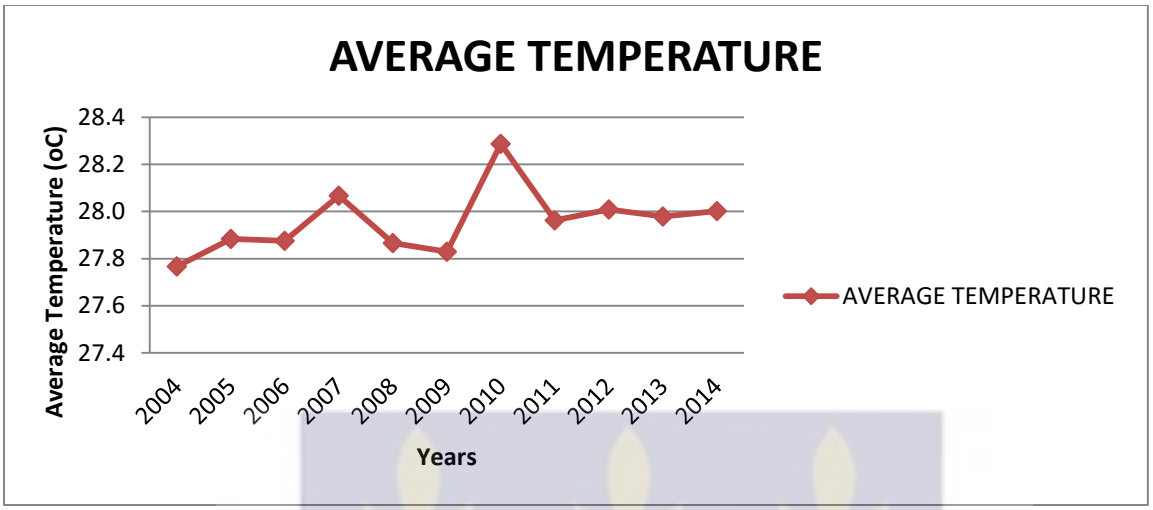

Figure 5: A graph of the average annual temperature of the study area from 2004 to 2014
Source: Ghana Meteorological Agency

The cocoa farmers stated that due to the change in climate, there had been a reduction in yield of crops over the years. Cocoa farmers stated that they coped with climate change by planting shade trees and intercropping to help reduce temperature of farms and the continual use of agro chemicals to enhance productivity. Some farmers stated they dug gutters on farms to reduce flooding.

4.4 LIVELIHOOD ASSETS

4.4.1 Human capital

In the three communities in the district, there were two sources of labour; family labour and hired labour. One hundred and twenty four (124) (82.7%) respondents stated they use family members as a source of labour and 26 (17%) respondents stated they do not use family labour. The average number of family labour was 2.2400 people. Farmers also hire other people to help with activities on the farm and pay them for their services. This kind of labour is called hired labour. Hired labour is the main source of labour for cocoa farmers in the district. One hundred

and forty four (144) (96%) respondents stated they use hired labour and 6 (4%) stated they do not use hired labour.

The number of years of farming (farm experience) and number of years of cocoa farming help contribute to productivity and income of cocoa farmers. The average number of years of farming was 23.033 years and the average number of years of cocoa farming was 16.320 years. The average number of days of farming was 4.9667 days and the average number of hours of farming was 7.0133 hours

Twenty six (26) (17.3%) respondents stated they fall sick very often, 42 (28%) respondents stated they fall sick often and 82 (54.7%) of respondents stated they do not often fall sick. The respondents who fall sick two or more times a month were categorized as very often, the respondents who fall sick once a month were categorized as often and the respondents who rarely fall sick were categorized as not often.

One hundred and thirty (130) (86.7%) respondents had National Health Insurance Scheme (NHIS) and 20 (13.3%) respondents did not have NHIS. Fifteen (15) (71.4%) respondents of 20 respondents stated they do not have NHIS because they do not require it since they do not get sick, 4 (19%) respondents stated registration for the NHIS is expensive and 2 (9.5%) stated they do not have the time to register for the NHIS. From table 4, respondents sought treatment of ailments from different places. Fifty six (56) (37.3%) respondents sought treatment from local community clinic/health centre and district/urban hospitals and only 1 (0.7%) respondent sought treatment from a herbalist.

Table 4: Sources of treatment of ailments of cocoa farmers

SOURCES OF TREATMENT	FREQUENCY	PERCENT
Community clinic/health centre only	20	13.3
Distant community clinic only	2	1.3
District/urban hospital only	32	21.3
Herbalist only	1	.7
Self medication only	23	15.3
Distant community health centres and district/urban hospitals	16	10.7
Community clinic/health centre and district/urban hospital	56	37.3

Source: Field data (2015)

4.4.2 Natural capital

Land is a very important asset to farmers. The land size can determine the crop production, the maximum total land size was 40 acres, the minimum was 2 acres and the mean was 9.81 acres. The maximum land size for cultivation of crops was 35 acres, the minimum was 2 acres and the mean was 8.7467 acres. The maximum land size for cultivation of cocoa was 30 acres, the minimum was 1.5 acres and the mean was 7.22 acres. Some farmers cultivated on more than one land. The maximum number of lands farmers cultivated was 4, the minimum was 1 and the mean was 1.38 acres. The land size used for cultivation of cocoa had increased by 0.95% from season 2010/2011 to season 2014/2015.

One hundred and twenty nine (129) (86%) respondents owned the land on which they farmed and cultivated crops, 1 (0.7%) of the respondents rented the land, 10 (6.7%) respondents were sharecroppers, 5 (3.3%) of the respondents cultivated family lands, 4 (2.7%) owned and rented

lands for cultivation of crops and 1 (0.7%) respondent owned his land and also was a sharecropper on other lands.

The main water source used for farming was rain. The farmers practiced rain-fed agriculture. Only 5 (3.3%) of the respondents had irrigation which served as source of water in the dry season.

The cocoa farmers were asked about the productivity of their soil. First, farmers were asked about their satisfaction with productivity of their soils. Fifty four (54) (36%) respondents stated they were very satisfied with their soil productivity, 69 (46%) of respondents stated they were satisfied with their soil productivity, 19 (12.7%) respondents stated they were somewhat satisfied with their soil productivity, 8 (5.3%) respondents stated they were not satisfied with their soil productivity. Secondly, farmers were asked about yielding of their soil for the past five years. Fifty one (51) (34%) of the farmers stated their soils were higher yielding for the past 5 years, 79 (52.7%) respondents stated their soils were lower yielding for the past 5 years and 20 (13.3%) respondents stated there had been no change.

4.4.3 Physical capital

All the cocoa farmers used traditional tools such as hoes and cutlass for farming. From Table 5, 77 (51.3%) respondents had spraying machine, 15 (10%) respondents had storage facilities and 5 (3.3%) respondents had a water pump.

Table 5: Tools owned and used for farming

	FREQUENCY Yes	FREQUENCY No
Cutlass	150 (100%)	0 (0%)
Hoes	150 (100%)	0 (0%)
Harvesting hook	150 (100%)	0 (0%)
Spraying machines	77 (51.3%)	73 (48.7%)
Storage facility	15 (10%)	135 (90%)
Water pump	5 (3.3%)	145 (96.7%)

Source: Field data (2015)

Fertilizer use decreased over the years whereas pesticides use has increased over the years (Table 6).

Table 6: Agrochemicals usage over the past 5 seasons.

Season	Fertilizer FREQUENCY		Pesticides FREQUENCY	
	Yes	No	Yes	No
2010/2011	72 (42%)	78 (58%)	126 (84%)	24(26%)
2011/2012	60 (40%)	90 (60%)	135 (90%)	15(10%)
2012/2013	55 (36.7%)	95 (63.3%)	139 (92.7%)	11(7.3%)
2013/2014	48 (32%)	98 (68%)	142 (94.7%)	8(5.3%)
2014/2015*	45 (30%)	105 (70%)	139 (92.7%)	11(7.3%)

*2014/2015 main crop (as at week 14)
Source: Field data (2015)

During interviews, respondents stated that the reasons why they did not use agrochemicals (fertilizers and pesticides) were because they were expensive, they were not required, they were not available to buy and the cocoa trees were too young.

One hundred and twenty seven (127) (84.7%) respondents walked to their farms, 11 (7.3%) respondents used bicycles, 7 (4.7%) used motorbikes whiles only 5 (3.3%) respondents used vehicles (cars) to get to their farms. The maximum distance to farm was 12km, the minimum distance to farm was 0.5km and the mean distance was 2.4967 km.

4.4.4 Financial capital

Forty four (44) (29.3%) respondents received remittances from relatives and friends. 76 (50.7%) respondents had savings accounts and 74 (49.3%) did not have savings account. The respondents without savings account stated that those who have surplus income save and they do not have surplus income. Nineteen (19) (25%) out of 76 respondents saved in commercial banks, 29 (38.2%) respondents saved in rural banks and 28 (36.9%) saved in 'susu' banks.

One hundred and one (101) (32.7%) respondents had access to credit and 49 (32.7%) did not have access to credit. The main source of credit was the cocoa farmers' purchasing clerks (shown in table 7).

Table 7: Sources of credit for respondents

SOURCE OF CREDIT	FREQUENCY	PERCENT
Money Lenders (Purchasing Clerks)	65	65.0
Banks	17	17.0
Microcredit Organizations	5	5.0
Relatives	3	3.0
Friends	6	6.0
Moneylenders And Friends	3	3.0
Moneylenders And Relatives	1	1.0

Source: Field data (2015)

Seventy four (74) (49.3%) respondents took credit last year and 76 (50.7%) respondents did not take credit. Table 8 shows how credit was used by respondents in 2014. The majority of respondents 38 (50.7%) out of 74 respondents used the credit to educate their children.

Table 8: Credit use of respondents

USE OF CREDIT	FREQUENCY	PERCENT
Education of children	38	50.7
Farm inputs	5	6.7
Health issues	8	10.7
Household consumption	2	2.7
Personal issues	3	4.0
Funerals	4	5.3
Education and health issues	1	1.3
Farm inputs and health issues	1	1.3
Education and farm inputs	9	12.0
Education and travel	1	1.3
Education, farm inputs and household consumption	2	2.7
health issues and household consumption	1	1.3

Source: Field data (2015)

The maximum amount in respondent's savings account was GHS 5000, the minimum amount in respondent's savings account was 10 and the mean amount in respondent's savings account was GHS 686.4474. The maximum amount of credit taken last year was GHS 4500, the minimum amount was 20 and the mean amount was GHS 977.0667.

4.4.5 Social capital

One hundred and fifty (150) (100%) respondents belonged to at least one Farmer Based Organization (FBO), 131 (87.3%) respondents belonged to only one FBO, 18 (12%) respondents belonged to two FBOs and 1(0.7%) belonged to three FBOs. 4 (2.7%) respondents were

executives in their FBOs, 143 (95.3%) were members in their FBOs. Farmers benefited from FBOs. One hundred and forty seven 147 (98%) respondents benefit from joint learning only, 2 (1.3%) respondents benefit from joint learning and bulk buying only and 1 (0.7%) respondent benefit joint learning and access to credit/finances only.

Eighty three (83) (55.3%) respondents had access to extension officers. Twenty nine (29) (35.8%) stated they very often had access to extension and advisory services, 32 (39.5%) respondents stated they often had access to extension and advisory services and 20 (24.7%) respondents stated they do not often have access to extension and advisory services. One hundred and forty one (141) (94%) respondents had undergone training programmes before and 9 (6%) had not undergone any training programmes before. Farmers were taught sustainable agricultural practices such as mulching, intercropping, etc. and good cocoa practices such as importance of pruning and weeding on time.

4.5 PRODUCTION

As presented in table 9, the highest cocoa output and yield were recorded in 2013/2014. Cocoa output and yield have steadily increased from 2010/2011 season to 2013/2014 season. The highest cocoa output was 158969.38 kg and the lowest was 142244.40 kg. The highest cocoa yield was 13083.76 kg/acre and the lowest yield was 19647.64 kg/acre.

Table 9: Cocoa output (kg) and yield (kg/acre) over the past five seasons in the study area

Year	Cocoa output(kg)	Average cocoa output (kg)	Cocoa yield (kg/acre)	Average cocoa yield (kg/acre)
2010/2011	142244.40	948.30	19647.64	130.98
2011/2012	145346.88	968.98	19772.63	131.82
2012/2013	147334.38	982.23	20049.81	133.67
2013/2014	158969.38	1059.80	21513.78	143.43
2014/2015*	97319.375	648.80	13083.76	87.23

*2014/2015 main crop (as at week 14)
Source: Field data, Purchasing companies and Cocoa passbook (2015)

4.5.1 Climate change and Cocoa Production and Yield

To determine the influence of climatic variables (rainfall and temperature) on cocoa yield for the 5 seasons, regression analysis was used. The results from the regression analysis are shown in Table 10. R^2=0.985, the F test (32.572) was not significant with a p value of 0.30.

Table 10: Regression analysis of climatic factors influencing cocoa yield (kg/acre) from 2010/2011 season to 2014/2015 season.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	11418.370	1221.981		9.344	.011
Rainfall	4.644	3.921	.772	1.184	.358
temperature	6.287	18.931	.216	.332	.771

Dependent Variable: yield (kg/acre) from seasons 2010/2011-2014/2015

F = 32.572, p = 0.030, R^2= 0.985

From the results in table 10, total rainfall (X_1) and temperature were not significant (X_2) at 0.05%.

To determine the influence of climatic variables (rainfall and temperature) on cocoa production/output (kg) for the 5 seasons, regression analysis was used. The results from the regression analysis are shown in Table 11. R^2=0.951, the F test (19.337) was not significant with a p value of 0.49.

Table 11: Regression analysis of climatic factors influencing cocoa production/output (kg) from 2010/2011 season to 2014/2015 season.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	85405.267	11330.942		7.537	.017
rainfall	33.164	36.361	.763	.912	.458
temperature	45.000	175.537	.215	.256	.822

a. Dependent Variable: cocoa output (kg) from seasons 2010/2011-2014/2015

F = 19.337, p = 0.049, R^2= 0.951

From the results in table 11, total rainfall (X_1) and temperature were not significant (X_2) at 0.05%.

4.5.2 Socioeconomic factors influencing cocoa yield (kg/acre) over the past five seasons

To determine socioeconomic factors influencing cocoa yield (kg/acre) for the past five seasons, regression analysis was used. The results from the regression analysis are shown in Table 12. R^2=0.391., F test (7.322) was significant with a p value of 0.000.

Table 12: Regression analysis of socioeconomic factors influencing cocoa yield (kg/acre) from 2010/2011 season to 2014/2015 season.

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-95.817	62.403		-1.535	.127
Hired labour	1.341	.383	.345	3.504	.001**
Sex	-3.243	12.376	-.021	-.262	.794
Age of respondent	10.738	6.566	.142	1.635	.104
Highest educational level	-3.735	4.593	-.058	-.813	.417
Number of years of farming (cocoa)	2.795	.769	.334	3.632	.000***
Family labour	2.124	2.913	.052	.729	.467
Days of farming in a week	18.518	10.098	.136	1.834	.069
Hours of farming	2.003	2.660	.054	.753	.453
Number of lands	19.202	8.769	.168	2.190	.030**
Number of FBO membership	-1.161	15.072	-.005	-.077	.939
Land size for cultivation of cocoa	-6.686	1.505	-.428	-4.442	.000***
Fertilizer	2.336	1.000	.186	2.336	.021**
Pesticide	.147	.978	.013	.151	.881

Dependent Variable: cocoa yield (kg/acre) from seasons 2010/2011-2014/2015
F = 7.322, p = 0.000, R^2= 0.391
***denotes significance at the 1 percent level; ** denotes significance at the 5 percent level.

From the regression results in table 12, hired labour (X_1), number of years of farming (cocoa) (X_4), number of lands(X_8), land size for cultivation of cocoa (X_{10}) and quantity of fertilizer (X_{11}) were all significant at 0.05%.

4.5.3 Socioeconomic factors influencing cocoa production/output (kg) over the past five seasons.

To determine socioeconomic factors influencing cocoa yield (kg/acre) over the past five seasons, regression analysis was used. The results from the regression analysis is shown in Table 13, the R^2=0.74, F test=32.564 and was significant with a p value of 0.000.

Table 13: Regression analysis of socioeconomic factors influencing cocoa output (kg) from 2010/2011 season to 2014/2015 season

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-1752.085	459.155		-3.816	.000
Hired labour	13.895	2.816	.317	4.934	.000***
Age	45.638	48.309	.053	.945	.346
Highest educational level	-17.444	33.796	-.024	-.516	.607
Years of farming (cocoa)	20.149	5.661	.214	3.560	.001**
family labour	29.222	21.431	.064	1.364	.175
days of working	167.296	74.302	.109	2.252	.026
Duration of working	-3.462	19.570	-.008	-.177	.860
number of lands	174.119	64.521	.135	2.699	.008**
FBO	87.024	110.896	.036	.785	.434
Land size for cultivation of cocoa	70.734	11.074	.402	6.387	.000***
Fertilizer	14.993	7.359	.106	2.037	.044**
Pesticide use	-3.398	7.196	-.026	-.472	.638

Dependent Variable: cocoa production/output (kg) from seasons 2010/2011-2014/2015
F =32.564 , p = 0.000, R^2= 0.74
***denotes significance at the 1 percent level; ** denotes significance at the 5 percent level.

The regression results are presented in table 13. Hired labour (X_1), number of years of farming (cocoa) (X_4), number of lands(X_8), land size for cultivation of cocoa (X_{10}) and quantity of fertilizer (X_{11}) were all significant at 0.05%.

4.6 INSTITUTIONS

All cocoa farmers sold their cocoa harvest to local cocoa purchasing companies which are located in the communities. The cocoa farmers sold the other crops in distant/urban markets. The maximum distance to the local cocoa purchasing companies was 5 km, the minimum was 0.5 km and the mean distance was 0.66 km. The maximum distance to distant/urban markets was 11km, the minimum distance was 2.5km and the mean distance was 9.05km. Farmers were asked whether good roads were essential to the sale of their crops and all respondents stated yes. Farmers were also asked whether their income have decreased due to bad roads, 76 (50.7%) respondents stated they strongly agreed, 69 (46%) respondents stated they agreed and 5 (3.3%) stated they somewhat agreed.

Eleven (11) (7.3%) respondents did not get any support from the government, 117 (78%) benefited from the mass spraying initiated from the government and 22 (14.7%) stated they benefited from the mass spraying and also got agro chemicals from the government.

NGOs also supported the cocoa by organizing training programmes to teach farmers about good agricultural practices to enhance productivity.

4.7 LIVELIHOOD STRATEGIES

All the respondents practiced mixed cropping thus all the respondents cultivated other crops alongside cocoa. They cultivated cereals and grains (such as maize and rice), roots and tubers (such as cassava, plantain, yam and cocoyam), fruits and vegetables (such as pineapple, pepper, tomato and okro) and oil palm.

Twenty four (24) (16%) respondents stated that the reason they cultivated the crops was because they serve as sources of food only and 126 (84%) respondents stated the reason they cultivated the crops was because they serve as sources of food and income (Table 14).

Table 14: Frequencies and percentages of crops cultivated

	FREQUENCY Yes	FREQUENCY No
Cereals and grains	105 (70%)	45 (30%)
Roots and Tubers	150 (100%)	0 (0%)
Fruits and Vegetables	101 (67.3%)	49 (32.7%)
Oil palm	30 (20%)	120 (80%)

Source: Field data (2015)

The maximum number of crops cultivated was 12, the mean number of crops cultivated was 5.7533 and the minimum number of crops cultivated was 1. The maximum number of crops sold was 8, the mean number of crops sold was 2.16 and the minimum number of crops 0.

Alongside crop farming, cocoa farmers engage in other activities to help enhance their livelihoods. They engaged in livestock rearing, off farm activities such as farm wages and non-farm activities such as trading, salary worker, masonry, tailoring, etc.

Livestock rearing was very limited in the three communities. The only livestock reared was poultry. During focus discussion and interviews, the farmers stated there was a ban on rearing of sheep and goats for two reasons. The first reason was a superstitious one, where the inhabitants believed the River Tano close to the communities 'hates' goats so goats were forbidden in the communities and the second reason was that sheep and goats destroyed farmers' backyard farming. Poultry farming was also under threat since poultry are always attacked by the

Newcastle disease thus most of the poultry die, the farmers incurred costs and were not able to sell them.

One hundred and thirty eight (138) (92%) respondents stated they had livestock and all of them were poultry and only 4 (2.8%) respondents sold poultry.

Sixty nine (69) (46%) respondents diversified from crop farming and 81 (54%) did not. Sixty five (65) (94.2%) respondents out of the 69 respondents had only one alternative livelihood, 3 (4.35%) respondents had two alternative livelihoods and one respondent had four.

4.7.1 Reasons for livelihood diversification

Table 15 represents the reasons why farmers diversify their livelihoods from crop farming. Thirty one (31) (40.9%) respondents of 69 respondents stated they diversified because they want to increase their income, 30.3% diversified to avoid risk associated with crop farming, 25.8% diversified to meet family necessity and 1 (1.5%) respondent diversified to get income to invest in crop farming.

Table 15: Reasons farmers diversify their livelihoods from crop farming

Reason	Frequency	Percent
To increase income	31	40.9
To avoid risk associated with crop farming	20	30.3
To meet family necessities	17	25.8
Income to Invest in crop farming	1	1.5

Source: Field data (2015)

The maximum amount earned from alternative livelihood in 2014 was GHS 120000, the minimum amount earned was GHS 50 and the mean amount was GHS 4149.8551.

4.7.2 Factors influencing cocoa farmers to diversify livelihoods from crop farming

Table 16 shows the logistic regression analysis with SPSS. It was observed that the model as stated in the method of analysis had a good fit (omnibus tests of model coefficients was significant with $\chi 2 = 41.474$, $p = 0.000$) and the Hosmer and Lemeshow test for poor fit was not significant (with $\chi 2 = 7.261$, $p = 0.509$). The variation in the data explained by the model according to the Cox and Snell R2 was 26.1% and 34.9% according to the Negerkeke R^2. That is, the logistic independent variables stated could explain 26.1% to 34.9% of the factors influencing the adoption of alternative/additional livelihoods alongside crop farming by cocoa farmers. The 2 log likelihood ratio test was 147.564.

Table 16: Logistic regression on factors influencing cocoa farmers to diversify livelihoods from crop farming

	B	S.E.	Wald	df	Sig.	Exp(B)
headofhouse(1)	-2.031	.731	7.713	1	.005**	.131
numberinhouse	.028	.099	.081	1	.776	1.029
Hhearn	.001	.320	.000	1	.998	1.001
Realage	-.113	.028	15.761	1	.000***	.893
EduLevel			2.606	4	.626	
EduLevel(1)	-.244	1.781	.019	1	.891	.784
EduLevel(2)	.447	1.774	.064	1	.801	1.564
EduLevel(3)	.663	1.762	.142	1	.707	1.941
EduLevel(4)	.775	1.731	.201	1	.654	2.171
Sex(1)	1.533	.662	5.358	1	.021**	4.631
numcropssold	.115	.160	.521	1	.470	1.122
landcultivate	.082	.050	2.711	1	.100	1.085
numberoflands	-.108	.361	.089	1	.765	.898
daysoffarm	-.546	.460	1.408	1	.235	.579
cropincome	.000	.000	.663	1	.415	1.000
Exacrdt	.000	.000	1.313	1	.252	1.000
distancecrop	.305	.144	4.469	1	.035**	1.357
Constant	3.905	3.247	1.446	1	.229	49.656

Variable(s) entered on step 1: headofhouse, numberinhouse, hhearn, Realage, EduLevel, Sex, numcropssold, landcultivate, numberoflands, daysoffarm, cropincome, exacrdt, distancecrop.

***denotes significance at the 1 percent level; ** denotes significance at the 5 percent level

As presented in Table 16, the significant predictors of the model were household head (X_1) (headofhouse), age of respondents (X_4) (Realage), sex of respondents (X_6) (Sex) and distance to market (X_3) (distancecrop).

4.8 INCOME LEVEL

Cocoa farmers generate income from farm, off farm and non-farm activities and remittances received. From Figure 6, 58.75% of cocoa farmers' income came from cocoa, 21.06% came from cultivation of other crops, 19.5% came from alternative livelihood activities like livestock rearing, farm wages, trading and other non-farm activities and 0.69% came from remittances received from relatives and friends.

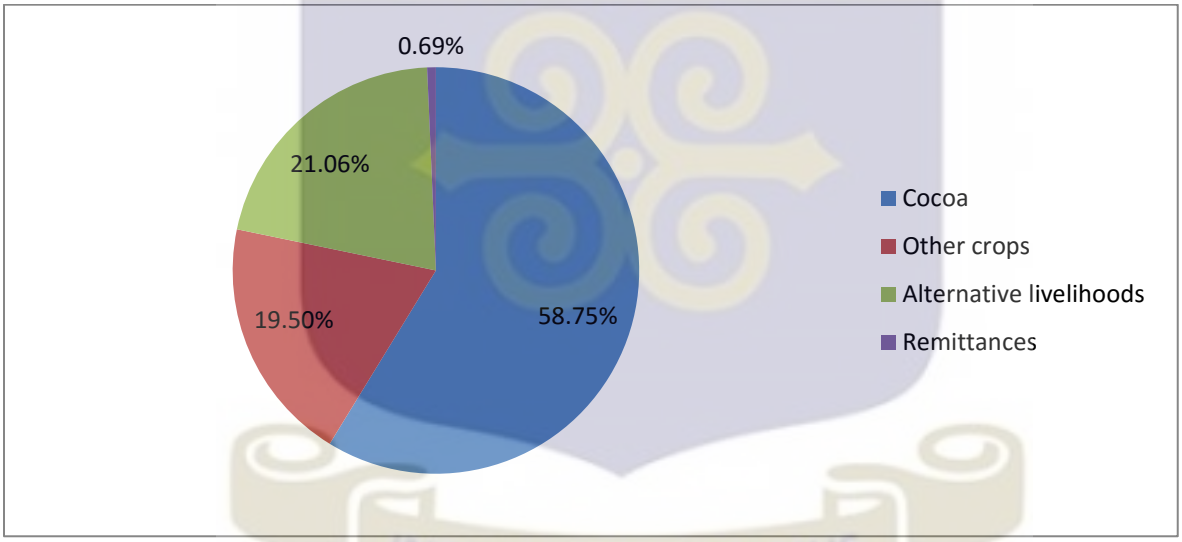

Figure 6: A pie chart of the distribution of income sources of cocoa farmers.

The maximum income from all income sources in 2014 was GHS 133,276.19, the mean income was GHS 8,296.6037 and the minimum income was GHS 648.00. The total income from all livelihood activities or sources of all cocoa farmers was GHS 1,244,663 in 2014 and total income from cocoa was GHS 731,314.9 in 2014. The Gini coefficient (derived from Lorenz curve

(Figures 7 and 8)) for total income from all livelihood sources was 0.473553 and the Gini coefficient for income from cocoa farming was 0.440868 (Table 17).

Table 17: Income and Gini coefficient of Respondents

	INCOME (GHS)	GINI COEFFICIENT
All livelihood/income sources (farm, off farm, non-farm and remittances)	1,244,663	0.473553
Cocoa	731,314.9	0.440868

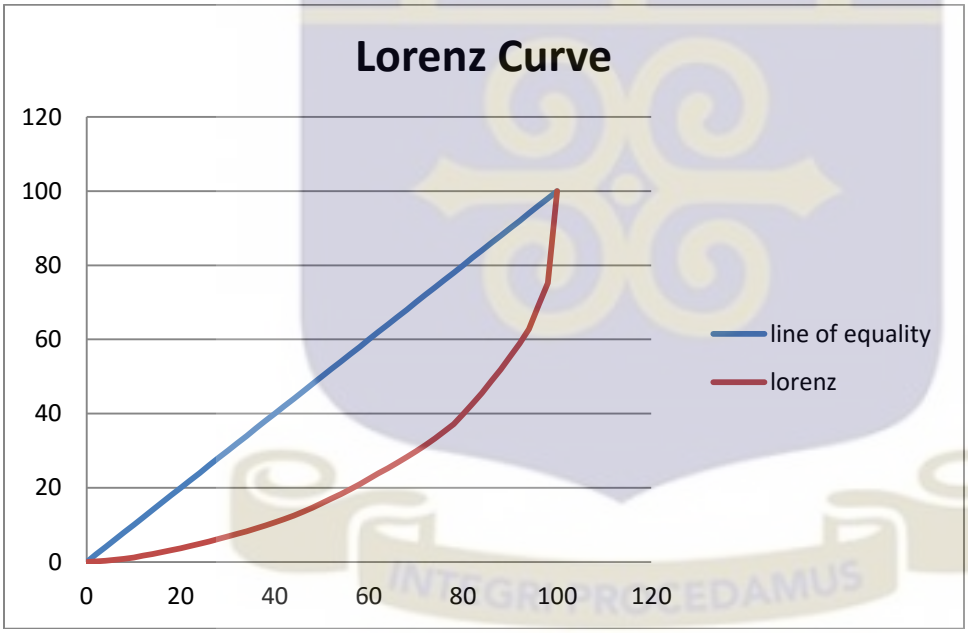

Figure 7: A graph of the Lorenz curve of income from all livelihood/income sources

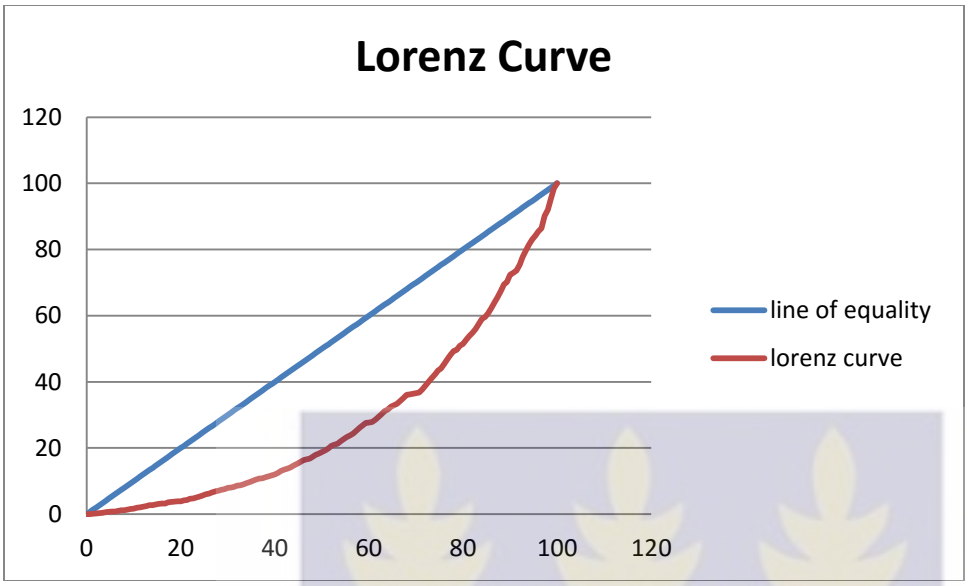

Figure 8: A graph of the Lorenz curve of income from cocoa.

4.9 HOUSEHOLD CHARACTERISTICS

One hundred and eighteen (118) respondents were household heads and 32 respondents were not household heads. The relationship of those who were not household heads to the household head was; 31 respondents were wives and only one was a son to the household head. The maximum number of household members of cocoa farmers was 15 people, the minimum was 1 person and the mean number of household members was 6.113 people.

Cocoa farmers' households experience cash and food shortages during the course of the year. One hundred and thirty nine (139) (92.7%) respondents experience only cash shortages during the course of the year and 11 (7.3%) respondents experience both food and cash shortages during the course of a year.

The households address the shortages in various ways. For cash shortages, 83 (55.3%) households borrow money, 59 (39.3%) households economize and make new budget, 5 (3.3%)

households sell crops meant for household consumption, 2 (1.3%) households borrow money and sell crops meant for household consumption and 1 (0.7%) household borrows and economizes.

For food shortages, 7 respondents stated their households reduce quantity of food and 4 respondents stated their households eat two times daily. All households do not experience water shortages or any other shortages in the course of a year.

Cocoa farmers were asked about which areas of living standard have decreased over the years namely food, clothes, education of children, transportation/travel and health. Twenty six (26) (17.3%) respondents stated none of their areas of living standard have decreased over the past years. Education of children had the highest percentage, with 105 respondents representing 70% of total respondents (Table 18). Cocoa farmers stated that it was difficult to pay the school fees of their children and associated educational accessories cost.

Table 18: Areas of living standard that have decreased over the past years

AREA	FREQUENCY	PERCENT
None	26	17.3
Food	5	3.3
Clothes	1	0.7
Education	105	70.0
Transportation	1	0.7
Health	4	2.7
Food and Education	5	3.3
Food and Transportation	1	0.7
Education and Transportation	1	0.7
Food, education and transportation	1	0.7

Source: Field data (2015)

4.9.1 Human capital

Eleven (11) (7.3%) respondents stated they had no children/household members in school, 22 (14.7%) respondents stated they had only one child in school, 27 (18%) respondents stated they

had 2 children in school, 25 (16.7%) respondents had 3 children in school, 35 (23.3%) respondents had 4 children in school, 14 (9.3%) respondents had 5 children in school, 7 (4.7%) respondents had 6 children in school, 6 (4.0%) respondents had 7 children in school and one respondent each had 8, 9 and 10 children in school representing 0.7% each.

Four (4) (2.7%) respondents stated their household members fall sick very often, 69 (46%) respondents stated their household members fall sick often and 77 (51.3%) respondents stated their household members do not often fall sick. All respondents stated all their household members had NHIS. Household members of respondents also sought treatment of ailments from different places. 87 (58%) sought treatment from local community clinic/health centre and district/urban hospitals and only 1 (0.7%) of respondents stated respondents stated household members sought treatment from herbalists.

The number of household members who are working and earning income forms a major support or safety net for cocoa farmers in times of income shocks. One hundred and thirty six (136) (90.7%) respondents had household members who earned income from various livelihood activities and 14 (9.3%) respondents did not have household members who earned income. One hundred and five (105) (77.2%) respondents out of 136 respondents had only one household member earning income, 22 (16.2%) respondents had 2 household members earning income, 7 (5.2%) respondents had 3 household members earning income, one respondent each had 4 (0.7%) and 5 (0.7%) household members earning income. Farmers were asked about the adequacy of income contribution by household members. Sixteen (16) (11.8%) respondents out of 136 respondents stated the income contribution of household members was adequate, 24

(17.6%) respondents stated somewhat adequate, 92 (67.7) respondents stated inadequate and 4 (2.9%) stated very inadequate.

4.9.2 Physical Assets

One hundred and thirty three (133) (88.7%) households owned radio, 84 (56%) households owned TV set, 144 (96%) households owned cell phones, 57 (38%) owned bicycle, 14 (9.3%) owned motorbike, 36 (24%) owned refrigerator and 71 (47.3%) owned fan (Table 19).

Table 19: Physical assets owned by households

ASSET	FREQUENCY Yes	FREQUENCY No
Radio	133 (88.7%)	17 (11.3%)
TV	84 (56%)	66 (44%)
Cell Phones	144 (96%)	6 (4%)
Bicycle	57 (38%)	93 (62%)
Motorbike	14 (9.3%)	136 (90.7%)
Refrigerator	36 (24%)	114 (76%)
Fan	71 (47.3%)	79 (52.7%)

Source: Field data (2015)

Eighty six (86) (57.3%) owned the houses they lived in, 85 (56.7%) of the houses were made of cement, all the houses were roofed with iron sheets and 148 (98.7) had electricity in their houses (Table 20).

Table 20: Household Characteristics of respondents

	FREQUENCY	PERCENT
OWNERSHIP Of HOUSE		
Owned	86	57.3
Rented	4	2.7
Family house	59	39.3
Work house	1	0.7
MATERIAL Of HOUSE		
Cement	85	56.7
Mud	46	30.7
Wood	3	2.0
Brick	16	10.7
ROOFING MATERIAL		
Iron sheets	150	100
Grass	0	0
ELECTRICITY		
Yes	147	98.7
No	3	1.3

Source: Field data (2015)

Eighty four (84) (56%) respondents stated their houses were strong enough to be able to give them shelter throughout the year and 66 (44%) respondents stated their houses were not strong enough to give them shelter throughout the year. All 66 respondents stated their houses leaked when it rained.

One hundred and forty five (145) (96.7%) respondents did not have water source in their households and only 5 (3.3%) had water source in their households which were wells. Of those who did not have water sources in their houses, 144 respondents drew water from community boreholes and only one person fetched water from the riverside.

Ninety two (92) (61.3%) respondents did not have any toilet facility in their houses and 58 (38%) respondents had toilet facility in their houses. Fifty seven (57) respondents of 58 respondents had

pit latrines in their houses and one respondent had water closet (WC). Of those who did not have any toilet facility, 53 respondents used the public toilet in the community and 39 practiced open defecation (bush), this mostly happened in Tanodumasi since they did not have public toilets in the community.

4.10 LIVELIHOOD OUTCOMES

One hundred and thirty eight (138) (92%) cocoa farmers stated the main reason they undertook all these livelihood activities was to get income to educate their children and 16 (8%) stated to get income to take care of household needs.

Cocoa farmers were asked to compare their livelihood outcome in 2013 and 2014. Seventy one (71) (47.3%) respondents stated there had been an increase their income in 2014 compared to 2013 and 79 (52.7%) stated there had been a decreased in income in 2014 compared to 2013. Thirty four (34) (22.7%) respondents stated there had been an increase their food security in 2014 compared to 2013, 32 (21.3%) stated there had been a decreased in food security in 2014 compared to 2013 and 84 (56%) stated there had been no change. Thirty four (34) (22.7%) respondents stated there had been an increase their health in 2014 compared to 2013 and 43 (28.7%) stated there had been a decreased in health in 2014 compared to 2013 and 73 (48.7%) stated there had been no change (Table 21).

Table 21: Comparison of livelihood outcomes between 2013 and 2014

Livelihood outcome	INCREASE	DECREASE	NO CHANGE
Income	71 (47.3%)	79 (52.7%)	0 (0%)
Food security	34 (22.7%)	32 (21.3%)	84 (56%)
Health Status	34 (22.7%)	43 (28.7%)	73 (48.7%)

Source: Field data (2015)

Farmers were asked whether their income from farming was enough to cater for their families. Twenty (20) (13.3%) respondents stated they agree, 4 (2.7%) respondents stated they somewhat agree, 3 (2%) respondents stated they are not sure, 111 (74%) stated they disagree and 12 (8%) respondents stated they strongly disagree.

Farmers were asked what they liked about farming. One hundred and forty nine (149) (99.3%) stated they liked farming because farming served as sources of food and income and one respondent stated he liked farming because it served as sources of food, income and gifts for people. He stated he gives foodstuffs to relatives and friends as gifts.

Respondents were asked if they had an option, would they still be doing farming, 92 (61.3%) respondents stated 'Yes', they would still be doing farming even if they had an option and 58 (38.7%) stated 'No', they would not be doing farming.

CHAPTER FIVE

DISCUSSION

5.1 Introduction

Chapter five presents the discussion of the results. The chapter is subdivided into six (6) main sections based on results and objectives.

5.2 Perceptions on Climate Change

To answer the first objective, farmers were asked about their perceptions on climate change. Most respondents (98%) stated to have noticed changes in the climate over the past ten (10) years. They perceived change in climate as increase in temperature and changes in rainfall patterns. The perceptions of the farmers was verified using historical annual mean rainfall and temperature data of Atwima Mponua District from Ghana Meteorological Agency from 2004 to 2014. The data showed that the annual rainfall of the study area has reduced steadily after an increase of 1681.1mm in 2008 to 1254.5mm in 2014 (Fig. 4). The mean annual temperature has also increased since 2004 with temperature of 27.80^{o}C to 28.001^{o}C in 2014 (Fig. 5). This finding is consistent with result from Fosu-Mensah *et al.*, 2010, which stated that there has been a recorded increase in temperature in Ghana over the past 30 years. According to Owusu and Waylen (2009), rainfall patterns have changed in Ghana with most parts experiencing reduction in rainfall.

During focus group discussions and interviews, the respondents stated that due to the change in climate, there has been a reduction in yield of crops over the years and their responses are in line with literature. According to Anim-Kwapong and Frimpong, (2005), cocoa is highly sensitive to changes in climate, particularly to temperature due to its effects on evapo-transpiration. The

International Cocoa Organization (2005) stated that changes in the weather alters stages and development rate of cocoa and increase the prevalence of cocoa pest and pathogens and this ultimately leads to reduction in cocoa yield and negatively affects socio economic variables such as farm income, livelihood and farm level decisions (Ajewole and Iyanda, 2010). Since cocoa plays an important role in economic growth of many African countries and supporting livelihoods of many individuals, this is worrisome (Lawal and Emaku, 2007).

From the results, cocoa farmers stated they that coped with climate change by planting shade trees and intercropping to help reduce temperature of farm, the increased and continual use of agro chemicals to enhance productivity. Some farmers stated they dug gutters on farms to reduce flooding. The responses are supported by literature. Ogunsola and Oyekale (2013) stated that farmers in an attempt to cope with the changing climate which results in low yield, most farmers coped by regular cocoa spraying. Coping strategies used by farmers across Africa to protect their crops against included early planting and digging drainage channels, tree planting, income diversification and among others (Deressa *et al.*, 2009; Okonya *et al*., 2013).

5.3 Livelihood assets

To answer the second objective, the livelihood assets of the cocoa farmers in the Atwima Mponua district were determined.

According to (Sen, 1981; Ellis, 2000b; Barrett, *et al*., 2002; Shepherd *et al*., 2011) assets create a buffer between production, exchange and consumptions and in case of need, assets can be transformed into production inputs or directly into consumption. The more assets people have, the less vulnerable they are, and the greater the erosion of people's assets, the greater their insecurity.

As presented in the results, natural capital of the cocoa farmers consisted of land, soil and water sources. According to DFID (1999), "Natural capital is very important to rural dwellers because they derive all or part of their livelihoods from natural resource-based activities (farming, fishing, and gathering in forests, mineral extraction, etc.)". The land size can determine the crop production, the maximum total land size was 40 acres, the minimum was 2 acres and the mean was 9.81 acres. Nationally, more than 90 per cent of farm holdings are less than 2 hectares in size and are subsistence farms (WFP, 2009; MoFA, 2011). This leads to limited income and increases vulnerability of farmers. The main water source used for farming was rain. The farmers practiced rain-fed agriculture. Only 5 (3.3%) of the respondents had irrigation which served as source of water in the dry season. Due to agriculture in Ghana being mainly rain fed, production is erratic and vacillating between scarcity, sufficiency and glut depending on the vagaries of the weather (World Bank, 2010). This introduces an element of risk in agricultural production since decisions are made in the face of uncertainty and risk (Ellis, 2000).

Fifty four percent (54%) of farmers were satisfied with the productivity of their soil. The soil quality of different farms is believed to cause important variations in the effect of farm size on agricultural production (Berry, *et al.* (1979); Lamb (2003)).

From the results, physical capital of the cocoa farmers consisted of tools such as cutlasses and hoes, agrochemicals such as fertilizers and pesticides, and other infrastructure such as storage facilities used for farming and household purposes. The farmers used rudimentary tools such as hoes and cutlasses but lacked advanced technologies such as tractors and irrigation system and this may affect their cocoa productivity. According to World Bank (2007) food yields are poor in Sub Saharan African because of low adoption of productivity enhancing inputs. Only 5% of respondents used water pump (irrigation) and only 15% had storage facility.

As shown in the results, human capital of the cocoa farmers consisted of labour, number of years of farming, number of days of farming in a week and number of hours of farming daily and health. Human capital represents the skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives. At a household level human capital is a factor of the amount and quality of labour available; this varies according to household size, skill levels, leadership potential, health status, and so forth (DFID 1999). It is argued that all available knowledge in modern economics supports the facts that for the average person, the amount of knowledge that one possesses is positively correlated with his or her personal earnings. Labour as a human capital or asset contributes to productivity. An increase in labour causes an increased in cocoa and crop production (Vigneri, 2007). Ill health is a serious threat to livelihoods. Health is a priority for the rural poor. Prolonged illness of a person of working age is one of the factors that can push the whole household into poverty. Access to good health is thus important to rural farmers.

From the results, financial capital of the cocoa farmers consisted of savings, remittances and credit. According to DFID (2000), financial capital denotes the financial resources that people use to achieve their livelihood objectives. Regular inflows of money may include earned income and other common types of inflows such as pensions and remittances). Availability of credit can help farmers to cope with poor weather and credit availability also reduces income diversification (FAO, 2015). Nyemeck *et al.* (2007) concluded that there is the need to promote credit institutions which specializes in savings, mobilization and credit supply to smallholders. To them, when loans are made available to cocoa farmers without much emphasis on collateral security, the problem of poor harvest will become history as smallholder cocoa farmers will be empowered to go for any chemical without concern for the cost.

From the results, social capital of the cocoa farmers consisted of FBOs and help from household members. All the farmers were involved in at least one FBO and they gained benefits from joining such groups. The Sustainable Livelihood Framework identifies social capital as one of the key resources on which people draw in constructing their livelihood portfolios. It is taken to mean the social resources upon which people draw in pursuit of their livelihood objectives. Social capital, like other types of capital, can be valued as a good in itself. It can make a particularly important contribution to people's sense of well-being (through identity, honour and belonging) (DFID, 2000).

5.4 Production

Assets combine in a multitude of different ways to generate positive livelihood outcomes (DFID, 2000). Livelihood assets combine to generate increased production, increased income and livelihood strategies needed to ensure well being of people.

As presented in table 9, the highest cocoa output and yield were recorded in 2013/2014. Cocoa output and yield have steadily increased from 2010/2011 season to 2013/2014 season. The increase in cocoa output and yield may be attributed to the increase in the use of pesticides, increase in cocoa prices, increase in government support and extension of farm lands. Cocoa production in recent years has increase due in part to control of diseases and pests programmes, credits for fertilizer and pesticides, government-supported rehabilitation programmes, input supply privatization and higher producer prices (ICCO, 2007). Vigneri (2007) stated that increase in land for cocoa cultivation leads to increase in cocoa production and output.

To answer the first hypothesis, a regression analysis was used to determine the influence of climatic variables on cocoa yield/acre (kg) and cocoa output (kg/acre) (Table10 and Table 11 respectively).

As shown in Table 10, total rainfall (X_1) and temperature were not significant (X_2) at 0.05%. This could be due to the fact that climatic variables influence in a long term rather than a short term. To know the influence of climatic variables on cocoa yield (kg/acre), data should be of longer seasons (such as 30 seasons) rather than just 5 seasons.

As presented in table 10, we fail to reject the first null hypothesis. The null hypothesis (H_0) that stated climatic variables have no significant effect on cocoa yield (kg/acre) is not rejected.

From the results in Table 11, total rainfall (X_1) and temperature were not significant (X_2) at 0.05%.This could be due to the fact that climatic variables influence in a long term rather than a short term. To know the influence of climatic variables, data should be of longer seasons such as 30 seasons rather than just 5 seasons. The results are contrary to a study by Anim-Kwapong and Frimpong (2004). The study concluded that the multiple regression analysis showed that over 60% of the variation in dry cocoa beans produced could be explained by the combination of the preceding year's total annual rainfall, total rainfall in the two driest months and total sunshine duration.

As presented in table 11, we fail to reject the first null hypothesis. The null hypothesis (H_0) that stated climatic variables have no significant effect on cocoa output (kg) is not rejected.

Socio economic factors that influence cocoa yield and cocoa output/production

To answer the third objective and second hypothesis, regression analysis was used to determine the socioeconomic factors which influence cocoa yield and coca output (Table 12 and 13 respectively).

Socio economic factors that influence cocoa yield

As shown in table 12, hired labour (X_1), years of farming (X_4), number of lands(X_8), land size for cultivation of cocoa (X_{10}) and quantity of fertilizer (X_{11}) were all significant at 0.05%.

Hired labour had a positive correlation with yield (kg/acre), for every unit increase in hired labour by 1 man-day, yield (kg/acre) increases by 1.341 kg/acre. This is expected since an increase in hired labour means increase in the working force. This is collaborated by findings from Osuntogun and Olusola (2009) and Onoja et *al.*, (2012) which stated that increase in of mandays of labour significantly increased cocoa yield.

Number of years of farming (experience) had a positive correlation with yield (kg/acre). For every unit increase in years of farming by 1 year, yield increases by 2.795 kg/acre. This was expected since with experience comes knowledge and knowledge helps to choose practices that enhance yield. Experience helps farmers to decide and know what practices will enhance yield.

Number of lands had a positive correlation with yield (kg/acre). As the number of land for production of cocoa increases, it is expected that the yield (kg/acre). For every unit increase of number of lands, yield (kg/acre) increases by 19.202 kg/acre.

The quantity of fertilizer applications had a positive correlation with yield (kg/acre). For every unit increase of fertilizer by 1kg, yield increase by 2.336 kg/acre. This was expected since fertilizer applications increases nutrients in the soil and thus increases in yield (kg/acre). This

finding is in line with results from Amos (2007) which stated that increase in quantity of fertilizer increased cocoa yield and Osuntogun and Olusola (2009) also stated that increase in aggregated fertilizer supply significantly increased cocoa yield.

Land size for cultivation of cocoa had a negative correlation with yield (kg/acre). For every increase in land size for cultivation of cocoa by 1 acre, yield decreases by yield 6.686 kg/acre. This was not expected since an increased land size should mean an in production thus yields. According to Vigneri (2007), most of the rise in output came from increased land area, not increased land productivity (yields). This means though cocoa output (kg) may increase with increasing land area, productivity/yield (kg/acre) of the land is low. This may be due fact that rise in prices of labour and agro chemicals may cause farmers to use cheap supplements thus causing productivity to reduce. As the farmer increases the farm size, management becomes difficult leading to poor yield. Yields have clearly increased across time, and across all regions (Vigneri, 2007). However, this positive increase has not boosted the productivity of land under cocoa cultivation in Ghana to any noticeable degree. Cocoa yields in the country remain low by comparative international standards: with an average of just under 400 kg/hectare on full bearing farms (farms with tree stock of 10–15 years old) (Vigneri, 2007).

The second null hypothesis (H_0) that stated socioeconomic factors have no significant effect on cocoa yield is rejected. The alternative hypothesis (Ha) that socioeconomic factors have significant effect on cocoa yield of farmers is accepted.

Factors that influence cocoa production/output

From the regression results in Table 13, hired labour (X_1), number of years of farming (X_4), number of lands(X_8), land size for cultivation of cocoa (X_{10}) and quantity of fertilizer (X_{11}) were

all significant at 0.05%. Hired labour had a positive correlation with cocoa production/output (kg), for every unit increase in hired labour by 1 man-day, cocoa production/output (kg), increases by 13.895 kg. This is expected since an increase in hired labour means increase in people to take care of the farm.

Number of years of cocoa farming (experience) has a positive correlation with cocoa production/output (kg). For every unit increase in number of cocoa years of farming by 1 year, yield increases by 20.149 kg. This was expected since with experience comes knowledge. Experience helps farmers to decide and know what practices will enhance production.

Number of lands had a positive correlation with cocoa production/output (kg). As the number of land for production of cocoa increases, it is expected that the cocoa production/output (kg) increases. For every unit increase of number of lands, cocoa production/output (kg) increases by 174.119 kg.

The quantity of fertilizer applications had a positive correlation with cocoa production/output (kg). For every unit increase of fertilizer by 1kg, cocoa production/output (kg) increase by 14.993 kg. This was expected since fertilizer applications increases nutrients in the soil and thus increases in yield (kg/acre). Land size for cultivation of cocoa had a positive correlation with yield (kg/acre). For every increase in land size for cultivation of cocoa by 1 acre, cocoa production/output (kg) increases by 70.734 kg.

These results are in line with Vigneri (2007) and Adeniyi and Ogunsola (2014), they stated that increases in labour, farm size of cocoa and fertilizer applications increases cocoa production/output.

The second null hypothesis (H_0) that stated socioeconomic factors have no significant effect on cocoa output/production is rejected. The alternative hypothesis (Ha) that socioeconomic factors have significant effect on cocoa output/production of farmers is accepted.

5.5 Livelihood Strategies

From the results, farmers diversified from cocoa and crop farming. The result presented in Table 15 is in line with a study by Nasa'i *et al.,* (2010), which stated that respondents reported income as their first priority for engaging in livelihood diversification. This finding also corroborates those of Ellis (1998), Gordon (2000) and Dercon and Krishnan (1996) whose studies show that rural farmers diversify sources of livelihood to increase households' income portfolios.

Factors that influence livelihood diversification

To answer the fourth objective and third hypothesis, a logistic regression was used in Table 16. The significant predictors of the model were household head (X_1) (headofhouse), age of respondents (X_4) (Realage), sex of respondents (X_6) (Sex) and distance to market (X_{13}) (distancecrop).

Household head showed a positive correlation with diversifying from crop farming. Not being a household head reduces the burden associated with being household head. A household head has to provide for the rest of the household members and as income from crop farming was not enough, household heads engage in other livelihood activities. Not being a household head makes a cocoa farmer 0.131 times less likely to diversify from crop farming than a household head.

Age of respondents had a negative correlation with diversifying from crop farming. This was expected as the older one get the more reluctant to engage in different activities and also increasing age is associated with less energy and ability to do many activities. As the age of the cocoa farmer increases, the farmer is 0.893 times less likely to diversify from crop farming than younger farmers. This finding is in line with Chukwuezi (2001), Maegher (2001) and Bryceson (2002) and which stated younger people are involved in and purse multiple livelihood activities more than older people in rural areas of Nigeria.

Sex of respondents had a positive correlation with diversifying from crop farming. A female cocoa farmer is 4.631 times more likely to diversify from crop farming than a male cocoa farmer. Females tend to have less access to land, credit and agrochemicals resulting in low crop yield thus low income from crop farming so to meet needs and increase income, female cocoa farmers are more willing to engage in crop farming. Saha and Bahal (2010) found out that more women than men in the West Bengal were engaged in different diversification activities in order to obtain income.

Distance to market (km) to sell crops had a positive correlation with a farmer diversifying from crop farming. For every unit increase in the distance to market by l kilometer, there is an increase in a farmer diversifying from crop farming by 0.305. With the poor nature of roads in rural areas, an increase in distance to markets means less access to the markets leading to increase in spoilage of crops since most farmers do not have storage facilities. This result in low income from crop farming thus farmers need to diversify from crop farming to meet needs and increase income.

The third null hypothesis (H_o) that stated socioeconomic factors have no effect on cocoa farmers diversifying from crop farming is rejected. The third alternate hypothesis (H_a) that stated socioeconomic factors have effect on cocoa farmers diversifying from crop farming is accepted.

5.6 Income distribution

To determine disparity in income distribution among farmers a Gini coefficient was used. This answers objective five and hypothesis four. A Gini Coefficient of 0 indicates equal income for all earners and a Gini Coefficient of 1 would mean that one person has all the income and nobody else has any. Thus, lower Gini Coefficients indicate more equitable distribution of income among the households, while higher Gini Coefficients mean that income is concentrated in the hands of fewer people. From Figures 7 and 8, the Lorenz curve shows distribution of income among farmers. The further away the Lorenz curve from the line of equality the further the Gini coefficient approaches 1.

As presented in Table 17, Gini coefficient of income from all livelihood activities was 0.473553. This shows there is a moderately high inconsistency in distribution of income. This means there is a moderately high unequal distribution of income among cocoa farmers. This could due the fact that numbers of income sources are different among cocoa farmers. Ndambiri et *al.*, (2012) stated that variations in livelihood strategies led to unequal income distribution among farming households in Nyeri District in Kyena. Mat (2012) also stated that non-farm income sources contributed to the increase in income inequality among agricultural households.

The Gini coefficient of income from cocoa was 0.440868. This shows there is a moderately high inconsistency in distribution of income. This means there is a moderately high unequal distribution of cocoa income among cocoa farmers. This could due the fact that various livelihood assets such as land, fertilizer, educational level and labour differ for each cocoa

farmer, resulting in difference in cocoa production thus cocoa income. This is supported by literature. Quah (1997) stated that inequality in ownership of land asserts is widely attributed to high levels of income inequality on agriculture dominated countries. Findings from Reardon and Matlon (1992) showed that increase in average years of schooling led to reduced income.

The fourth null hypothesis (H_0) that stated income is equally distributed among cocoa farmers is rejected. The fourth alternate hypothesis (H_a) that stated income is unequally distributed among cocoa farmers is accepted.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

Chapter six presents conclusions and policy recommendations of the study. The chapter is therefore subdivided into two main sections.

6.2 Summary of the Study

The primary objective of the study was to assess livelihood of rural cocoa farmers in the Atwima Mponua district in the Ashanti Region of Ghana. To achieve this objective, four main research questions were raised and answered through a combination of both qualitative and quantitative approaches. Using a structured questionnaire, a total of one hundred and fifty cocoa farmers were sampled across three communities in the district. The perceptions of cocoa farmers on climate were determined using questionnaires and focus group discussions and were supported by literature and data from relevant institutions. The livelihood assets or capital of cocoa farmers were identified. The cocoa output (kg) and yield (kg/acre) of farmers for 5 seasons were determined and climatic variables (rainfall and temperature) influencing cocoa output and yield were identified using linear regression analysis as well as socioeconomic factors influencing cocoa output and yield were identified using multiple regression analysis. The livelihood strategies adopted by these women farmers as well as socioeconomic factors influencing the diversification of cocoa farmers from crop farming were identified using logistic regression analysis. The incomes of cocoa farmers were first added and then distribution of income was determined using the Gini coefficient.

The analysis showed that cocoa farmers perceive change in climate as reduced rainfall, increased temperature, change in rainfall patterns and weather extremes (such as flooding). Cocoa farmers used traditional tools in farming; fertilizer use had decreased over the years whiles pesticides use increased over the years. All the respondents were in at least one Farmer Based Organization (FBO), 50.7% of respondents had savings and 32.7% had access to credit.

Cocoa output (kg) and yield (kg/acre) had increased for the past 5 seasons. Analysis showed that climatic variables (rainfall and temperature) had no influence on cocoa production and yield for the 5 seasons.

Multiple regression analysis showed that socioeconomic factors influenced cocoa output (kg) and yield (kg/acre). Hired labour, years of cocoa farming, number of lands used for cocoa cultivation, land size for cultivation of cocoa and quantity of fertilizer had influence on cocoa output and yield. Hired labour, years of cocoa farming, number of lands used for cocoa cultivation, land size for cultivation of cocoa and quantity of fertilizer had positive effects on cocoa output (kg). Hired labour, years of cocoa farming, number of lands used for cocoa cultivation and quantity of fertilizer had positive effects on cocoa yield (kg/acre) whiles , land size for cultivation of cocoa had a negative effect on cocoa yield (kg/acre).

Cocoa farmers cultivated other crops alongside cocoa. Respondents cultivated cereals and grains, roots and tubers, fruits and vegetables and oil palm. These crops served as sources of food and income to cocoa farmers. Cocoa farmers also diversify from crop farming. They engaged in livestock rearing, off farm activities such as farm wages and non-farm activities such as trading, masonry, etc. Cocoa farmers diversify from cocoa farming to increase income, to avoid risk associated with crop farming, to meet family necessities and get income to invest in

crop farming. Using logistic regression, household head, age of respondents, sex of respondents and distance to market influenced diversification from crop farming by cocoa farmers.

Cocoa farmers get income from farm, off farm and non-farm activities and remittances received from relatives and friends. Cocoa income forms 58.75% of total income of respondents. The Gini coefficient showed that income was unequally distributed among cocoa farmers.

Analysis of household characteristics showed that cocoa farmers' households experience cash and food shortages during the course of the year. Education of children had the highest percentage, of areas of living standard that have decreased over the years. One hundred and thirty six (136) (90.7%) respondents had household members who earned income from various livelihood activities.

Cocoa farmers' main reasons for undertaking all these activities were to get income for education of their children and to get income to take care of household needs. Ninety-two (92) (61.3%) respondents stated 'Yes', they would still be doing farming even if they had an option and 58 (38.7%) stated 'No', they would not be doing farming if they had an option.

6.3 Conclusions

Based on the findings of the study, the following conclusions can be drawn:

i. Cocoa farmers perceived change in climate as reduced rainfall, increased temperature, change in rainfall patterns and weather extremes (such as flooding). Fifty five (55) (37.4%) respondents stated rainfall has reduced and 32 (21.8%) respondents stated that there had been an increase in temperature and reduced rainfall. These results are supported by data from the Ghana Meteorological Agency (GMet). The main economic

trends that affected cocoa farmers were cocoa prices, agrochemicals prices, labour prices and cutlass prices. Twenty five (25) respondents had experienced bad events/disturbances over the past 5 years. The sudden events or disturbances that affected farmers were health problems, motor accidents, burning of farms and land conflicts. The disturbance with the highest percentage was personal health problem (60%).

ii. Cocoa output (kg) and yield (kg/acre) had increased over the past 5 seasons. Analysis revealed that climatic variables (rainfall and temperature) had no influence on cocoa production and yield for the 5 seasons.

iii. Socioeconomic factors influenced cocoa output (kg) and yield (kg/acre). Hired labour, years of cocoa farming, number of lands used for cocoa cultivation, land size for cultivation of cocoa and quantity of fertilizer had influence on cocoa output and yield. Hired labour, years of cocoa farming, number of lands used for cocoa cultivation, land size for cultivation of cocoa and quantity of fertilizer had positive effects on cocoa output (kg). Hired labour, years of cocoa farming, number of lands used for cocoa cultivation and quantity of fertilizer had positive effects on cocoa yield (kg/acre) whiles , land size for cultivation of cocoa had a negative effect on cocoa yield (kg/acre).

iv. Cocoa farmers cultivated other crops alongside cocoa. One hundred and five (105) (70%) respondents cultivated cereals and grains, all respondents cultivated roots and tubers, 101 (67.3%) respondents cultivated fruits and vegetables and 30 (20%) cultivated oil palm. Sixty nine (69) (46%) respondents diversified from crop farming. They engaged in livestock rearing, off farm activities such as farm wages and non-farm activities such as

trading, masonry, etc. Household head, age of respondents, sex of respondents and distance to market influenced diversification from crop farming by cocoa farmers.

v. Cocoa farmers get income from farm, off farm and non-farm activities and remittances received from relatives and friends. Fifty eight percent (58.75%) of cocoa farmers income came from cocoa, 21.06% came from cultivation of other crops, 19.5% came from alternative livelihood activities live livestock rearing, farm wages, trading and other non-farm activities and 0.69% came from remittances received from relatives and friends. The Gini coefficient for total income from all livelihood sources was 0.473553 and the Gini coefficient for income from cocoa was 0.440868. This shows there is a moderately high inconsistency in distribution of income among cocoa farmers.

vi. Cocoa farmers' main reasons for undertaking all these livelihood activities were to get income to educate their children and to get income to take care of household needs. Ninety two (92) (61.3%) respondents stated 'Yes', they would still be doing farming even if they had an option and 58 (38.7%) stated 'No', they would not be doing farming if they had an option.

6.4 Policy Recommendations

The study provides important policy implications that can help improve livelihood cocoa farmers in the Atwima Mponua district:

i. As rainfall and temperature are important factors influencing cocoa production and other crops, measures such as irrigation schemes should be introduced to supplement the inadequacies of water if any, and land cooling strategies in form of mulching could also help to check excessive soil temperature.

ii. Government should encourage and fund research institutes especially, Cocoa Research Institute of Ghana (CRIG) to undertake research that will produce new varieties and breeds of cocoa plants that can adapt and thrive under severe climatic conditions.

iii. Efforts should be at making farm inputs such as agrochemicals and cutlass readily available and affordable to farmers. Prices of such inputs should be heavily subsidized to encourage cocoa farmers acquire them.

iv. Improving health service delivery, including public health measures, can reduce morbidity rates. Risk-reduction strategies minimize the downside variance in income profiles and increase the overall expected average income.

v. There is need to improve upon the storage facilities especially those that will enable cocoa farmers to overcome weight and content loss of crops. This will prevent crop and income loss.

vi. Cocoa farmers should be encouraged to form cooperative societies so that they can access funds for procurement of various farm inputs such as agrochemicals and spraying machines.

vii. Cocoa farmers should be invigorated by providing them training, capital and other equipment to diversify their activities not only in agriculture, but also in non-farm sector that has the potential to increase income.

viii. Public infrastructure investments can do much to reduce the risk exposure of rural cocoa farmers. Rural feeder roads can do much to integrate market economies, reducing some

market price volatility as well as diversifying market opportunities for the rural cocoa farmers.

ix. Government and NGOs should support producer organizations of the poor and provide social protection; and enhance access to savings, credit and venture capital services which are all lacking in rural communities.

x. Government and other civil society organizations should provide cocoa farmers' alternative livelihood activities to increase their income. This would help cocoa farmers to move into high return livelihood activities.

xi. It will be profitable for rural cocoa farmers be included in decision making in to be empowerment. Rural people's evaluations of institutions show that they are excluded from participation in decision making and in equal sharing of benefits from government programs as well as from those of NGOs.

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APPENDICES

APPENDIX 1: Questionnaire for assessing the sustainable livelihoods of cocoa farmers in the Atwima Mponua district of Ghana.

Community: ……

SECTION A- DEMOGRAPHICS

1. Sex 1. Male [ ] 0. Female [ ]
2. Age 1. Under 20 [ ] 2. 21-30 [ ] 3. 31- 40 [ ] 4. 41-50 [ ] 5. 51-60 [ ] 6. 60+ [ ]
3. Marital status 1. Single [ ] 2. Married [ ] 3. Divorced/Separated [ ] 4.Widow/Widower[ ]
4. How many children do you have? 0. None [ ] 1. 1 [ ] 2. 2 [ ] 3. 3[ ] 4. 4 [ ] 5. 5 [ ] 6+ [
5. What is your highest level of education? 1. No formal education [ ] 2. Primary [ ] 3. JSS/Middle school [ ] 4.Secondary Education (SHS/Vocational/Technical school) [ ] 5. Diploma [ ] 6.Bachelors [ ] 7. Post graduate [ ]

SECTION B PERCEPTIONS OF VULNERABILITY CONTEXT

6. Have you noticed any changes in the climate during the last 10 years which have affected your livelihood? 1. Yes [ ] 0. No [ ]
7. If yes to 6) above what are the changes you have noticed?
8. How have the changes affected your livelihood?
9. What do you do to mitigate the effects of these changes on your livelihood?
10. What economic trends (prices, fees, levies, etc) have you noticed that affect your livelihood?
11. How have the changes affected your livelihood?

12. Have any events (bad times/disturbances (eg. conflicts, deaths, etc) occurred abruptly that have affected your livelihood in the past 10 years? 1. Yes [ ] 0. No [ ]

13. If yes to 12) what are the events?

14. How did it/they affect the livelihood?

SECTION C FARMING PRACTICES

15. Why do you grow cocoa?

16. How adequate is the price of cocoa? 1. Very adequate 2. Adequate 3. Somewhat Adequate 3.Not adequate

17. What type of planting system do you use? 1. Monoculture [ ] 2. Mixed cropping [ ]

18. What other crops do you grow apart from cocoa? 1. Grains and cereals [ ] 2. Fruits and Vegetables [ ] 3.Roots and Tuber [ ] 4. Oil palm 5.Others (specify)…….

19. Why do you grow these crops? 1. Food [ ] 2. Income [ ] 3. It is less expensive to cultivate [ ] 4. The crops require a lot of chemical inputs [ ] 5. Other specify…….

SECTION D LIVELIHOOD ASSETS

HUMAN CAPITAL

20. How many years have you been farming?

21. Do you have people working on your farm? 1. Yes [ ] 0. No [ ]

22. Is it hired labour? 1. Yes [ ] 0. No [ ]

23. If yes to 22) how many people seasonally?

24. Do you use family labour? 1. Yes [ ] 0. No [ ]

25. If yes to 24) how many?

26. How many days of the week do you work on your farms?

27. How many hours do you spend on your farm?

28. How often do you fall sick? 1. Very often [ ] 2.Often [ ] 3. Not often [ ]

29. Where do you seek treatment of the ailments? 1. Community clinic/health centre [ ] 2. District hospital [ ] 3. Traditional/spiritual healers [ ] 4. Herbalists [ ] 5. Self medication[ ] 6. Other (specify) ……

30. Do you have National Health Insurance Scheme? 1. Yes [ ] 2. No [ ]

NATURAL CAPITAL

31. Land size of respondents

	Season 2010/2011	Season 2011/2012	Season 2012/2013	Season 2013/2014	Season 2014/2015
Total land size (acres)					
Land size for cultivation of crops (acres)					
Land size for cultivation of cocoa (acres)					

32. How many lands do you use for cultivation of cocoa and other crops?

33. Is the land owned, rented or share holding? 1. Owned [ ] 1. rented [ ] 2.share holding [ ]

34. What other source of water do you use for farming apart from rain? 1 Tap system at home/nearby [ ] 2. Tap system/water far away [ ] 3. River/lake [ ] 4. Boreholes/well [ ] 5. Irrigation [ ]

35. How satisfied are you with the soil productivity on your farm? 1. Very satisfied [ ] 2. Satisfied 3. Somewhat satisfied [ ] 4. Not satisfied

36. Are your soils higher or lower yielding for the past 10 years? 1. Higher [ ] 2.Lower [ ] 3. Same [ ]

37. What do you think accounts for any changes?

PHYSICAL CAPITAL

38. What tools do you use for farming? 1. Traditional tools [ ] 2. Mechanized tools [ ]

39. What are the main tools for farming?

40. Do you have a storage facility for storing crops? 1. Yes [ ] 2. No[ ]

41. Do/did you use:

Season	Fertilizers 1=Yes 0=No	If No, 1=Expensive 2=Not required	Pesticides/ Insecticide 1=Yes 0=No	If No, 1=Expensive 2=Not required	Quantity in units (bags/gallons)	Cost per unit
2010/2011						
2011/2012						
2012/2013						
2013/2014						
2014/2015						

42. Mode of transport to farm. 1. Walking [ ] 2.Bicycle [ ] 3. Motorbike [ ] 4. Car [ ]

43. What is the distance to your farm (km)?

FINANCIAL CAPITAL

44. Do you have savings account? 1. Yes [ ] 2.No [ ]

45. If yes to 44) where do you save? 1. Commercial banks [ ] 2.Rural bank [ ] 3.Susu (mutual savings schemes) [ ] 4. Other (specify).

46. If yes to 44), how much do you have in your savings account?

47. Do you have access to credit? 1. Yes [ ] 2.No [ ]

48. If yes to 47) what are your sources of credit? 1. Money lenders [ ] 2. Banks [ ] 3. NGOs [ ] 4. Neighbours [ ] 5. Microcredit organizations 6.Others (specify)……..

49. Did you take credit last year? 1. Yes [ ] 0. No [ ]

50. If yes to 49) how much?

51. How do you use the credit if yes to 49)?

SOCIAL CAPITAL

52. Are you a member of any farmer organisation, farmer association or cooperative? 1. Yes [ ] 0.No [ ]

53. If yes to 52) how many?

54. What role do you play?

55. What is the main benefit from being a member of the group?1. Joint learning e.g. Farmer Field School [ ] 2.Bulk input buying [ ] 3.Contract farming [ ] 4.Produce marketing [ ] 5.Access to credit/finances [ ] 6.Other (specify) …….

56. Do you have access to extension officers? 1. Yes [ ] 2. No [ ]

57. How often do you have access to extension and advisory services? 1. Very often [ ] 2. Often [ ] 3. Not often [ ]

58. Have you undergone any training before?

59. What type of training and when was the training?

60. Who provided the training and for how long?

SECTION D PRODUCTION AND YIELD

61. Please state how many bags of cocoa you have harvested over the past 5 seasons?

Season 2010/2011	Season 2011/2012	Season 2012/2013	Season 2013/2014	Season 2014/2015

62. What do you think most importantly accounts for the changes in yield of cocoa? 1. Lack of proper care and timing of planting and harvesting [ ] 2. Pests and diseases on the farms [ ] 3.Insufficient nutrition of the soil/land degradation [ ] 4.Poor infrastructure and personal attitudes of the farmers [ ] [ ] 5.Lack of agro chemicals [ ] [ ] 5.Drought [ ] 6.Flood [ ] 6. Proper care and timing of planting and harvesting 7. Sufficient nutrition of the soil/land degradation 8. Use of agrochemicals 9. Others (specify)……..

63. Has the quality of the harvest has changed over the years? 1. Yes [ ] 0. No [ ]

64. Has the quality of cocoa decreased or increased? 1. Increased [ ] 2. Decreased [ ]

65. What do you think account for changes in the quality? 1. Lack of proper care and timing of planting and harvesting [ ] 2. Pests and diseases on the farms [ ] 3.Insufficient nutrition of the soil/land degradation [ ] 4.Poor infrastructure and personal attitudes of the farmers [ ] [ ] 5.Lack of agro chemicals [ ] [ ] 5.Drought [ ] 6.Flood [ ] 6. Proper care and timing of planting and harvesting 7. Sufficient nutrition of the soil/land degradation 8. Use of agrochemicals 9. Others (specify)

66. Please state how much you earn from selling cocoa and other crops in 2014?

	Cocoa	Cereals and grains	Roots and Tuber	Fruits and Vegetables	Oil Palm
INCOME (GHS)					

INSTIUTIONS

67. Where do you sell your cocoa? 1. Local- farm gate [ ] 2. Local-roadside [ ] 3. Local-area centre/PBC depots [ ] 4. Local- urban (distant market) [ ] 5. Export [ ]

68. Where do you sell your other crops? 1. Local- farm gate [ ] 2.Local-roadside [ ] 3.Local-area centre [ ] 4.Local- urban (distant market) [ ] 5. Export [ ]

69. What is the distance to the market in km or minutes (cocoa)?

70. What is the distance to the market in km or minutes (other crops)?

71. Who is the buyer of cocoa harvest? 1. Individual buyers/local consumers [ ] 2.Local traders [ ] 3. Processing Industry [ ] 4.International companies [ ] 5. Others (specify)…….

72. Who is the buyer of the other crops? 1. Individual buyers/local consumers [ ] 2.Local traders [ ] 3.Processing Industry [ ] 4.International companies [ ] 5. Others (specify)…….

73. Are good roads essential to selling of your crops? 1. Yes [ ] 0. No [ ]

74. My income has decreased due to bad roads to markets. 1. Strongly agree [ ] 2. Agree [ ] 3. Not sure [ ] 4. Disagree [ ] 5. Strongly disagree [ ]

75. What kind of support do you get from the state?

1. Fertilizer/Herbicides/Weedicide/Insecticides [] [] [] [] []

/Improved seedlings Subsidies

2. Merchanized subsidies [ ]
3. Micro-financing/investment support [ ]
4. Others state…….

76. Do you get support from any NGO? 1. Yes [ ] 0. No [ ]

77. What kind of support do you get from the NGO?

1. Fertilizer/Herbicides/Weedicide/Insecticides [] [] [] [] []

   /Improved seedlings Subsidies

2. Merchanized subsidies [ ]
3. Micro-financing/investment support [ ]
4. Mass spraying [ ]
5. Others state…….

LIVELIHOOD DIVERSIFICATION

78. Do you have a different source of income apart from crop farming? 1. Yes [ ] 0.No [ ]

79. What kind of work?

80. When did you start?

81. How much did earn from the 2nd job in 2014?

82. Why do you have an alternative livelihood? 1. To increase income [ ] 2. To ensure food security [ ] 3. To avoid risk associated with farming 4. To meet family necessities 5. Others specify……

83. Do you have livestock? 1. Yes 0. No

84. What kind of livestock?

85. Do you sell them?

86. How much earn from selling the livestock in 2014?

SECTION E HOUSEHOLD

87. How many people do you have in your household?

88. Are you a household head? 1. Yes [ ] 0. No [ ]

89. What shortages do you experience during the course of a year? 1. Cash [ ] 2. Food [ ] 3. Water [ ] 4. Other (specify)……..

90. What do you do to address such shortages when they occur?

91. Which of the areas of living standard have decreased?

92. How often do members of your household fall sick? 1Very often [ ] 2.Often [ ] 3. Not often [ ]

93. Where do you seek treatment of the ailments? 1. Community clinic/health centre [ ] 2. District hospital[ ] 3.Traditional/spiritual healers [ ] 4.Herbalists [ ] 5.Self medication 6. Other (specify) [ ]

94. Do your household members have National Health Insurance Scheme? 1.Yes [ ] 0.No[ ]

95. How many household members/children are currently in school?

96. What are the Educational levels of HH members currently in school? 1. Primary and KG ……. 2. JSS……3. SHS…… 4. Tertiary……5. Other (specify)……

97. What skills do household members have? 1. Dressmaking [ ] 2. Hairdressing [ ] 3.Masonry [ ] 4. Carpentry [ ] 5. Driving [ ] 6. Vendor [ ] 7. Farming [ ] 8.Other (specify)……

98. How many household members earn income?

99. What will you say about the contributions of household members who earn income towards household security? 1. Very adequate [ ] 2. Adequate [ ] 3. Inadequate [ ] 4. Very inadequate [ ]

100. What are the items your households have? 1. Radio set [ ] 2. TV set [ ] 3. Cell Phones [ ] 4. Bicycle [ ] 5. Refrigerator 6. Other (specify)…….

101. Ownership of house? 1. Owned [ ] 2. Rented [ ] 3. Family house [ ].

102. Type of house? 1. Cement [ ] 2. Mud [ ] 3. Wood [ ]

103. What is the roofing material of the main house? 1. Grass [ ] 2. Iron sheets [ ] 3. Tiles 4. Others specify……

104. Is your house able (strong enough) to give you shelter throughout the year?1.Yes [ ] 0.No [ ]

105. If no in 111) why? 1. Roof sometimes ripped off by storm [ ] 2. Rooms sometimes collapse during rainy season [ ] 3. Roof leaks badly during the rains [ ] 4. Other specify ……

106. What facilities do you have in your house? 1. Electricity [ ] 2.Tap water [ ] 3. Bulk rain water storage facility [ ] 4. Borehole [ ] 5.Pit latrine 6. KVIP 7. Water closet 8. Other (specify) ……

107. If there is no water source in your house, where do you (household) draw water? 1. Village dugout [ ] 2. Community borehole [ ] 3. Public tap [ ] 4. Other (specify)…….

108. If there is no toilet facility in your house, where do you use? 1. Open defecation (bush) [ ] 2. Neighbours toilet [ ] 3. Public toilet [ ] 4. Other (specify)…….

SECTION F- LIVELIHOOD OUTCOMES

109. What is the main reason why you undertake all these livelihood activities mentioned above? 1. To be able to get food to feed the household all year round [ ] 2. To get money to educate the children [ ] 3. To get money to take care of needs of your household [ ] 4. Other (specify)……

110. My income from farming is enough to cater for my family. 1. Strongly agree [ ] 2. Agree [ ] 3. Not sure [ ] 4. Disagree [ ] 5. Strongly disagree [ ]

111. Using the scale (1) Increase (2) Decrease (3) No change ; complete the following table comparing your livelihood outcome in 2013 and 2014

Livelihood outcome	Assessment	Reason/Comment
Income		
Food Security		
Health Status		

112. What do you like most about farming?

113. What do you not like about farming?

114. In ten years' time (from now), how do you want your farm to look like?

115. What measures do you think can help you to achieve this status?

116.

117. If you had an option would you still be doing farming? 1. Yes [ ] 0. No [ ]

Appendix II: Questionnaire for Key Informant and Focus Group Discussions

Community: ……

1. How satisfied are you with the prices you get for your produce? 1. Very satisfied 2. Satisfied 3.Dissatisfied 4. Very dissatisfied
    a) Cocoa:
    b) Food crops
    c) Oil palm:
2. How did the price of your produce change during last year?
    a) Cocoa:
    b) Food crops
    c) Oil palm:
3. How satisfied are you with the prices you pay for inputs? 1. Very satisfied 2. Satisfied 3.Dissatisfied 4. Very dissatisfied
    a) Cutlass:
    b) Fertilizer:
    c) Pesticide:
4. Which inputs are available in the community and which ones are not?

5. What help do you get from people in the community to facilitate your livelihood?

6. What support do you get from the community in the following situations?

    a) Bereavement:

    b) Wedding:

    c) Outdooring:

7. What taboos in the community have affected you positively or negatively?

    a) Positively:

    b) Negatively:

8. What problems do cocoa farmers face in this community?

9. What other jobs are available to cocoa farmers in this community apart from crop farming?

10. What work would you have engaged in if you were not a farmer?

11. Cocoa farmers are generally rich in this community? 1. Strongly agree 2. Agree 3. Somewhat agree 4. Disagree 5. Strongly disagree

12. What help do you want from government?

13. What help do you want from NGOs?

Appendix III: Calculation

Gini coeffient (Income from all livelihood activities)

Income		%pop		%cum income		gini=
648	1	0.666667	0.052062	0.05206227		0.000174
650	2	1.333333	0.052223	0.104285225		0.000521
692.16	3	2	0.05561	0.159895442		0.000881
848.56	4	2.666667	0.068176	0.228071306		0.001293
1132.82	5	3.333333	0.091014	0.319085473		0.001824
1159	6	4	0.093118	0.41220302		0.002438
1159.3	7	4.666667	0.093142	0.50534467		0.003058
1190.78	8	5.333333	0.095671	0.601015518		0.003688
1392	9	6	0.111837	0.712852986		0.00438
1463.26	10	6.666667	0.117563	0.830415697		0.005144
1599	11	7.333333	0.128468	0.958884168		0.005964
1620	12	8	0.130156	1.089039842		0.006826
1781.6	13	8.666667	0.143139	1.232178947		0.007737
1874.78	14	9.333333	0.150625	1.382804412		0.008717
1887.6	15	10	0.151655	1.534459876		0.009724
1970	16	10.66667	0.158276	1.692735603		0.010757
2140	17	11.33333	0.171934	1.864669642		0.011858
2183.51	18	12	0.17543	2.040099405		0.013016
2183.51	19	12.66667	0.17543	2.215529168		0.014185

2257.82	20	13.33333	0.1814	2.39692922		0.015375
2295	21	14	0.184387	2.581316425		0.016594
2329.68	22	14.66667	0.187174	2.768489925		0.017833
2386	23	15.33333	0.191698	2.960188344		0.019096
2390	24	16	0.19202	3.152208135		0.020375
2400	25	16.66667	0.192823	3.345031356		0.021657
2558.58	26	17.33333	0.205564	3.550595371		0.022985
2577.5	27	18	0.207084	3.757679476		0.024361
2600	28	18.66667	0.208892	3.966571299		0.025748
2617	29	19.33333	0.210258	4.176828953		0.027145
2645.2	30	20	0.212523	4.389352279		0.028554
2801	31	20.66667	0.225041	4.614393047		0.030012
2810	32	21.33333	0.225764	4.840156901		0.031515
2964	33	22	0.238137	5.078293579		0.033062
3070.5	34	22.66667	0.246693	5.324986787		0.034678
3091.33	35	23.33333	0.248367	5.573353541		0.036328
3142.2	36	24	0.252454	5.825807343		0.037997
3143.39	37	24.66667	0.252549	6.078356753		0.039681
3150.75	38	25.33333	0.253141	6.331497488		0.041366
3183.47	39	26	0.25577	6.587267046		0.043063
3239	40	26.66667	0.260231	6.847498051		0.044783
3346.37	41	27.33333	0.268857	7.116355485		0.046546
3370	42	28	0.270756	7.387111424		0.048345

3388	43	28.66667	0.272202	7.659313538		0.050155
3403.98	44	29.33333	0.273486	7.932799533		0.051974
3410	45	30	0.27397	8.206769193		0.053799
3471.3	46	30.66667	0.278895	8.485663879		0.055641
3700	47	31.33333	0.297269	8.782933011		0.057562
3710	48	32	0.298073	9.081005573		0.059546
3732.4	49	32.66667	0.299872	9.380877819		0.06154
3748	50	33.33333	0.301126	9.682003416		0.063543
3749.1	51	34	0.301214	9.98321739		0.065551
3840	52	34.66667	0.308517	10.29173454		0.067583
3905.38	53	35.33333	0.31377	10.60550452		0.069657
3931.54	54	36	0.315872	10.92137628		0.071756
4144.56	55	36.66667	0.332986	11.2543627		0.073919
4172.8	56	37.33333	0.335255	11.589618		0.076147
4180	57	38	0.335834	11.92545178		0.078384
4440	58	38.66667	0.356723	12.28217474		0.080692
4654.26	59	39.33333	0.373937	12.65611199		0.083128
4663	60	40	0.374639	13.03075144		0.085623
4774.66	61	40.66667	0.383611	13.41436199		0.08815
4811.6	62	41.33333	0.386578	13.80094041		0.090718
4827.63	63	42	0.387866	14.18880673		0.093299
4845	64	42.66667	0.389262	14.57806861		0.09589
4955.38	65	43.33333	0.39813	14.97619875		0.098514

5006.4	66	44	0.402229	15.37842798		0.101182
5042.35	67	44.66667	0.405118	15.78354555		0.103873
5105.54	68	45.33333	0.410194	16.19374		0.106591
5130.86	69	46	0.412229	16.60596873		0.109332
5260	70	46.66667	0.422604	17.02857295		0.112115
5279.22	71	47.33333	0.424148	17.45272137		0.114938
5295.6	72	48	0.425464	17.87818581		0.11777
5406.15	73	48.66667	0.434346	18.31253217		0.120636
5416	74	49.33333	0.435138	18.7476699		0.123534
5434.46	75	50	0.436621	19.18429077		0.12644
5447.58	76	50.66667	0.437675	19.62196574		0.129354
5506	77	51.33333	0.442369	20.06433434		0.132288
5561.25	78	52	0.446808	20.5111419		0.135252
5705.27	79	52.66667	0.458379	20.96952046		0.138269
6030	80	53.33333	0.484468	21.4539888		0.141412
6038.18	81	54	0.485126	21.93911435		0.144644
6240	82	54.66667	0.50134	22.44045472		0.147932
6430	83	55.33333	0.516606	22.95706027		0.151325
6435.04	84	56	0.51701	23.47407074		0.15477
6466.34	85	56.66667	0.519525	23.99359596		0.158226
6486	86	57.33333	0.521105	24.51470071		0.161694
6620.48	87	58	0.531909	25.04660999		0.165204
6724.6	88	58.66667	0.540275	25.58688459		0.168778

6767.82	89	59.33333	0.543747	26.13063161		0.172392
6798	90	60	0.546172	26.67680338		0.176025
6822.8	91	60.66667	0.548164	27.22496766		0.179673
6865.23	92	61.33333	0.551573	27.7765409		0.183338
7414.17	93	62	0.595677	28.37221762		0.187163
7653.73	94	62.66667	0.614924	28.98714132		0.191198
7671.12	95	63.33333	0.616321	29.60346218		0.195302
7686.64	96	64	0.617568	30.22102996		0.199415
7813.78	97	64.66667	0.627783	30.84881256		0.203566
7872.06	98	65.33333	0.632465	31.48127754		0.207767
7872.7	99	66	0.632516	32.11379395		0.211984
8114.99	100	66.66667	0.651983	32.76577666		0.216265
8182.46	101	67.33333	0.657403	33.42318012		0.22063
8323.6	102	68	0.668743	34.09192318		0.22505
8354.4	103	68.66667	0.671218	34.76314082		0.229517
8423.6	104	69.33333	0.676777	35.43991818		0.23401
8467.68	105	70	0.680319	36.12023707		0.238534
8499	106	70.66667	0.682835	36.8030723		0.243078
8538.41	107	71.33333	0.686002	37.48907385		0.24764
8748.14	108	72	0.702852	38.19192574		0.25227
9128.89	109	72.66667	0.733442	38.92536823		0.257058
9274.5	110	73.33333	0.745141	39.67050946		0.261986
9617.76	111	74	0.77272	40.44322924		0.267046

9645.66	112	74.66667	0.774961	41.21819059		0.272205
10014.72	113	75.33333	0.804613	42.02280332		0.27747
10150.71	114	76	0.815539	42.8383419		0.28287
10150.71	115	76.66667	0.815539	43.65388049		0.288307
10231.36	116	77.33333	0.822018	44.47589873		0.293766
10391.92	117	78	0.834918	45.31081685		0.299289
10535	118	78.66667	0.846414	46.15723045		0.304893
10629.44	119	79.33333	0.854001	47.01123164		0.310562
10644.03	120	80	0.855173	47.86640503		0.316259
10689.78	121	80.66667	0.858849	48.72525412		0.321972
10938.12	122	81.33333	0.878801	49.60405559		0.327764
10945.03	123	82	0.879357	50.48341223		0.333625
11535.5	124	82.66667	0.926797	51.41020901		0.339645
11969.66	125	83.33333	0.961678	52.37188751		0.34594
12421.95	126	84	0.998017	53.36990435		0.352473
12575.22	127	84.66667	1.010331	54.38023536		0.359167
12900	128	85.33333	1.036425	55.41666017		0.36599
13152.46	129	86	1.056708	56.47336838		0.372967
13647.62	130	86.66667	1.096491	57.56985923		0.380144
14120	131	87.33333	1.134443	58.70430251		0.387581
14933.6	132	88	1.19981	59.90411287		0.395361
15897.65	133	88.66667	1.277265	61.1813779		0.403618
16499.26	134	89.33333	1.3256	62.50697809		0.412295

16617.2	135	90	1.335076	63.84205394		0.421163
16714.11	136	90.66667	1.342862	65.18491582		0.43009
16732.39	137	91.33333	1.344331	66.52924638		0.439047
17045.28	138	92	1.369469	67.89871546		0.448093
17142	139	92.66667	1.37724	69.27595531		0.457249
17183.3	140	93.33333	1.380558	70.65651334		0.466442
18768.75	141	94	1.507938	72.16445118		0.47607
18909.79	142	94.66667	1.519269	73.6837206		0.486161
21054	143	95.33333	1.691542	75.37526231		0.496863
21488.92	144	96	1.726484	77.1017468		0.508257
21936.16	145	96.66667	1.762417	78.86416389		0.519886
30152.34	146	97.33333	2.42253	81.28669361		0.533836
33001.17	147	98	2.651413	83.9381069		0.550749
33141.14	148	98.66667	2.662659	86.6007658		0.568463
33499.17	149	99.33333	2.691424	89.2921899		0.58631
133276.2	150	100	10.70781	100		0.630974
1244663			100			26.32233

Gini coefficient= 0.473553