Kwame Nkrumah University of Science and Technology, Ghana

College of Humanities and Social Sciences

Department of Economics

FARMERS' LIVELIHOOD IN RURAL GHANA: EMPIRICAL INVESTIGATION INTO RISK PERCEPTIONS AND ATTITUDES

By

Emmanuel Buabeng

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Supervisors:

Dr. (Sr) Eugenia Amporfu

Department of Economics, KNUST, Kumasi

Dr. Robert Aidoo

Department of Agricultural Economics, Agribusiness and Extension

Faculty of Agriculture, KNUST, Kuamsi

Prof. Helle Overgaard Larsen

Department of Food and Resource Economics (IFRO), University of Copenhagen

Declaration of Authorship

I, Emmanuel Buabeng, declare that this thesis titled, **"Farmers' livelihood in rural Ghana: empirical investigation into risk perceptions and attitudes"** and the work presented in it are my own. I confirm that:

- This work was done wholly while in candidature for a research degree at this University and no part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution.
- Where I have consulted the published work of others, due acknowledgements and citations have been provided. With the exception of such quotations, this thesis is entirely my own work.

Emmanuel Buabeng (PhD Candidate)	..... Signature	20/05/2016 ..... Date
Certified by Dr. (Sr) Eugenia Amporfu (Supervisor)	..... Signature	20/05/2016 ..... Date
Certified by Dr. Robert Aidoo (Supervisor)	..... Signature	23/05/16 ..... Date
Certified by Prof. Joseph Ohene-Manu (Internal Examiner)	..... Signature	23-05-2016 ..... Date
Certified by Dr. Hadrat M. Yusif (Head of Department, Economics)	..... Signature	25/5/2016 ..... Date

Dedication

This work is dedicated to the memory of my late father ***Opanin Yaw Buabeng*** and my late son ***Jo-Hansel Kwaku Akowuah Buabeng***. May your souls continue to rest in perfect peace.

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Abstract

Agriculture has and continues to be the backbone of the Ghanaian economy contributing about 21.5% to GDP and employs about 50% of the labour force and contributes substantially to the foreign exchange earning of the economy. Agriculture in Ghana is dominated by smallholder farmers who produce substantial amount of the food needs of Ghanaians. Most smallholder farmers live in the rural areas of Ghana producing a wide range of crops, from cocoa to pepper to cassava and plantain. Notwithstanding the importance of smallholder farmers' contribution to the economy of Ghana, rural households in Ghana are the poorest as poverty is basically a rural phenomenon in Ghana. These farmers face a wide range of risks that impede their ability to expand and increase their income and ultimately their welfare. These risks and their attitude towards them have profound impact on their output and welfare as their perception and attitudes determine their responses to unfavourable conditions.

The research sought to examine the livelihood of rural farmers in Ghana, their risk perception, risk attitudes and how risk perceptions and attitudes impact on their economic, and their overall livelihood.

Primary data were gathered from a sample of 1,200 respondents from a field survey of rural farmers from three districts in Ghana selected from three different regions; Offinso North District from Ashanti Region, Techiman Municipality from Brong Ahafo Region and Sefwi Wiawso Municipality from Western Region. Face-to-face questionnaires were administered to the respondents to collect the relevant information from the respondents. Five components of livelihood, Economic, Health, Food, Education and Empowerment were computed. Using the Equally Likelihood Certainty (ELCE), and with three utility functional forms, and the Arrow-Pratt risk aversion formula, risk aversion position of the rural farmers were determined. Using ordinary least squares, multiple regressions were

run to examine the associations between livelihood and socioeconomic characteristics of respondents, risk perception and socioeconomic characteristics and risk attitudes and socioeconomic characteristics as well as the association between risk perception and attitudes and livelihood.

The results from the study show that plantation crop farmers are more secured in terms of livelihood than that of food and vegetable crop farmers. Rural farmers in Ghana located at plantation crop producing areas, have higher economic and overall security status than others located at other areas. The results show that plantation crop farmers consider disease and pests and credit availability as the most important risks that they face whereas food crop farmers perceive yield variability, disease, and pests as the most important risks. However, vegetable crop farmers perceive output prices and yield variability as the most important risks conditions.

The work found that livelihood is generally low in the rural areas of Ghana, with differences in livelihood based on location of the farmers and crop type. Farmers were also found to be risk averse with the level of aversion changing with location, crop type and the kind of utility function employed.

The research recommends that government can institute policies like expansion of cocoa scholarship to other farmers' wards, irrigation schemes, establishment of small to medium sized food processing firms for price stabilization to enhance farming in the rural areas to guarantee the income of farmers and their overall livelihood. It is also recommended that any policies enacted should take into consideration the differences in the risk perception and the attitudes of farmers to these risks in order to make the policies work.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

An important characteristic of the countries in the developing world is the rural nature of their population. According to the World Poverty Report by International Fund for Agricultural Development (IFAD), some 3.1 billion people or 55% of the population in developing countries live in rural areas (IFAD, 2011). Most people in rural areas live in poverty, finding it difficult to enjoy the necessities of life. According to IFAD (2011), at least 70% of the world's very poor people are rural (IFAD, 2011). Thus, understanding rural livelihood is one crucial key of putting an end to global poverty (Angelsen, 2011). This is because poverty is still predominantly a rural phenomenon. When one picks any poor person at a random from a pool of poor peole in this world, there is high probability that that person will be found in a rural area and most likely working as a farmer or an agricultural worker (Dercon, 2009). Although Sub-Saharan Africa has the highest poverty rate overall globally, rural poverty is about a quarter higher than urban poverty, with 65 percent of the population and 70 percent of the poor living in rural areas (Dercon, 2009). At current patterns of growth, poverty reduction, and population growth, poverty is likely to remain a predominantly rural phenomenon for the next few decades (Ravallion et.el 2007). In other words, with rural population rising fast in the developing countries, the current economic growth may not be enough to reduce poverty in the rural areas., it is therefore important that poverty reduction policies should be designed to tackle the very poor. For instance, in Ghana, the Savannah Accelerated Development Authority (SADA) is an independent agency for coordinating a comprehensive development agenda for the northern savannah ecological zone in Ghana. This area has been noted to be the poorest in Ghana and therefore the SADA is meant to target that area as government continues to pursue growth-oriented programmes (Ministry of Food and Agriculture, 2014)

1.1.1 Rural Livelihood Strategies and Security

Rural households in the developing world undertake different livelihood strategies. Some households diversify their livelihood strategies, while others rely on one or few activities. (Babulo, et al. 2008). In other words, rural households earn income from diverse allocations of their natural, physical and human capital assets among various income generating activities. These activities include both farm and non-farm, though farming activities dominate. Several reasons have been advanced in the literature to explain the reason for this diversification of activities in rural areas. For instance, Barret et al. (2001) classify these reasons into both push and pull factors. Some of the push factors advanced by them are risk reduction, response to diminishing factor returns, response to crises or liquidity, high transactions costs that induce households to self-provision in several goods and services, etc. For the pull factors, they argue that realization of strategic complementarities between activities, such as crop-livestock integration or milling and hog production, specialization according to comparative advantage accorded by superior technologies, skills or endowments, etc. play vital role in the willingness for households to diversify. Research by Wagayehu Bekele and Adugna Eneyew (2007) showed that household characteristics such as age, sex and education play vital role in the diversification of household activities. Brown, et. el. (2006) argue that households may wish to diversify as a strategy for coping with an unexpected shock, or to minimize risk *ex ante* by participating in activities that generate entirely different returns that do not correlate.

In order for households to have the best standard of living, the literature has shown that households choose different patterns of livelihood diversification. As argued by Barret et al. (2001), nonfarm activity is typically positively correlated with income and wealth (in the form of land and livestock) in rural Africa, and thus seems to offer a pathway out of poverty if nonfarm opportunities can be seized by the rural poor. According to Ellis (1998), a livelihood strategy encompasses not only activities that generate income but many other kinds of choices, including cultural and social choices, that come together to make up the primary occupation of a household. Rural Livelihood

Diversification refers to the expansion of the range of rural activities outside the farm and is seen as a dynamic adaptation process created through pressures and opportunities (Ellis, 2000). Ellis, (1998) further argues that diversification is important in order to benefit the environment, improve the income generating capabilities of women, for assets improvements, higher income and for risk reduction. However, he argues that some negative effects exist for diversification. These include widening income distribution between the rural poor and those who are better off, potential for stagnation of home farm output and adverse gender effects.

Several different methods of characterizing household livelihood strategies can be found in the literature. Most commonly, economists group households by shares of income earned in different sectors of the rural economy. For example, Barrett et al. (2005) analysed the relationship between overall household income and the proportion of income earned in on-farm and off-farm activities in several African countries, noting how these proportions changed across income quartiles and that different income sources became dominant as one moved up the income distribution. They found out that more than 60 percent of Ivorians and Kenyan households and 44 percent of Rwandan households earn income from off-farm agricultural labour. They also found extensive wealth differentiated diversification behaviours in rural Africa, with the poor more reliant on farm wage labour and the wealthy drawing more heavily on income from plantation crop and livestock production and on non-farm earnings. Thus in most rural Africa, richer households derive more livelihoods from plantation crops and livestock as well as investment income. Dercon and Krishnan (1996) used income share composition to examine the relationship between income, household characteristics and barriers to entry into higher return activities. Others have examined the potential determinants of diversified income portfolios for rural smallholders (Reardon et al. 1992). The common denominator of this literature is that data on realized incomes underpin most

classifications.

The emphasis here is that households' aim is to ensure livelihood security. Livelihood security, as defined by Sanzidur and Akter (2010) refers to the ability of the household to meet its basic needs as well as realize its basic rights. Basic needs here refer to both economic and food and basic rights means access to health, shelter, basic education, and community participation. According to Chambers & Conway (1992), a livelihood "comprises the capabilities, assets (stores, resources, claims, and access) and activities required for a means of living. They maintain that a livelihood is said to be sustainable when an individual or a household can cope with and recover from unexpected breaks in income generating activities and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation" (Chambers & Conway 1992).

Ellis (2000) defines livelihood as comprising the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household. Sanzidur and Akter (2010) defined five livelihood security areas of emphasis are economic security, food security, health security, educational security and empowerment. This work adopts these five livelihood security areas to analyse the livelihood security status of rural farmers in Ghana. This is meant to help identify the factors that contribute to the livelihood security levels of rural farmers in Ghana.

1.1.2 Agriculture and Rural Livelihood

Agriculture plays a crucial role in the lives of rural dwellers in the developing countries of the world. As the main source of employment and wage goods, improved agricultural productivity indisputably plays a central role in resolving rural poverty problems in Africa. As emphasized by the World Development Report 2008, agriculture is the predominant activity for most rural households in Sub-Saharan Africa (SSA), and it offers a strong option for spurring growth, overcome poverty, and enhancing food security (WDR, 2008). Agriculture employs 65 percent of

Africa's labour force and accounts for 32 percent of its gross domestic product (World Bank, 2008).

Given the importance of agriculture to the economies and the people of Africa, it follows growth in agricultural is the primary source of poverty reduction in most agriculture-based economies. In other words, for the rural poor to escape poverty, there should be massive growth in the agricultural sector in the economies of Sub-Saharan African countries. This is because expansion of smallholder farming can lead to a faster rate of poverty alleviation, by raising the incomes of rural cultivators and reducing food expenditure (World Bank, 2008). As observed by Ravallion (2001), a rise in average household income by 2 percent leads to a fall in the poverty rates by about 4 percent on average. Thus reducing poverty hinges on the households ability to raise household income which in rural areas of SSA depends on agriculture.

The 2008 World Development Report also observed that GDP growth originating from agriculture is about four times more effective in reducing poverty than GDP growth of other sectors (World Bank, 2008). These data show clearly that the surest way to reducing poverty and hunger in Africa is to ensure sustainable growth in agriculture in Africa and tackle the problems mitigating the growth of agriculture. Just like in most African countries, agriculture is the main occupation for rural households in Ghana. Statistics indicate that agriculture and livestock (agro-industry) together contribute almost 21.5% of Ghana's GDP, and employ approximately 50% of the population in 2015 (ISSER, 2015). Almost every household one visits in rural areas in Ghana has a farm. Farm households in Ghana cultivate agricultural crops and raise livestock. These farmers earn greater part of their income and food from their farms. In other words, the major sources of incomes and food consumed by rural households come from the production and sale of crops and livestock.

However, agricultural output per area cultivated in Africa is relatively very small compared to the world. According to World Bank (2007), the average farmer in sub-Saharan Africa produces only one ton of cereal per hectare – less than half of what an Indian farmer produces, less than a fourth of a Chinese farmer's production, and less than a fifth of an American farmer's production. (Salami, Kamara and Brixiova, 2010). This is due to the various challenges that agriculture faces in the SSA.

This means that for agriculture to be able to reduce poverty, there should be policies to help grow the sector in order to grow to help raise rural income and reduce poverty.

1.1.3 Risks in Agriculture

Schaffnit-Chatterjee (2010) of Deutsche Bank Research defines risk "as the potential deviation between expected and real outcomes". According to him, while this deviation may be positive or negative, a negative outcome has greater importance from a practical point of view and is usually the focus of decision-makers. Rural households engaged in agricultural activities face considerable risks in their income process. In other words, several risks affect rural agriculture in the rural areas around the world, mostly in SSA. The Deutsche Bank Research team in its September 17th 2010 Edition identified five types of agricultural risk that are generally considered in agriculture according to their sources. The first is Production risk which is the risk associated with production losses. For crops, common causes of yield risk include weather events (drought, excess moisture, hail, freeze and flooding), crop pests and disease. The second identified is Price risk, which refers to variability in output prices and in input price. Technological risks, is the third identified by the research which is associated with the adoption of new technologies. The fourth is financial risks resulting from different methods of financing the farm business, subject to credit availability, interest and exchange rates, etc. The last to be identified is human resource risks, which are associated with unavailability of personnel that may result from death, divorce, disability and disagreement.

These Agricultural risks are especially important if they result in income and consumption fluctuations. Fluctuations in consumption usually imply relatively high levels of transient poverty, which is defined, by Gaiha and Deolalikar (1993) as cited by Rafael and Ana (2007) as poverty that is associated with a fluctuation of income around the poverty line. High income risk may also be a cause of persistent poverty. This is likely when insurance and credit markets are absent or incomplete as it is the case for developing countries. (Nmadu, Eze and Jirgi, 2012). In Ghana, for instance there

is no insurance against cop failures and other agricultural shocks. This means that once there is crop failure, farmers suffer with no relief. It is very common in Ghana to hear farmers calling on Government to assist them whenever natural disaster strikes, such as floods and bush fires. This is because farmers do not insure their crops and therefore any loss have heavy effect on them.

Risks are defined by economists as stochastic events with known and unknown probability distributions respectively (Siegel and Alwang, 1999). Both result in welfare losses. Since rural farming is rain-fed, the risks in agriculture makes farmers to engage in activities that are not optimal (Devereux, 2001). Dependence on a single crop for food or cash introduces unpredictable vulnerability to production failures or crop failures and low prices. Pursuing an undiversified livelihood strategy matters less if the source of income is secured and stable than if it is subject to uncertainty or intertemporal fluctuations (Devereux, 2007).

Different disciplines, including economics, geography and nutrition have analysed the consequences of life in this risky rural environment. Some specific policies such as preventive health care, safety nets, and early famine warning systems are used by policy makers to mitigate the effect of risks on rural dwellers in developing countries.

Risk and uncertainty impact households' production and consumption decisions. Risk has negative consequences on agriculture and because farmers have to be risk averse. (Torkamani and Rahimi, 2001; and Binici et al., 2003). They manage risk by selecting enterprises that provide security even if with lower output and by preferring to use established techniques of production (Nyikal and Kosura, 2005, cited by Korir, 2011). As a result, farmers do not produce at their optimal levels. Pinstrup-Anderson et al. (2001) argue that the risks inherent in agriculture easily trigger food shortages and deterioration in nutritional status, which are common occurrences in for example Kenya (Korir, Lagat and Njehia, 2009)

There is strong evidence that poor farm households are risk-averse (Moscardi and de Janvry, 1977; Dillion and Scandizzo, 1978; Binswanger, 1980, 1981, 1982; Antle, 1983, 1987). These general conclusions and observations have stimulated considerable research into the effects of risk on farmers' economic decisions. Some studies have focused on production decisions and choice of technology. Feinerman and Finkelshtain (1996) found out that the wealthier, experienced and smaller family farmers are less susceptible to risk. They therefore concluded that in the presence of output price risk for example, ceteris paribus, such farmers are expected to choose a larger scale of production. Other studies have analysed risk coping and risk management strategies. For instance, Satit Aditto (2011) found crop diversification, a farm reservoir for water supplies in dry season, investing in non-farm investment/business, etc. as some of the coping strategies used by farmers to cope with risk in agriculture. The presence of risk in agriculture has long been recognized as a significant factor influencing farmers' decisions on production, investment and adoption of new technology. While risk can be viewed as an obvious characteristic of farm family, there are no clear consensus about the degrees of attitude that farmers have towards risk. Intuitively, farmers are likely to be risk averse; hence they prefer sure return to uncertain return given the same level of expected return. Farmers' attitudes toward risk can be affected by broad variety of things that range from cultural background to individual characteristics (Binswanger, 1980, Turan Binici, 2005). The existence of such risks has been found to alter household behaviour in ways that at first glance seem suboptimal.

It is important to note that farmers take their farming decisions in an uncertain environment. As a result, the consequences of their decisions are often unknown with certainty until long after those decisions occur. As a result, outcomes may be better or worse than expected. There are evidence in the literature that point to the fact that the existence of risks make farmers to be less willing to undertake activities and investments that have higher expected outcomes, but carry with them risks of failure (Adebusuyi, 2004, Alderman, 2008). For example, it has been found that farm households use less fertilizer, improved seeds and other production inputs than they would have used if they

simply maximized expected profits. It is very common to observe farm households in developing countries being reluctant to adopt new technologies even when those technologies provide higher returns to land and labour than traditional technologies. For instance, in Ghana when the government of Ghana started the free spraying of coca farms to help fight cocoa diseases, there were farmers who resisted the spraying gangs from entering their farms as they were not sure of the outcomes. One aspect of this reluctance is reaction to risk. Hence, knowledge on how farmers make decisions as well as their attitudes towards risks is important in determining the strategies for Agricultural development (Kouamé, 2005).

As indicated earlier farming in Ghana is characterized by smallholder farmers, living in the rural areas of Ghana. These farmers face enormous risks which impact on their income and entire livelihood. For instance, farmers that are risk averse are less willing to venture into farming techniques they are not familiar with. It is hoped that information of the nature of risks that affect rural farmers can form the basis for the developing appropriate solutions to deal with these risks (Aditto, 2012). In other words, for Ghana to develop any meaningful policies to help farmers to invest and adopt modern farming technologies, it is important to examine the risk aversion and perception levels of rural farmers in Ghana. However, empirical studies on farmers' responses to risks and how risk affects farmers' income, especially in rural Ghana are limited. For instance, Dadzie and Acquah (2012) examined the attitudes toward Risk and Coping Responses: The Case of Food Crop Farmers at Agona Duakwa in Agona East District of Ghana. However, they did not examine the impact of risk on the livelihood of rural farmers. Ascertaining the farmers' perception of the risk they face and their attitude of farmers toward risk is an important first step in understanding their behaviour and coping strategies. Also determining the impact of risk perception and attitude on livelihood would help policy makers to develop policies that are directly helpful to farmers. Thus, the focus of this work was to examine farmers risk attitudes and perception, their determinants and impact on livelihood among rural farmers in three areas noted for three distinct production. These are, Techiman District (noted for Yam

production), Offinso North (Noted for Vegetable production) and Sefwi Wiaoso District (noted for Cocoa Production). Agriculture is the main stay of the economies of these districts. The three were selected based on their distinct farming activities that epitomize the entire farming activities in Ghana.

1.2 Problem Statement

Agriculture is the main occupation of rural people in most developing countries, producing a large chunk of the output of these countries. In Ghana, agriculture and its related activities remain the largest employer, employing approximately 50% of the labour force and contributing almost 21.5% of Ghana's GDP (ISSER, 2014). Agricultural activities in Ghana are mostly at small-scale level. Statistics show small-scale farmers cultivate average farm sizes of about 1.2 hectares with little use of improved technology and that yields of most crops were very low. However, small scale farmers produce approximately 85% of cereals, 40% of rice and 100% of the starchy staple needs of Ghana (Ayitteh and Banini, 2007). This shows that small-scale farmers make significant contribution to the economy of Ghana, as they create employment and ensure food security for the family.

Despite the contribution of small-scale farming to the income and livelihood of the family, these farmers are exposed to poverty, hunger, preventable diseases and death. Small scale farmers constitute about half of world's hungry people and include three quarters of Africa's malnourished children (Mugera and Karfakis, 2010). It is reported that poverty in Ghana is basically rural; about 75% of all poor people in Ghana live in rural areas (Osei-Fosu, 2011). Since rural farming is primarily rain fed and these farmers do not have well-defined markets for their produce, this make them very susceptible to any change that they are not used to. Thus, understanding individual attitudes toward risk is intimately linked to the goal of analysing the agricultural practices and economic behaviours of farmers. To devise appropriate solutions to risk that are workable, it is important to know the risks that are most critical to rural farmers and their attitudes to risks as well as the factors that determine

them. This is because there are several risks that farmers face and since there are several risk management strategies that can be designed to mitigate them, it is important to understand how farmers perceive these risks in order to design those that are important and workable. However, there is limited work on issues of risk and livelihood in Ghana. Though some works have been done about vulnerability to climatic changes and livelihood in Ghana, these works are limited in scope and coverage. For instance, Penaranda, Perrino and Barreras (2012) analysed the perception of farmers about climate change in Abura-Aseibu-Kwamankese district, Central Region; Etwire, et al. (2013) looked at vulnerability of farmers in the Northern region of Ghana to climate change; Ghartey, Dadzie and Weittey (2014) examined the relationship between poverty and risk attitudes among cassava farmers in Awutu-Senya District of the Central region and Dadzie and Acquah looked (2014) at Attitudes Toward Risk and Coping Responses: The Case of Food Crop Farmers at Agona Duakwa in Agona East District of Ghana. However, all these are limited to just one districts or one crop type. It is important to understand how risks differ across district and crop type. This will help prevent situations when policies are universally designed leading to rejection by other farmers. Thus, this study fills that gap which is critical if the several attempts by successive government to alleviate rural poverty in Ghana are to succeed.

1.3 Research objectives

The main objective of this thesis was to analyse the livelihood security status of rural farmers in Ghana and the impact of risk perception and attitude on livelihood. The specific objectives were to:

1. Examine the Livelihood security status and Determinants among rural farmers in Ghana.
2. Find out the Risk perception, determinants and impact on rural livelihood status in Ghana
3. Evaluate the Risk Attitude, Determinants and Effect on rural livelihood in Ghana.

1.4 Hypotheses

Three different districts were chosen for the study. These three districts are noted for three different crop types. Based on this, the following hypotheses were tested:

1.

H_o: There are no differences between the livelihoods of rural farmers based on location

H_1: There are differences in the livelihood of rural farmers based on location

2.

H_o: There are no differences between the livelihoods of rural farmers based on crop type

H_1: There are differences in the livelihood of rural farmers based on crop type

3.

H_o: There are no differences in the risk perception and attitude of rural farmers based on location

H_1: There are differences in the risk perception and attitude of rural farmers based on location

4.

H_o: There are no differences in the risk perception and attitude of rural farmers based on crop type cultivated

H_1: There are differences in the risk perception and attitude of rural farmers based on the type of crop cultivated

5.

Ho: Risk attitude and perception of rural households have no effect on economic security and overall livelihood security

H_1: Risk attitude and perception of rural households affect economic security and overall livelihood security

1.5 Justification or rationale for the study

The study aims to examine the livelihood security and the risk perception and attitude of rural people in three districts in Ghana. It also looks at the determinants of livelihood security and the impact of risk aversion and risk attitude on livelihood. The finding from this research is expected to provide insight into the kind of risks that are most critical to farmers in Ghana. information to reinforce the empirical basis for risk analysis for Ghanaian farmers. Since farmers grow different kinds of crops in Ghana, this research sought to analyse the important sources of risks that these farmers face. To make the analysis easier, these farmers were grouped into three different groups; plantation farmers, vegetable crop farmers, food crop farmers, and the thesis sought to explore the most important sources of risks important to each group. Thus the research provide a more accurate information to policy makers and stakeholders in farming so that they can devise more focused policies that are workable for the different farming groups.

It would also help policy makers understand the issues that are most important to framers. Though it is known that people in the rural area are generally poor, the research would provide empirical evidence of the livelihood security and how their primary sources of livelihoods are enough to provide enough economic and social security for them.

It is generally known that a person's attitude to risk determines the kind of decisions that they take in the face of these risks. The thesis further sought to examine the risk attitudes of rural farmers in the three districts used for the study. This means that the research would assist policy makers understand the attitudes of the rural farmers to risk so that policies that are meant to influence their activities would take into considerations their behaviour in the face of risk. In addition, if government wants to embark on any policy aimed at tackling rural poverty, the main causes and what the people themselves are trying to do must be known in order for the policy to have the desired impact.

1.6 Methodology

1.6.1 Study area

The study was carried out in three districts, Offinso North of Ashanti, Techiman municipality of the Brong Ahafo Region and Sefwi Wiawso in the Western Region of Ghana. These districts are mostly rural. For instance, information available from the Sefwi Wiawso District indicates that 81% of the labour force is engaged in Agriculture. These districts are important agricultural production centres in Ghana and mostly rural. Also, the crops of interest /farm in these districts are slightly different; for example, whereas farmers in Wiawso District are mainly Cocoa, Offinso North farmers mainly Tomato farmers and those in Techiman are mostly Yam farmers. This diversity in crop forms provides an opportunity to compare different risks faced by different categories of farmers and their various risk attitudes.

1.6.2 Data Types and Sources

The research relied on both primary and secondary data. Secondary information was sought from the Ghana Living Standard Survey Reports, the strategic plan documents of the various District Assemblies, Ghana Statistical Service Data Bases (for the population and demographic characteristics of the district assemblies), and the District Directorate of the Ministry Of Food And Agriculture. Primary data was collected through a cross-sectional survey of the study areas through structured questionnaires and focus group discussions. The main data used for the study were of three main categories largely based on the objectives. The three main data are household demographic and economic characteristics, the various economic activities and their importance, risk perception and attitude, and risk management perception

1.6.3 Population, Sample Size and Sampling Techniques

The population for the study is all rural households in the three selected districts. A sample of one thousand, two hundred (1,200) households were randomly selected for the study, with four hundred (400) households sampled from each district. To ensure that the core objective of the thesis is achieved, only rural areas of the selected districts were included in the study. According to the 2010 population and housing census, a rural community is a community with a population of less than 5000. Therefore, only such communities in the three selected district were included in the study. In each district, ten rural communities were randomly selected using simple random sampling method. Names of the communities were obtained and coded and thirty were drawn, ten from each district. In the final stage, forty households were selected from each of the communities. To make the selection of communities random and unbiased, every fourth household was selected from the street of all the communities.

1.6.4 Data collection method

The main instrument for the data collection was structured questionnaires. Given the low literacy rates in the selected districts, the questionnaires were administered through personal face to face method in order to ensure that the right responses are obtained. The research also adopted focus group discussions as well as key informant interview to obtain the relevant information and also to verify some of the findings. Well trained research assistants were used to administer the questionnaires. Since most of the rural farmers did not understand the English language in which the questions were drawn, the questions were interpreted to them in the Twi language.

1.7 Organization of the Study

The thesis is organized into seven chapters. The first chapter introduced the study with the background and research problem, questions and objectives. Chapter two is devoted to a comprehensive review of both theoretical and empirical literature. Chapter Three discusses the methodology adopted for the study. The sampling methods and the models used to analyse the data obtained from the questionnaires are discussed in this chapter. The Models that were used for the study were also comprehensively outlined and discussed. Chapters Four, Five and Six are devoted to the data analysis. In chapter four, the livelihood security components and the overall livelihood security are computed and the determinants are analysed. Chapter five looks at the risk perception of rural farmers and the determinants. and the impact on livelihood. Chapter Six looks at the risk attitude of rural farmers and the determinants as well as the impact on livelihood. The final chapter, Chapter Seven concluded the study with findings, recommendations and suggestions for further research in the area of risks and rural livelihood.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction:

This chapter presents the literature review. It looks at the concept of livelihood and measurement as well as the determinants. It also looks at the concept of risk and its measurement.

2.2 The concept of Livelihood and Livelihood Security

2.2.1 Livelihood definition and concept

According to Ellis (2000), the concept of livelihood is widely used in contemporary writings on poverty and rural development, but its meaning can often appear elusive either due to vagueness or to different definitions being encountered in different sources (Bekele and Eneyew, 2000).

Chambers (1989) defined livelihood as ‘‘adequate stocks and flows of cash to meet basic needs’’. However, as argued by Niehof (2004), the problem with this definition is that it does not say how these adequate stocks and flows of cash come about. In other words the definition does not talk about the activities and the assets needed to provide these needs. This definition was improved by Chambers and Conway (1992) who describe livelihood as the capabilities, assets and activities required for a means of living.

Ellis (2000) defines livelihood as one which comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutionsand social relations) that together determine the living gained by the individual or household.

Niehof and Price (2001) define livelihood in terms of a system, which can be conceptualized as having the following components:

- **Inputs:** resources and assets.

- **Output**: livelihood.
- **Purpose:** livelihood adequacy for meeting basic needs
- **Activities**: livelihood generation and the composition of the livelihood portfolio.
- **Agency**: efforts of households and individuals to achieve livelihood adequacy.
- **Quality**: degree of vulnerability (or sustainability) of the livelihood produced.
- **Environment**: context within which the livelihood system functions interfaces with other systems and institutions.
- **Locus**: the household as the locus of livelihood generation

This approach to the definition looks at livelihood in more holistic approach in the analysis of livelihood. From the above definitions, it can be concluded that Livelihoods are created by livelihood resources which include: natural capital, financial capital, human capital and social capital. An individual creates livelihood strategies by recognizing their livelihood resources. This organization of resources depends basically on the kind of work the household does. For instance, livelihood strategies can take the form of agricultural intensification, diversification and migration. (Niehof, 2004). Thus livelihood diversification is an important concept in the analysis of households' livelihood. Livelihood diversification is the process by which families establish a diverse portfolio of activities and social support capabilities both as a survival mechanism and also to improve their standards of living (Ellis, 1998). It includes income, social institutions (e.g. kin family, village), gender relations and property rights necessary to maintain a given standard of living (Ellis, 1998). It is recognized that an increasing number of smallholder farmers now derive part of their income from non-farm sources (Korir, et.el, 2009).

2.2.2 Definition and Measurement of Livelihood Security

Household livelihood security is defined, in general terms, as adequate and sustainable access to income and other resources to enable households to meet basic needs (including adequate access to

food, potable water, heath facilities, educational opportunities, housing, time for community participation and social integration, etc.) (Frankenberger, 1996). Thus for Livelihood security strategies means that households combine their livelihood resources within the limits of their context and use their institutional connections to pursue a number of different livelihood strategies. Such strategies can include various types of production and income-generating activities (e.g. agricultural production, off-farm employment, formal sector employment) or a combination of the two. A Household's Livelihood Security analysis should determine the livelihood strategy portfolios that different households pursue and the historical pathways they have taken.

Chambers and Conway (1992 defined livelihoods as "the capabilities, assets (stores, resources, claims and access) and activities required for a means of living; a livelihood is sustainable when people can cope with and recover from stress and shocks, maintain or enhance their capabilities and assets, and provide sustainable livelihood opportunities for the next generation.

Frankenberger (1996) identifies four components that can be used to evaluate the livelihood security of the household. The first is Health Security. He proposes four sets of indicators might be compiled under this index. These could include health service access (measured in distance or time); health service use patterns (immunization)); environmental health (access to potable water, access to latrines, maintenance of facilities); and birth spacing (% under 24 months).The second is Food Security with which he proposes three sets of indicators could be compiled under this index. These include food security index (frequency and severity of coping strategies); dietary intake to get at changes in quantity and quality of food consumed (24 recall); and percentage change in selfprovisioning point (a change in the proportion of household consumption that is met by household production).The third component is Educational Security for which he proposes the following indicators that might be used in this index; literacy rate (disaggregated by gender); percentage of children under 16 years of age completing the 4th level (disaggregated by gender); and percentage of wastage (drop and repetition) (disaggregated by gender).The last is Economic Security. The types of indicators that could be

considered for this index might include access to assets; diversity and importance of income sources; productivity per unit of land; per capita household food expenditure; change in the number of retail businesses in the target area; percentage of eligible children in school; and percentage of loans given directly to women (Frankenberger, 1996).

2.2.3 Measuring Livelihood Security

Historically, efforts have been made to measure well-being at the household level. Belcher and Sewell (1951) have designed scales to measure well-being at the household level as far back as the 1950s. The household livelihood security framework has been adopted and deployed by a number of international nongovernmental organizations such as the International Food Policy Research Institute and CARE. These organizations especially CARE has contributed significantly to improving the framework as the tool for appraising household and community need by any stakeholder organization.

The CARE piloting of the household livelihood security frame in many countries have culminated into the development of the household livelihood security index which CARE applied in their work in Kenya, India and Sri Lanka. The household livelihood security index is a more focused and detailed index that helps to clarify the constraints to household and community livelihood security and also aid in identifying the coping strategies adopted by households and communities tackle poverty.

The index has eight components, which include income and assets, food and nutrition, education, participation, water, sanitation, primary health and reproductive health. The process of constructing the index consists of rating the availability, accessibility, quality and status of these components on a five-point scale. The rankings of each of the eight components can be reported separately to reflect the community or household performance in these areas. They can also be aggregated into an index, where each component is given equal weights.

Most often, the components of the index are group into five areas – economic security, food security, health security, educational security and empowerment. Each of these five areas can be treated as separate indices and are constructed based on the availability, accessibility and the quality of these livelihood components in the communities. The economic security measure is measured using annual income and asset data obtained from households. The health security measure depends on the availability, accessibility and quality of water, sanitation and basic health care.

The computation of the index is the easy part of the construction of the household livelihood security index. The vital and tedious part is the data collection process. The data collection involves a number of steps. One of the initial actions is the solicitation of the interest of stakeholders such as governments, NGO and community leaders. After all stakeholders express their interest, CARE expects in collaboration with local expect adjust the defining of each components to suit the local situations. This is regarded as one of the major advantages of the household livelihood security index as it allows the adjustment of its range to reflect the definition of its components in the country it is being applied. For example, the definition of what constitute food security or water security in a developed country differs very much from developing countries. A number of the experts also engage in the design of sampling strategy that suit the nature of the communities under study.

The data collection processes also consist of the conduct of focus group meetings with the purpose of understanding critical issue as they pertain to the communities. At the focus group meetings questions regarding the type of crops produced, the growing season, agricultural practices, diseases, cropping calendar, the types of food consume, the number of organizations presents in the communities, are asked. Questions in the general focus group are meant to help the researchers understand seasons of food abundant as well as seasons of food shortage and when interventions will be needed.

The general focus groups are followed by specialized focus group meetings that focus on special interest groups such as women. Extensive amount of information are obtained from the general and

focus group meetings, some of this information are used to design and recalibrate the ranges of the rankings while others are used in the actual construction of the index.

Another group of experts as part of the data collection process engage health related data collection survey from mothers in the community. They also measure and weigh all children under the age of five. Data obtained from this stage are used in the computation measures to reflect the nutritional status of children under five. These measures are then compared to country growth charts to determine the proportion of children suffering from malnutrition.

While the focus group meetings and the anthropometric surveys are ongoing, another team of experts engage in detailed household interviews with from 20 percent to 50 percent of the community households. The sample size will depend on the total number of households in the community. The household survey includes questions on literacy, family size, work dynamics, water and sanitation, cultural practices, assets, income sources, participation in community organization and others. The interviewers based on predetermined criteria rank the housing quality, the water source and literacy level of household members. The purpose of the household survey is to obtain relevant information on families and their coping mechanism.

Finally, the data collated from all these stages are put together, tabulated and used in the construction of the measures of income securities, health securities, food security, educational security and empowerment. The measures from these five indces are then aggregated to get the composite index of household livelihood security. Equal weight are given to all components. In other words, the household livelihood security index is just an average of the rankings from these five components.

In summary, the most important part of the computation of the household livelihood security index is the data collection procedure. It can be grouped into four different steps. The first step involves the adjustment of index and sampling strategy development based on the local definition of components of the index. The second stage involves the organization of generalized and specialized focus group,

where information on community and household dynamics are obtained. The third stage is the anthropometric survey where health related data about family and children under five are collected and used to determine the malnutrition level of children in the community. The fourth stage is the household survey where information on family size, literacy, water quality and access and other information are obtained. Data from all four stages are tabulated and used to construct the household livelihood security index and the results then discuss with all stakeholders including the communities (CARE, 2010)

2.3 Estimating rural livelihood security

The question about household security has been an important issue that researchers and international donor agencies have been working on over several decades. Several donor projects like DFID, UNDP, CARE International have all worked tirelessly to ensure livelihood security for the rural poor around the world. Theory proposes that if rural dwellers are secured, rural urban migration would be minimized (Somik, et al., 2006). Variables to consider in measuring livelihood security differ among researchers. In measuring livelihood security, Sanzidur and Akter (2010) used five domains of security namely economic, food, health, education and empowerment because they are "more appropriate and directly relate to the welfare of the poor and vulnerable people".

Economic variables are variables that affect people's incomes. They include income per person; the current value of land, house or livestock per person; the current value of machineries and equipment per person; the active population ratio (15-59 years), proportion of the active population employed; household income earned by women and savings per person (Akter, 2012).

Akter (2012) added that food security, as a variable can be measured using variables such as dietary diversity which measures the quantity of food groups consumed each day; food frequency measuring

the quantity of meals and snacks consumed per day; household food-grain stock; quantity of food-convenient months in a given year; and number of main meals taken by women in household.

Sanzidur and Akter (2010) and Akter (2012) all posited that the level of heath security depends on the number of days dwellers suffer from common sicknesses such as diarrhoea and malaria in a month; number of days people are incapable to work due to illness; the regularity of antenatal consultation; doses of tetanus immunization; body mass index (BMI) of women and children (under five year olds).

Education as a measure of security can be measured using population older than 7years who can read and write; adult male literacy rate (male population older than 15years who can read and write); adult female literacy rate (female population older than 15years who can read and write); 615 year olds who are enrolled in schools; and 16-23 years per son in household enrolled (Sanzidur & Akter, 2010; Akter, 2012).

Empowerment has to do with community participation or active participation with organization; the ease with which people get access to services or organizations that offer services; and the roles households play in planning process (Sanzidur & Akter, 2010; Akter, 2012).

2.4 The Concept of Risk and Risk Perception

Risk has been defined in many ways by different scholars. Burt (2011) has defined it as “the probability of something not occurring”. Relating his definition to this study risk is probability that a person living in a rural area would not succeed given certain conditions. Burt added that an event that is statistically related to the outcome of a risk is risk factor. A simpler definition was given by Knight (1921), as quoted in Burt (2011) that risk is a ‘quantifiable uncertainty’.

The level of risk has strong predictive power on a number of key household decisions including choice of occupation, portfolio selection, moving decisions and exposure to chronic diseases (Guiso and

Paiella, 2005). Risk perception attitudes are the various ways people behave and make choices considering some factors (Marilou & Isabelita, 2011; Thea et al., 2012; Mahmoud, 2009). Theory has identified three types of risk attitudes: risk averse, risk neutral and risk takers. The level of risk people (rural dwellers) are willing to take depends on some variable; such determinants are discussed below.

2.4.1 Risk aversion

A concept that is considered central and important in the utility theory is risk aversion (Quiggin, 1993, 2002). Risk aversion measures a decision maker's unwillingness to accept a bargain with an unknown payoff instead of a different bargain that may even have a more certain payoff. Every decision maker prefers higher payoff than lower payoff because the utility function of decision makers is positively sloped. As a result, the shape of the utility function reflects ones preferences (Hardaker, Huirne et al., 2004). If the utility function is expressed as a function income/wealth, then mathematically, this means that the first order derivative of the utility function is positive, given

$U\,w^{'}(\,) > 0$, where $U\,w^{'}(\,)$is the first derivation of the utility function with respect to wealth/income (Hardaker et al., 2004). However, to measure risk aversion, the second order derivative of the utility function with respect to wealth is used. In order words, risk aversion measures what happens to marginal utility when wealth changes, that is ($U\,w^{''}(\,)$) hence the change in the marginal utility as the level of wealth increases. Applying the second order derivative Hadaker et al (2004) and Schumann (2005), classify the aversion status of agents into three, risk loving, risk averse, and risk neutral. If the second order derivative of the is greater than zero, ($(\,)>0$), then the decision maker is said to be risk averse. If the second order derivative is equal to zero ($(\,)=0$),, then the decision maker is said to be risk neutral, and lastly, the decision maker is said to be risk loving if the second order derivative is less than zero ($(\,)<0$).

However, it is argued the second order derivative (*U'')* has little importance and that there is difficulty using it to compare risk aversion as a results of the positive linear transformation of the utility function measured on an ordinal scale (Binici, Koc, Zulauf and Bayaner, 2003; Quiggin, 1993). Therefore, a way has to be determined to obtain the risk attitude a decision maker that is not affected by the linear transformation of the utility function. Pratt (1964) and Arrow (1965) developed a way of obtaining the risk aversion coefficient of a decision maker remains unchanged irrespective of any positive linear transformation of the utility function (Hardaker, Huirne, et al., 2004). The Arrow-Pratt utility risk aversion coefficient is given as the negative of the ratio of the second order derivative of the utility function to the first order derivative. It assumes risk aversion.

Thus, the risk aversion measure by Arrow-Pratt is given by the expression:

$$r\,w_a(\ ) = \frac{-U''(\ )w}{U'(\ )w}$$

Where: $r\,w_a(\ )$ is the coefficient of absolute risk aversion; ( ) is the first order derivative of the utility function ( ) is the second and first order derivatives of the utility function. Hardaker, Huirne et al. (2004) stated that the coefficient of absolute risk aversion function can be classified in relation to how it changes with respect to increasing wealth (w).

Schumann (2005) also argued that the absolute amount of change can be calculated by using the derivative with respect to wealth of the absolute risk aversion coefficient$(\ (\ ))r\,w_a'$. The measurement of $r\ w_a(\ )$ relies on the monetary units of*w,* which means that different currency units are not comparable for risk aversion. Pratt and Arrow therefore introduced the coefficient of relative risk aversion $(\ (\ ))r\ w_r$ to overcome this restriction (Hardaker, Huirne et al., 2004; Quiggin, 1993). The coefficient of risk aversion can therefore be calculated as follows:

$$r\,w_r(\ ) = -wr\,w_a(\ )$$

Similarly, the relative risk aversion function can be categorized as decreasing relative risk aversion (DRRA), constant relative risk aversion (CRRA) or increasing relative risk aversion (IRRA). DRRA arises if $r\, w_r'(\,) 0 <$ and as a decision maker's wealth increases, the proportional amount of money that he/she is willing to pay with risky prospects increases. CRRA and IRRA arises if $r\, w_r'(\,) 0 =$ and $r\, w_r'(\,) 0 >$ respectively (Hardaker, Huirne, et al., 2004; Schumann, 2005).

2.4.2 Expected utility theory

The expected utility theory plays principal role in measuring a person's preferences under complex decision situations. Gabriel Creamer and Daniel Bernoulli first initiated the mathematical form of this theory in the eighteenth century (Anderson, Dillon and Hardaker, 1977; Schoemaker, 1980) which was later recognized as the St. Petersburg paradox, where the first coin game was demonstrated. The expected prize of the game is infinitely as follows:

$$\sum_{n=1}^{\infty} \frac{1}{2^n} 2^{n-1} = \infty$$

Where, $\frac{1}{2^n}$ is the probability of the occurrence and n can be any number from 1 to infinity.

According to Levy (2006), the amount a player is willing to pay to play the game is the certainty equivalent (CE) of the game. This game is similar to risk investment. The expected prize of the game takes an infinite number. However, using mathematical expression to explain how people feel about lotteries makes this paradox difficult in the real world. Generally, people are willing to pay comparatively small amount of money to maximize their expected payoff (Levy, 2006; McKenna, 1986).

Bernoulli also explained this theory by assuming that people in making their decisions prefer those alternatives that maximize their expected utilities (utility depends on wealth) rather than expected monetary values (Bassett, 1987; Levy, 2006; Schumann, 2005). Again, each person has different perception of the value of lottery since a rich man's utility of an extra dollar differs from that of a poor man. As a result, a person's utility in relation to wealth increases at a decreasing rate.

However, during the second half of the nineteenth century, his concept of expected utility was repeatedly reviewed as riskless theory in consumer economics in many studies (Fishburn, 1988)

Using a logarithmic function as a plausible expected utility function to describe his proposal (Bassett, 1978; Schoemaker, 1980), Bernoulli's utility function is expressed as follows:

$$U\,x\,b(\,) = \log\frac{\alpha + x}{\alpha}$$

Where: b is a constant, α is the initial wealth and x is the increase in wealth (Schoemaker, 1980).

In 1947, Newman and Morgenstern developed the economic theory of games, represented by rational decision – making under stochastic outcomes through axioms of preference (Schoemaker, 1980). According to this theory, people sought to constantly prefer an alternative with the highest expected utility (Schoemaker, 1980; Schumann, 2005). Again, this theory can explain the relationship between an individual's preferences and the probability of real outcomes throughout the functional forms. However, there was a measurability controversy among economists in the
1950s in relation to ordinal and cardinal utility (Mongin, 1997; Pennings and Garcia, 2004). Most Neoclassic economists agree that for a given individual's preferences, the ordinal properties of
$U\,a(\,)$ can be provided by using a non – stochastic theory of preferences among outcomes (Mongin, 1977). Maurice Allais in 1987, noted that the appropriate technique to analyse choices under risky prospects required both a function of wealth under certainty by using a cardinal specification and a

separate attitude toward uncertainty (Quiggin, 2002). The expected utility theorem says that a person's utility function (U)exhibits his/her preferences for consequences, which are congruent with axiomatic properties. This function therefore correlates a single utility value $(U(a_j))$ with any risky prospect (a_j) and has the following properties (Anderson et al., 1977; Hardaker, Huirne et al,. 2004):

1. If $(a_1)$is preferred to(a_2), then $U(a_1) > U(a_2)$and vice versa. That is the "*utility value can be used to rank risky prospects and to identify the one with the highest utility as the most preferred*" (Hardaker, Huirne, et al., 2004, p. 35).
2. The preference relation in terms of the expectation of some utility function based on the decision maker's subjective distribution of outcomes. In other words, "the utility of a risky prospect is its expected utility value" (Hardaker, Huirne et al., 2004, p. 35). This can be also be formulated as follows:

$$U(a_j) = E[U(a_j)] \tag{3.3}$$

In the case of discrete outcomes, equation (3.3) becomes:

$$U(a_j) = \sum_i U(a_j, \theta_i)(P_i) \tag{3.4}$$

Where: θ_i is an uncertain event and $P(\theta_i)$ is the probability of the incidence of an uncertain event θ_i.

In the case of continuous distributions of outcomes, equation (3.3) then becomes:

$$U(a_j) = \int U(a_j, \theta)f(\theta)\,d\theta \tag{3.5}$$

Hardaker, Huirne et al. (2004, p. 36) states that "the implication in both equations (3.4) and (3.5) is that, higher order moments of utility such as variance do not enter into decisions among risky prospects". This *U* function is "unique up to a positive linear transformation" (Hardaker, Huirne et al., 2004, p. 36)

2.4.3 Types of risk facing Rural Households

In a study of the attitudes towards risk among maize farmers in the dry savannah zone of Nigeria, Olarinde et al (2007) listed four types of risks affecting rural households (especially farmers); natural, social, economic and technical.

Natural risks are risks from nature which humans have no control of. They include drought, flood, wind and storm, disease and pests. By implication crop yield could be low due to the adverse effects of these natural occurrences. Harwood et al (1999) added to this category what they called 'production or yield risk's which measure not only risk from natural sources but risks involved in using technology as well. Introduction of new crop varieties and production techniques have the potential to improve efficiency but may at times yield poor results, predominantly in the short run.

Social risks are the reverse of natural risks because such risks are the by-products of societal actions. Examples of social risks are theft of produce, bush fire, invasion of farms by cows. Social risk is a major problem facing the farmers because it reduces their yields drastically.

Economic risks are risks associated with raw material (inputs) and price of the produce. Harwood et al (1999) called such risks as 'price or market risk'. They can be categorized into producer price fluctuation and insufficient supply of raw materials. Some production processes such as livestock and oil-palm farming can take months and years before harvest. Many of the farmers do not either get good prices for their maize output or that their particular varieties of maize are not adequately

patronized during the season to command moderate market prices. The other risk type in this category is that farmers had insufficient supply of maize seeds which resulted mostly in reduced output.

Technical risks are necessarily risk types that hinder the production process; examples are insufficient and untimely supply of inorganic fertilizers (Olarinde et al., 2007).

Harwood et al (1999) added two other risks not captured by Olarinde et. al. (2007); institutional risk which comes to play from changes in policies and regulations that affect agriculture, and financial risk which results from the way a firm's capital is obtained and financed.

2.5 Determinants of risk preferences

The levels of risks people are willing to take; especially rural folks depend on some economic and non-economic factors. Thea *et al* (2012) in their study of the consistency of risk preference measures of smallholder farmers in Vietnam showed that gender, age, idiosyncratic shocks, education, social norms, network-reliance with extended family, and connections to local authorities, the household's dependency ratio, wealth, and covariate shocks are significant determinants of risk preferences. These factors have been categorized into the decision domain, gender, prior experiences, and asset base.

The decision domain has been found to be an essential determinant in measuring risk preferences (Soane and Chmiel, 2005). Factors that are captured in the "decision domain" are inheritance, income-generating activities, household food security, financial investments, and an overall willingness to take risks (Thea et al, 2012). All else equal, a high fortune of inheritance, a good income-generating activity, a good reserve of household food in rural areas would encourage people to live in rural areas.

Prior experiences are proxied by impacts from distinctive and covariate shocks. Doss et al (2008) and Fafchamps and Lund (2003) in their various studies suggests a greater shocks augment risk aversion.

The "asset base" factor captures natural, physical, financial, human and social capital (Scoones,

1998). Social capital as defined by Putnam (1995) is "organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit". The concepts of social capital can be grouped into low (loose networks) and high (sharing many common friends); observable social structures; cognitive social capital (Grootaert, 2002); and linking social capital (Szreter & Woolcock, 2004). Social networks are important because relying upon relations and associates promotes information flows, honest behaviour, teamwork, and sanctions (Attanasioet al., 2012; Karlanet al., 2009). The prevalence of social networks makes it possible for credit transactions to rely upon social collateral rather than physical collateral (Karlanet al., 2009). Connections to local authorities, families and friends "may decrease risk aversion if individuals receive support from officials for risky investments or it may increase risk aversion if individuals are influenced by authorities' emphasis on equality or feel that they may have to share gains from a risky investment with authorities" (Thea et al., 2012).

To help measure the effects of the asset base variable on risk preferences a wealth index is used to classified households into wealth terciles (wealthy, middle income or poor). Literature (Thea et al., 2012) suggests that those in the poorest tercile are more risk averse for the reason that they have a lower capacity to cope with shocks. Years of formal education, age and the household's dependency ratio are all captured in human capital. Theory suggests that high dependency ratios are expected to cause an upsurge in risk aversion and the higher the respondent's formal education, the better they are able to assess risks which make them less risk averse; they are more knowledgeable about risky opportunities.

The weight that age has on risk aversion is uncertain given varying conclusion in previous studies. Tanaka et al. (2010) found a direct relationship with risk aversion whereas Picazo-Tadeo and Wall (2011) found a quadratic one.

Other factors which have the power to influence risk preferences include stature, cognitive ability, personality traits, level of education of parents (Harrison et al., 2005; Dohmenet al., 2011; Mishra &

Lalumi`ere, 2011) intergenerational transmission of risk preferences either as a result of hereditary (Cesariniet al., 2009) or upbringing (Levin and Hart, 2003; Dohmenet al., 2011).

2.5.1 Managing risk in rural areas

Harwood et al. (1999), has proposed series of measure that farmers can take to minimize or eliminate the risks that rhey face in their farming businesses.

Enterprise Diversification

Harwood et al. (1999) proposed diversification; which means participating in more than one economic activity, as one of the commonly used risk management strategies. If rural people engage themselves in more than one activity there is a higher probability that income from one activity could be used to offset any loss from other economic activities. For example a maize farmer, may have a number of productive enterprises such as millet and livestock so that should the market of crops become less profitable that of livestock would be used to offset the losses. Alternatively, a farmer may operate on disjoint parcels of land so that weather disasters in one area are less likely to reduce yields for all crops concurrently. Harwood et al. (1999) have noted that most crop farmers in the Corn Belt produce both corn and soybeans so that low corn revenues in a particular year may be compensated by relatively high revenues from soybean production. Problems that people face in diversifying their activities are unavailability of resources particularly land and finance.

Vertical Integration

Vertical integration is one of numerous strategies that fall under vertical coordination – all of the ways for which output from one production and distribution stage is transferred to another stage. As stated in Harwood et al. (1999), Martinez and Reed (1996) and Allen (1993) stated that vertical coordination has augmented as consumers have become progressively more sophisticated and technological advancement has also permitted greater product differentiation. In farming farmers who raise corn and hay as feed for their day-to-day productive activities are vertically integrated across both crop and livestock production. In the same way, livestock producers who combine raising, rearing and feeding the animal still slaughter are vertically integrated. Harwood et al. (1999) add that vertical integration could be either changing the form of the product or combining stages in the production process if the entity is owned by person.

Production Contracts

To be sure goods produced do not go waste, producers could take the concerns and taste and preferences of consumers and fuse them into the production process. Production contracts include the buyer specifying into detail inputs to be used in the production process, the quality and quantity of a particular good to be produced, and a fair compensation to the producer (Harwood et al., 1999). For example, a broiler contractor usually has power over how chicks are raised by the producer as well as the specifying the inputs used and management practices throughout adopted in the production cycle. Growers (hog and broiler growers) are compensated with incentive based fees in return for relinquishing control over decision making. Entering into production contracts guarantee timeliness and quality of commodities delivered and control over the methods and processes used in production. Production contracts yield good results when ‘specialized inputs and complex production technologies are used uniform products, oversupply and undersupply problems have persisted, the

trade would benefit the producer and the buyer, specific production technologies are used, and the product is highly perishable(Harwood et al., 1999).

Marketing Contracts

Production and Marketing contracts are both contractual agreement between producers and buyers but latter has to do with verbal or written agreements that set a price andor an outlet for a product prior to its harvest (Perry, 1997; in Harwood et al., 1999). Contrary to production contracts, marketing contract grant management decisions to the producer because he or she owns the product. Though the terms and conditions in marketing contracts vary, on average they all establish a price and also provide for delivery of a given grade within specific time periods.

Other ways of managing risk are hedging in futures (shifting risk from a risk averse party a risk lover in return for an expected profit);futures options contracts (taking the right of future position of a product at a specified price);maintaining financial reserves and leveraging (using debts to fund operations); liquidity (ability to raise money as quickly as possible in order to meet financial obligations); leasing inputs and hiring custom workers during peak periods; insuring crop yields and crop revenues; and engaging in off-farm employment to earn other types of off-farm income (Harwood et al., 1999).

Maintaining Financial Reserves and Leveraging

Another important risk management strategy that rural farmers can adopt to minimize the problem of risk is to maintain financial reserves and leveraging. Leveraging refers to the farmer's use of debt to finance the operation. This is mostly used to minimize the financial risks that farmers face. A producer's decision to choose debt (relative to equity) as a way to mitigate the financial risk associated

with their farming business depends on many factors, including the extent of farmer's risk aversion, the size and type of operation, the farmer's market relationships with input suppliers and output purchasers, lenders' willingness to provide loans among others.

Increasing the farm's leverage (that is, borrowing) increases the capital available for production, allowing expansion of the business, but also entails incurring a repayment obligation and creates the risk of loan default because of the risks inherent in the farming operation. Because of these many factors, a farmer's use of debt to finance the operation interacts with both the production and marketing risks faced by the producer (Barry and Baker, 1998; Gabriel and Baker, 1980).

Insuring Crop Yields and Crop Revenues

For farmers to manage the risks associated with yield and farm revenue, they can insure their yields against unexpected variations in order to stabilize their incomes. In other words, for crop producers to mitigate yield variability, they often use insurance (and hence, revenue). However, in most times, poor farmers may not be able to pay for the premium involved in the insurance of yields and income. For instance, a research by Dadzie and Acquah (2012) about food crop farmers in Ghana, they found out that out of the 40 respondents, none of them used crop insurance as a way of mitigating the risks associated with their farming business.

2.6 Risk Elicitation

Several methods have been developed to extract a decision maker's preference for wealth and convert their preferences into an appropriate utility function (McConnell and Dillon, 1997). Three common widely used methods are used to represent farmers' attitudes and their utilities toward risk (Gómez-Limón, Arriaza, & Riesgo, 2003).

This first method is the direct elicitation of utility (DEU) functions where farmers' risk preferences are assessed by interview and farmers are asked to state their indifference point with a series of hypothetical risky prospects and the sure outcomes. An individual's utility function can be calculated using regression. According to Young (1979) and Gómez-Limón et al. (2003), some empirical research that used DEU to elicit the risk preferences of farmers can be found in Francisco and Anderson(1972), Hamal and Anderson (1982), Ramaratnam, Rister, Bessler and Novak(1986) and Feinerman and Finkelshtain (1996).

The second method is the experimental methods (EM) where real money payoffs are employed to measure farmers' preferences rather than using hypothetical alternatives. This method is however not widely used and quite complicated to implement in practice (Gómez-Limón et al., 2003). The method has been employed by Binswanger (1980) to measure the attitude towards risk of rural farm households in India and the results showed that all respondents were moderately risk-averse. EM is therefore more reliable than DEU since interviewer's bias may affect DEU results.

The final method is the Observed economic behaviour (OEB) in which risk response behaviour of farmers can be estimated from econometric models that incorporate risk attitude parameters along with other observed parameters. OEB is less costly compared with the DEU and EM techniques and researchers can generate risk effects econometrically from a large amount of response data. However, the OEB approach has some restrictions because of the availability of aggregate data and other relevant economic variables that might influence risk attitudes (Gómez-Limónet al., 2003; Rovere, 1997; Young, 1979). Studies that used the OEB method to estimate farmers' attitudes toward risk include Chavas and Holt (1990), Chavas and Holt (1996), Pope and Just (1991) and Lence (2000).

Measurement of individual risk attitudes may also be grouped into two categories: econometric approach and experimental approach (Moscardi and de Janvry, 1977; Binswanger, 1980). Econometric approach is based on actual behaviour of individuals. Moscardi and de Janvry (1977)

used a safety – first rule to measure behaviour towards risk by explaining a set of socioeconomic and structural variables known to characterize peasant households. Their study found age, family size and years of schooling by household heads to significantly influence risk attitudes of household, whiles younger farmers are more prone to take risk than older farmers are. Antle (1987) also applied a moment-based model to estimate risk attitudes in India. His results showed population to be characterized by Arrow – Pratt and downside risk aversion. Pope and Just (1991) also proposed as well as implemented an econometric test to distinguish the class of preferences for potato supply response in Idaho. In their study, constant absolute risk and partial relative risk aversion were rejected. The econometric approach however, is criticized for confounding risks behaviour with factors such as limited resources faced by economic factors (Eswaran and Kotwal, 1990). Such a disadvantage according to Wik and Holden (1998) is vital in developing countries with high rates of market imperfections in terms of production and consumption decisions. The experimental approach is based on hypothetical questionnaires regarding risky alternatives or games with or without real payment form the basis of experimental approach. Using an experimental gambling approach with real payoffs, Binswanger (1980) estimated the structure of risk preferences for 240 farmers in India. His results showed that individuals are moderately risk averse at high payoff levels but with little variation according to personal characteristics. However, wealth insignificantly reduces risk aversion marginally. Similar evidence was found by Wik and Holden (1998) who also employed the same approach for 143 farmers in Northern Zambia and found that over 80 percent of farmers are moderately to extremely risk averse with decreasing absolute risk aversion and increasing partial risk aversion respectively. There was also evidence that most farmers are not only more risk averse in games with gains but also in games with losses. Using a random sample of 262 farmers from Ethiopia, Mahmud (2007) noted that most farmers are intermediate, severe and extreme risk averse. One advantage of this approach is its control over the experimenter with easier focus on testing economic theory assumptions. The approach is also highly recognized as the most desired method for elicitation

and risk aversion measurement but biased towards experiments launched in purely hypothetical settings.

Other methods have also been used to describe risk preference elicitation that provides indication that greater degree of risk aversion is associated with larger numbers. These are:

2.6.1 Non hypothetical elicitation method

The most widely used non-hypothetical elicitation method is the s Multiple Price Lists (MPL)technique based developed by Holt and Laury (2002). In the MPL, subjects are given a set of options (two options) to choose from; a relatively safer option and a relatively riskier option. Each option is assigned two potential pay-outs with dissimilar probabilities of each pay-out being realized. The pay-outs in the safer option are expected to have a lower variation than those in the riskier option (Thea et al, 2012). Risk preferences are based on the point at which subjects switch from the safer option to the riskier one. Prior expectations are that risk neutral people switch to the riskier option earlier than risk preferring and risk-averse people.

2.6.2 Hypothetical elicitation methods

In this approach risk preferences are based on financial risk tolerance, a self-assessment scale, hypothetical scenarios involving income, hypothetical scenarios involving inheritance, and hypothetical questions involving price and yield gambles for crops porduced (Thea et al, 2012). Unlike the other methods, the financial risk tolerance question and self-assessment scale allow subjects to identify their own willingness to take risks. The financial risk tolerance question originates from the U.S. where subjects were asked about the amount of financial risk they are willing to take. Thea et al(2012) writes that the categorization are (1) substantial financial risks as those taking risk but expecting to earn significant returns; (2) above average financial risks as those taking risk but

expecting to earn above average proceeds; (3) average financial risks as expecting to earn a mean returns; and (4) not willing to take any financial risks.

The self-assessment scale, whose validity has been confirmed by Dohmen et al. (2011), is based on the German Socio-Economic Panel Study conducted by the German Institute for Economic Research and has also been widely used to analyse risk preferences. In the self-assessment, respondents are shown a scale with integers ranging from zero (0) to ten (10). A zero means the respondents is fully avoiding risks a ten is interpreted as someone who is fully prepared to take risks. Respondents are then asked to point to the integer that best match their willingness to take risks. Afterwards, responses are rescaled so that 0 represents the most risk preferring and 10 the most risk averse (Thea et al, 2012).

The income and inheritance series determines how individuals would respond to hypothetical scenarios involving income and inheritance gambles. These methods originated from the Health and Retirement Study that was conducted the University of Michigan and examined by Anderson and Mellor (2009). Individuals imagine, being the sole income earner in the household for the case of the income series and they must change their income earning activity. The inheritance series on the other hand allows individuals to imagine they have an inherited say, a gas station which could be sold at a higher price. The final method to assess risk preference is the scenarios with different yields and price of maize and rice which are adapted to local conditions and more familiar to respondents due to their relationship with the two main crops. These series are based on Hill (2009) but uses minimum and maximum ranges of prices and yields in the study area. Respondents are then allowed to select which of the four options of prices and yields for rice and maize they prefer. This is done with the assumption that prices and yields of maize and rice remains constant every year. A CRRA interval may be calculated based on the risk option chosen.

Anderson et al.(1977) however, argued that the most reliable method to elicit decision maker's preferences is to require him or her to choose between two-state risky choices with equal probability

of 0.5 for each state and the sure prospect until indifference is achieved. Some decision makers therefore experience an uncomplicated assessment to choose whiles others find it difficult. Hence Anderson et. al.(1977) introduced two elicitation techniques to obtain the certainty equivalent (CE) with unbiased probability. Furthermore, Anderson et al.(1977) and Hardaker, Huirne et al.(2004) emphasized that a decision maker's risk behaviour can be evaluated using the information from CE. The expected money value (EMV) can be employed to compare with the CE to identify a decision maker's risk behaviour. The decision maker can be classified as risk averse if CE is smaller than EMV. Conversely, if EMV is larger than CE the decision maker is classified as risk loving. Moreover, the difference between the mean or EMV of a risky prospect and its CE (*EMV–CE*) is called the "risk premium" (McConnell & Dillon, 1997).The two utility elicitation techniques developed by Anderson et al.(1977)are: (a) the equally likely certainty equivalent (ELCE)method and(b)the equally likely risky outcome (ELRO) method. The details of these two techniques are discussed below.

2.6.3 The equally likely certainty equivalent (ELCE) method

The ELCE is the most common and efficient method used to elicit individual utility functions (Binici et al., 2003; Torkamani &Haji-Rahimi, 2001) and begins with a simple hypothetical lottery of 0.5/0.5 probabilities, which include the best and worst possible outcomes of the decision problem presented to the decision maker (Anderson et al., 1977). The decision maker is asked for a sure prospect (CE) that he or she would accept to make him/her indifferent between the sure sum and a risky prospect. The CEs are produced for each lottery questions and are used to plot the individual utility function. The upper and lower boundaries of the utility function are set at good and bad possible attribute levels (Ananda & Herath, 2005).

Hardaker et al. (2004) established shorthand notations to explain the elicited procedure by denoting

($a\ a_1, _2$,...)as a decision maker's judgments with a set of possible payoffs with corresponding probabilities. The risky decisions ($a\ a_1, _2$,...)with a discrete payoffs and the sure one(a_s)as follows:

(, ... , ...)~(;1.0)

Where: $X\ X_1, _2$,...is a set of possible payoffs, $p\ p_1, _2$,...is the probability, summing to 1.0 and the symbol implies "is indifferent between".

2.6.4 The equally likely risky outcome (ELRO) method

The ELRO method is quite similar to the ELCE method. Quiggin (1981) pointed out that the ELRO method compares the risky decision using pairs of values elicited from the same probabilities but with different outcomes. Anderson et. al. (1977) however argued that the ELRO presents the utility function for outcomes over the range $a$to z , where $a\ z<$ can be formally expressed in the general form as follows (Hardaker et al., 2004):

(, ;0.5,0.5)~(, ;0.5,0.5)

This method starts by picking a reference interval outcome with $a\ b<$ and $c\ a>$ is then asked for d that makes the decision maker indifferent among the risky prospects. To set the scale for the utility function, it is assumed that $U\ b\ U\ c( ) - ( ) = 1 \text{and} U\ a( ) = 0$ is defined as the origin. Hence $U\ d( ) = 1$.

The ELCE method is more reliable, unbiased method (since it is based on equal probability of 50:50 risky prospects) and less complicated compared to ELRO. Hence widely used and recommended for utility function evaluations, especially for farmers. Hardaker, Huirne et al. (2004, p.98) stated that *"most people find 50:50riskyprospects much easier to conceptualize than prospects with other*

probability ratios". In previous studies, survey questionnaires and interview techniques have been included in the ELCE method to elicit the CE for a series of risky outcomes to use as a utility value.

Tauer (1986) conducted a study using the ELCE method to assess risk preferences among dairy farmers in New York to explain the effect of risk preferences on farming decisions. Seventy-two respondents were interviewed and the results showed that 34 percent were risk averse, 39 per cent were risk neutral, and the rest were risk loving. However, there is limited evidence to reveal the relationship between farmers' risk preferences and their actions and on-farm decisions.

Oglethorpe (1995) also employed the ELCE to derive utility values for as ample of 20 farmers in Northern England. The author examined how farm plans developed under profit maximization approach by using a negative exponential function to fit values with non – linear least squares. The Arrow-Pratt coefficients of absolute risk aversion were estimated and the MOTAD programming model employed to generate the E-V frontiers. The results showed evidence that under profit maximization approach, risk-averse farmers are extremely sensitive in their decision making when the expected farm income declined slightly.

Torkamani (2005) evaluated the risk aversion attitudes of farmers in Fars province, Iran. A total of 60 respondents were interviewed using an applied ELCE questionnaire to elicit the farmers' utility values and the absolute risk aversion coefficients were assessed. The results showed that all farmers were risk averse. The empirical range of the absolute risk aversion values ranged from 0.0001 to 0.000001.

Using multi-attribute utility theory, Ananda and Herath (2005) conducted a study of community risk preferences of forest land– use in Australia and the ELCE method was used to extract the individual utility functions. There was significant risk-averse behaviour among stakeholders of the old-growth forest, conservation and forest-based recreation groups. However, there was less riskaverse behaviour in the native timber extraction group.

According to literature, the ELCE method has been employed as the basic instruments for generalization of individual utility function. However, Hardaker, Huirne et al. (2004) identified some constraints of the ELCE method. First, the ELCE method requires the decision maker to compare between a risky prospect and a sure outcome. If the person avoids gambling or is a gambling lover then biased decisions may occur. Particularly if the decision maker is a person who believes that gambling is prohibited by religion, the ELCE may not apply at all. When this occurs, the ELRO is the alternative method to elicit the individual utility function. Secondly, both the ELCE and ELRO may be used to compare only in the continuous outcomes, such as wealth or income, but cannot apply to discrete outcomes.

2.7 Estimating the Appropriate utility model for risk measurement

Various literature accept the use of a utility function in determining risk preferences but the correct functional form remains debated to date. As stated in Turanet al (2001), the use of a Box-Cox transformation developed by Lin and Chang (1978) to establish the most suitable functional form of utility was rejected Buccola (1982) because Box-Cox transformation do not satisfy the properties of a legitimate Bernoullian utility function, which is a necessary condition for a utility function. Some models researchers have used; as presented by Turan et al (2001) include but not limited to exponential, quadratic, and cubic utility functions (Zuhairet al, 1992), expo power utility function (Saha, 1993), standard reference contract or von Neumann-Morgenstern method (Bond & Wonder, 1980), interview method and experimental gambling approaches (Binswanger, 1980)and the expected utility maximization model (Hamal&Anderson,1982).

Turanet al (2001) proposed a solution to the problem of choice of model that the choice of model should be guided by the decision maker's risk attitude toward risky prospect.

2.7.1 Utility functional forms

The utility function determines an individual's relative preferences with respect to different levels of wealth (Norstad, 1999). The function can be transformed in terms of algebraic form for computing and making comparison among its properties of which different algebraic specifications may affect the classification of risk preferences of decision makers in different ways (Anderson et al.,1977; Hardaker, Huirne,et al., 2004).A number of functional forms have been used in previous research to illustrate farmers' attitudes toward risk.

Lin and Chang (1978) investigated the most appropriate functional forms to assess farmers' utility function and their results showed that logarithmic and semi- logarithmic were appropriate functional forms that can best describe decreasing absolute risk aversion. Buccola and French (1978) also reported that risk parameter estimation problems using the exponential utility form. Their results showed that logarithmic transformation of the exponential utility function was inconsistent with the Von Neumann and Morgenstern principles. The use of the Box-Cox transformation and power functional forms were inappropriate to estimate the utility function because of intercept problems (Buccola, 1982).

Musser et al. (1984) emphasized the problems when using different functional forms to classify the risk attitude of a decision maker. The authors applied the quadratic, semi-log and modified power functional forms to categorize risk preferences of13graduate students in an agricultural finance class during winter in 1981. Their results showed that the quadratic and modified power function categorized most respondents as risk neutral whereas all the respondents were risk-averse using the semi-log function form. The authors argued that alternative utility functions may affect classification of risk preferences.

Ramaratnam et al.(1986) examined the appropriateness among the four different utility functional forms (quadratic, log-linear, semi-log and exponential) to describe the risk behaviour of grain

sorghum farmers in Texas. The exponential function was determined as the most appropriate functional form to explain farmers' risk preferences. Zuhair et al. (1992) also stated that the exponential form was appropriate when employed to explain risk aversion and the prediction of farmers' harvesting strategy in Sri Lanka. Both studies argued that the choice of utility functional forms is very important because different utility functional forms can describe farmers' risk preferences in different ways.

Saha (1993) introduced a new utility functional form namely the expo-power utility function with emphasis that the expo-power utility function is flexible to demonstrate almost anytypeof risk aversion coefficient structure (DARA, CARA,IARA, DRRA or IRRA) that is devoid of restriction relying on parameter values. Saha et al. (1994) employed the expo-power utility function and production function using the joint estimation method to describe the risk preference structure and production technology among Kansas wheat farmers. The risk characteristics of farmers in their study exhibited DARA and IRRA. The authors argued that the joint estimation method was suitable when applied to estimate production parameters with utility function parameters.

Torkamani and Haji – Rahimi (2001) also used four different utility functional forms to test goodness of fit and compared their properties. Their results showed that all the farmers were risk averse when the exponential and expo – power utility functions were used. However, when the cubic and quadratic utility functions were used, 65 per cent and 75 per cent of the farmers showed risk averse behaviour respectively. Similarly, a study of 50 farmers from Turkey classified 49 and 48 farmers as risk averse for the expo – power and the power utility functions respectively whiles fifteen of the fifty farmers were risk loving when the cubic utility function was tested. On the contrary, all of the interviewed farmers were risk-averse when the negative exponential utility function was used (Binici et al., 2003). Ananda and Herath (2005) argued that the negative exponential functional form was popularly employed to produce the utility function in previous studies on multi-attribute conditions.

From the empirical studies, the most appropriate functional forms and type of risk measurement that are recommended to specify utility function are the cubic utility function, the negative exponential utility function, the power utility function and the expo – power utility function (Biniciet al., 2003; Hardaker, Huirne, et al., 2004; Torkamani &Haji-Rahimi, 2001).

1) The cubic utility function which is expressed as:

$$U(w) = a + bw + cw^2 + dw^3$$

Where: $U(w)$ is the utility with respect to wealth (w); $a, b, c,$ and d are the parameter.

The cubic function can also examine the Arrow – Pratt absolute risk aversion coefficient $r_a(w)$ as follows:

$$r_a(w) = \frac{-U''(w)}{U'(w)} = -\frac{(2c + 6dw)}{(b + 2cw + 3dw^2)}$$

Binici et al.(2003)and Torkamani and Haji-Rahimi (2001) pointed out that $r_a(w)$ of the cubic utility function can be either negative or positive depending on the parameter values and level of wealth. As a result, the cubic utility function is compatible with risk aversion, risk neutrality and risk loving behaviour because it exhibits both IARA and DARA.

2) The negative exponential utility function is formally expressed as:

$$U(w) = -1\exp(-cw), c > 0$$

Where exp denotes exponential; c is a parameter

The absolute risk aversion coefficient of the negative exponential utility function estimated as follows:

$$r\ w_a() = \frac{-U\ w''(\quad)}{U\ w'()} = c$$

The vital property of this utility function is that $r\ w_a(\ )$ is constant $(\ )c$ and positive over all levels of wealth (Binici et al., 2003;Ladányi&Erdélyi, 2007).Hence, the negative exponential utility function assumes CARA and is extensively used in empirical decision analysis because the function itself can be assessed using a single CE with normal distribution of wealth. However, Hardaker, Huirne et al.(2004)argued that it may have some numerical problems when assessing the negative exponential utility function for large values of wealth together with a relatively large values of *c*.

3) The power utility function with its functional form expressed as:

$$U\ w(\ ) = +\alpha\ \beta w^{\gamma}, 0 < < \gamma\ 1$$

Where: $\alpha\beta$' and γ are parameters

The absolute risk aversion coefficient of the power utility functional form can be calculated as follows:

$$r\ w_a(\ ) = \frac{-U\ ''(\ )w}{U\ '(\ )w} = -\ -(\gamma\ 1)w^{-1}$$

This power utility function has interesting properties because it exhibits DARA. Hence decreases whiles wealth increases and the $r\ w_a(\ )$ is positive (Binici et al., 2003).

4) The expo – power utility function with a functional form expressed as:

$$U\ w(\ ) = -\gamma\ \exp(-\beta\ \gamma\ \alpha\ \beta\ \alpha\beta w_{\alpha}),\ >1,\ \neq\ 0,\ \neq\ 0,\ >\ 0$$

Where:$\alpha\beta$' and γ are parameters

The absolute risk aversion coefficient of the expo – power utility functional form can be calculated as follows:

$$r\,w_a() = \frac{-U\,w''()}{U\,w'()} = \frac{(1- +\alpha\alpha\beta w^{\alpha})}{w}$$

According to Saha (1993), the attractive property of the expo – power utility function is its flexibility and can exhibit IARA if$\alpha>1$, CARA if $\alpha=1$and DARA if $\alpha<1$. Also, this functional form is quasi concave for all values of $w>0$.

Other common functional forms that could also be used to describe risk behaviour of farmers are log, exponent and hyperbolic absolute risk aversion (HARA) type of utility function (Schumann, Richardson, Lien, & Hardaker, 2004).

2.8 Empirical Review

In a study of the consistency of risk preference of smallholder farmers in a marginal upland environment in Vietnam, Thea et al (2012)using data from 300 sampled households found respondents have a high degree of risk aversion. Statistically significant variables which affect risk preferences according to the study are gender, age, idiosyncratic shocks, education, social norms, network-reliance with extended family, connections to local authorities, household's dependency ratio, wealth, and covariate shocks. However, using data from only one district (Yen Chau district) do not give a greater outlook of risk preferences of rural folks. As a result the explanatory power of their models was limited, demonstrating that other factors and other districts are of greater importance in determining risk preferences.

Dillon and Scandizzo (1978) employed a sampling approach to examine risk attitudes among small scale farmers in Brazil. Data for the study was obtained from two random samples for a total of 130 respondents (66 small scale farmers and 64 sharecroppers). Their results showed that most farmers in the Northeast part of Brazil are risk averse with the degree of risk aversion being greater among farm owners than sharecroppers are while few are risk neutral and risk lovers. Again, utility free and utility specific regression models, the results from the econometric analysis showed that age, family size, ethical attitudes, income and other socioeconomic factors determined risk attitudes among subsistence farmers in Brazil.

Farming (especially of perishable crops) is among the most risky investment of all activities peculiar to the rural sector. Mahmoud (2009) using a sample of 200 households, took upon himself to examine the attitudes of vegetable farmers towards risk in the Jordan Valley. Using the Von Neumann–Morgenstern model, he found that most of the farmers were risk takers (44%) with few risk averse farmers (26%). In analysing the correlation between farmers' personal characteristics including age, education, farm size, family size, experience in agriculture and their risk attitudes, farm size and family size were the only variables that were statistically significant at the 5% level of significance.

Olarinde et al. (2007) applied econometric techniques to examine individual risk attitudes from a sample of 350 maize farmers in the Savanna zone of Nigeria. A four – stage sampling technique was used to select the sample for the study. Their results indicated that about 8% of farmers are risk lovers (low risk averse) with about 42% being risk neutral (intermediate risk averse) and 50% of farmers sampled are highly risk averse to risk involved in maize production. These risk attitudes were influenced by natural risks, social risks, economic risks and technical risks such as drought, diseases and pests, storms, flood, theft, animals' invasion, bush fires unfavourable prices, adequate supply of maize seeds as well as untimely supply of inorganic fertilizers. The econometric analyses was done using the ridge regression analysis based on the Ordinary least square. The results showed maize

production is influenced by quality of seed planted, fertilizer, labour utilization and the amount of herbicide.

Nmadu et al. (2012) investigated the factors that influenced risk status of farmers in Nigeria using a cross sectional study. The primary data comprised respondents for the study were randomly selected from fifty households and in all 100 respondents were used for the study. Using both descriptive statistics and multinomial logistic regression, the results showed that about 46.17% of farmers were risk neutral, whiles 0.31% were risk lovers and 53.53% of farmers were risk averse. Again, factors such as education, sex, marital status, farming experience, size of the household, credit, capital, cooperative membership and acquisition of land influenced risk status of farmers at varying level of significance.

Bond and Wonder (1980) on the other hand assessed risk attitudes among farmers in Australia. Using a survey questionnaire to elicit certainty equivalents of different risky prospects, a total of 201 respondents were used for the study. Their study also evidenced that farmers in the agriculture sector are risk averse but the degree of risk aversion was relatively small. Again, incomes from off – farm jobs, age, wealth, zone and type of property determined individual risk attitudes.

Feinerman and Finkelshtain (1996) developed a theoretical framework to examine the impact of socioeconomic factors on risk attitudes of farmers. The primary data collected was surveyed from a random sample of 180 farmers from 20 villages in Israel. Their methodology was based on equivalence between probability of winning demanded and the Arrow - Pratt risk aversion measure. A generalized least square approach was used for the econometric analysis and the results showed that farm size farm type, milk, water and egg quotas affected risk attitudes negatively supporting the Arrow – Pratt's hypothesis of decreasing absolute risk aversion. On the contrary, lottery price had a positive and significant effect on risk attitudes. Other factors such as family size, off – farm jobs and education insignificantly affects risk negatively whiles that of experience and time spent on farm lands affect risk positively.

Using Von Neumann – Morgenstern model, Binici et al. (2001) also examined the socioeconomic factors of farmers risk attitudes for farmers in Turkey. A primary data collection for the 2000 to 2001 production year with a sample of fifty farmers was used for the study. The study found farmers in Turkey to be risk averse under all utility functions with the exception of quadratic utility function where farmer exhibited risk preference attitudes. However, the expo – power and negative – exponential utility functions were seen to be the best utility functions among the others. Also, using the logit model, education was found to significantly influence farmers risk attitudes whiles age, and capital insignificantly affected risk.

Again, using the Von Neumann – Morgenstern model and the Pratt coefficient, Hindi (2009) examined the attitudes of vegetable farmers towards risk in Jordan Valley. A total of 50 vegetable farmers were selected using a purposive sampling technique out of the 200 farmers that were randomly selected. Out of this number, 26% of the farmers were risk averse whiles 30% of farmers were risk neutral and 44% were risk lovers. A simple multiple linear regression model was used to measure the relationship between farmers risk attitudes and personal characteristics. The results showed that farm size and family size significantly influenced farmers risk attitudes in Jordan Valley. Other factors such as age, education and experience in agriculture did not show any significant impact on farmers' risk attitudes.

In examining farmers risk attitudes in Turkey, Binici et al. (2003) employed a two stage process to select 182 respondents. Hence managerial decisions made are mostly to reduce risk even if such decisions would generate lower income. Using a nonlinear least square, the ELCE model was employed to elicit information to determine risk preferences. The Arrow – Pratt coefficient showed farmers were either risk averse or risk lover whiles that of the negative exponential utility function showed all farmers to be risk averse. The cubic utility function also showed all farmers to be risk lovers.

Brauw and Eozenou (2011) conducted a study to assess risk attitudes among a sample of potato farmers in Mozambique. Data for the study was obtained from the REU project 2006 and 2009, and comprised 682 respondents. Their study assessed whether farmers followed a constant relative risk aversion utility function or an expected utility theory in choosing their preferences. Their results showed that farmers in Mozambique followed an expected utility theory which was a flexible power risk aversion preference. The study however, revealed that age, type of district, education, and wealth influenced risk attitudes of farmers in Mozambique.

Ozkan (2005) conducted a factor analysis to identify groups of farmers according to their risk source and management strategies. The study employed a face – to face questionnaire for a sample of 112 farmers. using a Likert – scale ranging from one to five, his results showed that sources of risk included, environmental sources, price, input costs, political, finance, marketing, educational level, catastrophe, health and social security, personal, production and technology. Risk strategies however, included off – farm income, marketing, planning, security, financing and diversification.

Drawing on livelihoods approach and household survey data, Sanzidur and Akter's (2010) study of the livelihood security in sampled settlements in Bangladesh proved economic security as the dominating factor in the overall livelihoods followed by food. They also found that, people in settlements appear to be equally insecure irrespective of regional disparities in opportunities. They concluded with a caution that the same intervention strategy for different regions would prove ineffective because of geographical disparities in the component indicators.

Akcaoz and Ozkan (2005) study of the risk sources and management of 112 farmers in Turkey revealed that environment, price, catastrophe, input costs, assess to market and finance and social security are the major sources of risk to rural folks.

In a study of the risk perceptions and risk attitudes of selected farmers of Ilocos Norte – Philippines, Marilou and Isabelita (2011) used the Likert scale and Kruskal-Wallis test to assess the farmers' risk

perceptions and the experimental method to determine farmers' risk attitudes. Results from their regression analysis showed that resource-endowed and resource-poor farmers in general perceived various risk sources as fairly low regardless of crops planted. Compared to resourceendowed counterparts, resource-poor farmers have little to lose or gain and considered farming as not risky. However the two groups of farmer agree that farming is relatively risky if the increase in price of fertilizer and environmental factors such as climatic conditions are considered because such variables are exogenous to the farmer; they are beyond their control. The size of a worker's farm and his wealth are the variables that affect the farmers' risk perceptions with age and availability of credit determining farmers' risk attitudes. The impacts of their risk perception attitudes vary across cropping patterns of farmers.

Lucas and Pabuayon (2011) used a Likert – scale and Kruskal – Wallis test to examine farmers' perception of risk and experimental approach to investigate factors that influence risk attitudes of farmers in Philippines. A sample of 100 farmers through an interview and purposive sampling technique were used for the study. The study revealed that farmers in Ilocos Norte (Philippines) are risk averse and as such those who are resource endowed perceives farming to be more risky while those who are resource poor perceives farming to be not risky since there is little to gain or lose. However, considering environmental factors and fertilizer prices, both groups of farmers perceive farming to be relatively risky. In terms of the type of crop grown, rice and corn are perceived to be relatively risky as well. Overall, the size of farms, age, credit and wealth significantly influence risk perception of farmers.

Kouamé (2013) investigated the factors that influence risk management decisions without formal insurance among farmers in Cote d'Ivoire. His study employed primary data using two – stages stratified sampling technique and experimental gambling component. Two sample comprised of fifteen villages and seven Sub – Prefectures based on three strata. As a result, 362 households were used for the study. The experimental method revealed farmers in Cote d'Ivoire to be moderately risk

averse. Using a multivariate probit and considering the correlation among these decisions, his results showed that adoption of other strategies is positively and greatly influenced by the decision to adopt risk management strategies. The study also found farm size, literacy level among household's head, risk aversion, access to inputs and engaging in off – farm activities to be significant factors of adopting risk management strategies.

Comparing two different risk elicitation methods, Ihli et al. (2013) assed risk behaviour of smallscale farmers in Uganda. Using groups from experimental sessions, 332 farmers were selected randomly for the study. Their results showed that the method used in measuring risk has a significant influence on risk preference. However, the modified Holt and Laury lottery methods showed relatively low rate of inconsistency though both methods by Holt and Laury (2002) and Brick et al. (2012) were inconsistent. Their results also found most farmers to be risk averse. Also the study showed that test score probability and wealth to be a significant influence in both methods whiles farm size, district, education and winning first lottery choice significantly influenced risk preference in only one method. That of age, household size, number of children, credit and membership group of farmers do not influence risk preference significantly.

Ghartey et.el (2014) examined the effect of poverty on risk attitudes among cassava farmers at Awutu-Senya district of the Central Region of Ghana. Using the Equal Certainty Equivalent Risk Model and regression, simple random sampling method was employed on to examine the effect of poverty on risk attitudes for 50 cassava farmers. The result showed that about 58% of farmers in the study area were found to be poor. they further found out that as 82% of the farmers were risk averse. With ogit regression, they found that age, household size, educational level, land size and degree of poverty were significant determinants of farmers' attitude towards risks. The effect of poverty on risk attitude was found to be positive meaning that poorer people are more risk averse than the non-poor.

Dadzie and Acquah (2012) examined food crop farmers' attitudes towards risks and the coping responses using food crop farmers at Agona Duakwa in the Agona East District of Ghana. Forty respondents were sampled from the study area. Their results show that, out of the forty respondents, twenty-seven (27) were found to be risk averse and nine (9) were risk neutral whereas four (4) were deemed risk loving. The logit regression showed that showed that years of education, household size, income and access to microcredit were the important and significant determinants of risk attitudes.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the methodology used for the study, which focuses on three thematic areas, namely, livelihood security and determinants in the rural areas; risks perception, determinants and effects on livelihood; and the impact of health shock on livelihood of rural dwellers on the. Section 3.2 discusses the research design of the study. The data type and sources are discussed in section 3.3, the locale of the study is presented in Section 3.4. The sample size determination and the samples selection techniques are discussed in section 3.5. The data collection procedure and the procedure for eliciting farmers' utility and certainty equivalence values are presented in section 3.6.The data analysis procedure and the modelling procedures are outlined in section 3.7

3.2 Research Design

The main research design applied is the quantitative method. The quantitative method enabled the research to answer the equations raised in the objectives. Application of mathematics allowed the work to measure quantitatively risk attitudes and perception and how they impact on livelihood.

3.3 Data type and Sources

The work relied mostly on primary data. However, secondary data was also used.

Primary data:

The data used for this research originated from a survey of rural households in three Administrative districts from three regions in Ghana. The survey explored the demographic, social and economic characteristics of the households in order to find out their livelihood security situation. The survey

also covered the risk perception and attitude of the households. It further looked at the health status of the households.

Secondary data

Some secondary data was also used for the research. The population of the various districts were obtained from the 2010 Population and housing census from Ghana Statistical Service. The economic characteristics of the various districts were obtained from District Planning offices.

3.4 Locale of the Study

The study is carried out in three districts in Ghana. The choice of the districts was based on the distinctive nature of their economic activities that would enable me to examine the impact of distinctive crop type on livelihood. Three regions are among those regarded, as the food baskets of Ghana. The districts are the three districts are Techiman in the Brong Ahafo Region, Sefwi Wiawso in the Western Region and Offinso North in the Ashanti Region. The districts are dissimilar in terms of location, main crop grown, economic development and population. The table below shows the differences in the main crop types produced in the districts.

Table 3.1: Crop Production description of the study areas

	Yam	Tomatoes	Cocoa

Main Production Area	Techiman	Offinso North	Sefwi Wiawso
Gestation Period	6 months	3 months	4-5 Years
Scale of Prod.	Small Scale	Small Scale	Small/Medium Scale
Crop Type	Staple Food	Vegetable	Plantation crop
Marketing	Local Consumption	Local Consumption	Export
Price Determination	Market	Market	Government
Perishability	Can be kept up to 6-12 months	Very perishable unless stored in a refrigerator or canned	The dried beans can be kept for long time
Gov't involvement	Limited	Limited	Very Active

Source: Author's Field Work, November 2013

At Techiman, the farmers grow mainly yam, which is one of the main staple tuber crops in Ghana. At Sefwi Wiawso, the farmers are mostly cocoa growers. Cocoa is the single most important plantation crop in Ghana. The cocoa industry has maintained its status as the second largest foreign exchange earner for the country. For instance, the cocoa sector's contribution to foreign exchange was 20% in 2012 (ISSER, 2013). It is however important to note that the sector is mostly dominated by smallholder producers. Western region is the biggest cocoa producer in Ghana. Offinso North District in Ashanti is known for its tomato production. It is estimated that about 90% of households in Akumadan are engaged in Tomato production (GSS, 2012). Tomato is the most important vegetable crop in Ghana, consumed in homes throughout the country.

3.4.1 Techiman Municipality

The Techiman Municipality was established under legislative Instrument (L.I. 1472) of 1989 as a District Assembly and later upgraded into a Municipality under Legislative Instrument (L.I. 1799) of

2004. The Assembly is one of the seven (7) Municipalities and fifteen (15) District Assemblies in the Brong Ahafo Region of Ghana. Techiman Municipality is situated in the central part of Brong Ahafo. The Municipality covers an area of 669.7km2 representing approximately 1.69% of the surface area of Brong Ahafo Region. The Municipal capital, Techiman is a major market centre and a nodal town or entrepol, where roads from the three northern regions converge. Trunk roads from Sunyani, Kumasi, Wa and Tamale all meet at Techiman thus making it a bustling food crop market and commercial centre.

Techiman Municipality has a total population of 204, 010, according to the 2010 population and housing census. There are 147, 627 households. This means that there are 4.3 persons per household in the Municipality. The municipality is the biggest district in the Brong Ahafo District in terms of population. The District capital, Techiman is highly populated given its strategic location. It has a population of 56,187, about 28% of the total population of the district. This makes the municipality more urban than rural. The data from Population census shows that the rural population amount to 123,939 (60%) while the urban population stands at 82, 917 (40%). (Population & Housing Census, 2010)

Agriculture and related trade is the main economic activity in the municipality. The Techiman Municipality in general is regarded as an agricultural production corridor. Over half of the economically active population is engaged in Agriculture and related trade. The major crops grown are food crops such as yams, maize, cassava, cocoyam, plantain and vegetables like tomatoes, garden eggs, onions and okro as well as plantation crops like cocoa, cashew and mango.

Agriculture and related activities constitute the major occupation in the Municipality accounting for about 55%. A significant proportion of the economically active populations are engaged as sales workers (14.7%). Production, transport operators and labourers constitute (13.4). Techiman has the highest percentage of sales workers (20.7) in the region. This is due to the presence of the largest

market centre in the region. There are more males engaged in agriculture than females whereas females outnumber males in service and sales work.

The Techiman Municipality is relatively more endowed in terms of health facilities. Using results from the Core Welfare Indicators Questionnaire Survey, 2003 about 69.4% of households in the Municipality takes less than 30 minutes to reach the nearest health facility as compared to the regional average of 53.85 and 57.6% for the nation. Whereas 11.2% needed medical services only 9.5% of those sick or injured consulted a health practitioner or used medical services.

The Municipality has twenty four (25) health care facilities; including two (2) mission hospitals at Techiman, that is Holy Family Hospital (with 205 beds) and Ahamadiyya Hospital (with 115 beds). There are nine (9) Government Health Centres, five (5) Private Maternity clinics and three (3) Private Clinics.

3.4.2 Sefwi Wiawso Municipality

The Sefwi Wiawso District was created in 1988. It was elevated to a Municipal status in March, 2012 under Legislative Instrument, L.I 2015. The Sefwi Wiawso Municipal Assembly is the seventh largest in the Western Region as in size. The municipal lies in the north-eastern part of the Region and is bordered by Juaboso and Bia District to the west and by Aowin / Suaman to the
South. It is bordered by Bibiani – Ahwiaso –Bekwai to the north-east and Wassa Amenfi West to the south-east. The Sefwi Wiawso Municipal Assembly, the political and Administrative Authority is located at Sefwi Wiawso, the Municipal Capital.

The population of the Municipality at its creation in 1988 was a little over 73,000. By the year 2000, the population had more than doubled to 148,950, representing 7.75% of the region's population, which included the current Akotombra district. (Currently according to the 2010 Population and Housing Census, Sefwi Wiawso has a total population of 139,200 representing 5.9% of the region's

population. The census further reveals that 89,375 representing 64 percent of the population are rural while 49825(36%) live in urban areas of the district. There are 30,074 households in the Municipality meaning that there is an average of four persons per household. (2010 PHC).

Agriculture is the major economic activity in the district in terms of employment and income generation, with about 66% of the working population engaged in this sector, which constitutes the main source of household income in the district. The Municipal is predominantly a cocoa growing area. Nine out of every 10 farmers have cocoa farm. Land for food crop production is becoming limited, and hence farmers normally inter-crop cocoa with food crops during the establishment of the new cocoa farms. Plantation crops like; coffee, oil palm, citrus and avocados are also grown. Food crops are mostly cultivated for home consumption and the surplus for sale. Reliance on rain fed agriculture and low level of mechanization in production and processing is common in the Municipality. Due to good rainfall, crops do well in most areas. (District MOFA office, 2013)

Livestock and poultry production in the Sefwi Wiawso Municipal play an important role in the livelihood of the people, as every household owns livestock, poultry or both. The main livestock reared in the Municipal are sheep, goat and pigs with few herds of cattle in some isolated villages, which are kept semi-intensively. Poultry production is mainly of free-range system for the local breads. However, there are few commercial poultry farmers who are involved in the production of layers, cockerels and broilers intensively for sale within or outside the Municipality.

It must however be emphasized that as is the case of most farmers in Ghana, the farmers sell their produce in their raw state. The only identifiable agriculture produce processing group in the municipality is located at Gyampokrom. The group consists of 6 males and 13 females. They process palm nuts into palm oil.

However, large deposit of gold has been discovered at Akoti and its surrounding areas. It is being mined in commercial quantities by Chirano Gold Mines Limited, an Australian mining firm. It commenced commercial production in 2004.(District Dev't plan, 2013)

3.4.3: Offinso North District

The Offinso North District Assembly was inaugurated on 29th February, 2008 and established by LI 1856. It was carved out of the former Offinso District Assembly, now Offinso Municipal Assembly. It is one of the 27 District Assemblies in the Ashanti Region and has its capital as Akomadan.

The population of the Offinso North District, according to the 2010 Population and Housing Census stood at 56,881, with 11,164 households which means that the average household size stands at 5 persons. The Offinso District has over 95 communities. By the national standards, rural-urban classification of localities is based on whether the population of a settlement is more or less than 5,000. In the case of a rural community, it should be less than 5,000 whilst an urban population should be 5,000 or more. In the case of the Offinso North District only three (3) of the communities can be said to be urban. This includes Akomadan, Nkenkaasu and Afrancho. The vast majority of the communities are therefore rural communities. The urban population stands at 23,461 and that of the rural population stands at 33,420.

The 2010 Population and Housing Census put the rural-urban split at 57.8:42.2 as compared to a national average of 56.2:43.8, with 70% of the settlements in the district rural,

Agriculture is the main economic activity in the district. Over 80% of the active population in the district are farmers. Out of this figure, the youth constitute about 25%.

Most of the land in the district is put under food crop production each year. Large tracks of fertile lands also remain uncultivated. The major crops cultivated are maize, tomatoes, plantain, cassava, yam and vegetables. The table below shows the major crops produced in the district in 2013

Table 3.2: Production figures of major food crops in 2013

NO.	FOOD CROPS	PRODUCTION (Metric Tons)	AREA OF PRODUCTION (Hectares)	YIELD (MT/HA)
1	Maize	13,240.5	9457.5	1.40
2	Yam	8,456.4	610.8	13.85
3	Cassava	40,289.0	3,822.5	10.54
4	Plantain	25,592.8	2,389.6	10.71
5	Cocoyam	4,858.5	814.0	5.97
6	Tomatoes	8,025.5	5,350.0	15.00
7	Garden Eggs	1,000.0	100.0	10.00
8	Pepper	1,200.0	200.0	6.00
9	Okro	1,656.0	300.0	5.52
10	Cowpea	500.0	500.0	1.00

Source: District Agric Office, 2013

In terms of health facilities, the District has one Government hospital located at Nkenkansu and one heath center at Akumadan and two clinics at Afrancho and Nyamebekyere No. 1.

3.5 Population of the study

The work is carried out in the rural communities in three districts. As defined by the 2010 population census, Localities with 5,000 or more persons were classified as urban while localities with less than 5,000 persons were classified as rural. A locality is defined as a distinct population cluster (also designated as inhabited place, populated center, settlement) which has a name or locally recognized status. It included fishing hamlets, mining camps, ranches, farms, market towns, villages, towns, cities and many other types of population clusters (GSS, 2012).

According to the 2010 population and housing census, Sefwi Wiawso Municipal, Techiman Municipal and Offinso North District have a combined population of 402,937, out of which 205,712 are rural and a combined households of 88,865. Since the work is on rural livelihood, the total population for the study is 88,865 households. The work is carried out at the household level. Therefore, the population for the study was all rural households in the selected districts.

3.6 Sample size determination and Sample selection techniques.

As indicated above, the total number of household of the three districts stands at 88,865. The sampling frame for this study focused on rural households in the three districts. The sample size for each district was calculated using the formula provided by Yamane T. (Yamane, 1973),

$$= + ()!$$

Where:

n = sample size; *N* = population size; and *e* = acceptable error (per cent).

Based on the formula, and using a 5 per cent acceptable error level (95% confidence level), the sample size is calculated and shown in the table below:

Table 3.3: Sample Size for each District

District	Total Households	Calculated Sample Size	Actual Sample used
Sefwi Wiawso	30,074	397	400
Techiman	47,627	395	400

Offinso North	11,164	387	400
TOTAL	88,865	1,179	1,200

Author's Calculation

However, as indicated by Padilla-Fernandez (2000) and Scheaffer et al. (2006) and cited by Aditto (2011), the sample size can be different from that calculated, based on the given cost and other limited conditions. In this case however, the calculated samples are adjusted upwards as shown in the table above. This was done to improve the accuracy of the work.

After determining the sample size, the next step involves the selection of the communities for the administration of the questionnaires. The first procedure involves the removal of the communities with population more than 5000. The next step involved the grouping of the communities into the various zonal councils. At Sefwi Wiawso, there are six Zonal councils and five at Techiman. However, the councils at Offinso north were not properly organized so the various groupings were not available.

In each of the zonal councils in Techiman and Sefwi Wiawso, two towns were randomly selected. This was by writing the names of the various communities on small pieces of paper and randomly selecting two. This gave us two communities each. At Offinso North, the names of all the communities were put together and then eight communities were drawn randomly.The table below summarizes the selected communities

In each community, 40 households were randomly selected for the questionnaire administration. To make the selection random and unbiased, every fourth household was selected starting from the outskirt of each of the community. The head of the household was the main agent for the administration of the questionnaires. However, the interviews were done in the presence of the wife or husband and other members of the households who were readily available.

Table 3.4: List of communities used for the study

District	Zonal Councils	Sampled Communities	No of Households
Sefwi Wiawso	Ahwiaa Zonal Council	1. Futa 2. Aboboyaa	40 each
	Gyenase Zonal Council	3. Tanoso 4. Nyameagyeso	40 each
	Baako Zonal Council	5. Sefwi Camp 6. Amanyentina	40 each
	Asawinso Zonal Council	7. Kogyina 8. Kwasiadekrom	40 each
	Asanfo Zonal Council	9. Kanchiabo 10. Achiachen	40 each
Techiman	Techiman Zonal Council	1. Bamiri 2. Forikrom 3. Fiaso	40 each
	Nsuta Zonal Council	4. Koforso 5. Abanaba	40 each
	Nkwaeso Zonal Council	6. Twimia 7. Adieso 8. Nsonkonee	40 each
	Tano Zonal Council	9. Bomiri 10. Akisiniasu	40 each
Offinso North		1. Adaa Nkwanta 2. Akrofoa 3. Apenten 4. Asempanaye 5. Asuoso 6. Mankramso 7. Mantukwa 8. Mpaepaem 9. Nkwankwaa 10. Sanso No. 1	40 each

3.7 Data collection procedure (Questionnaire design, Administration and Interview procedures)

The structured interview questionnaire method is employed to elicit information from the smallholder farmers. The questionnaire is divided into three major sections: (1) general economic and social profile of the household and farm information; (2) sources of risk on farm (3) farmers' utility elicitation procedure. The Questionnaire comprised of closed-ended questions, multiple choice questions and open-ended questions. The first section of the questionnaire contained questions

relating to respondents' general demographic characteristics and the household's income sources and livelihood activities. It also contains information about the farm sizes, owner status of land, farm finance and the details of on-farm activities and family assets. It also contains information on about the agricultural activities on the farm as well as non-farm activities. The respondents are asked to specify the main farm activities on the farm and the crop rotation. The areas allocated to each crop, total production, price of crop sold and production cost for each crop were obtained in order to generate a small farm cropping pattern and revenue.

Section two focuses on the sources of on-farm risk. This section looked at how important the sources of risk are to small farm operations. The scale ranged from 1 to 5 on the likert scale. In other words, the measurement is '1' not 'important' to '5' extremely important through '3' 'quite important'. The sources of risk variables are adapted from Martin (1993); Martin and McLeay (1998) and Pellegrino (1999) and Harwood et al. (1999). Section three contained a series of hypothetical risks lottery tickets with equal probabilities that were used to derive the respondent's utility function following the ELCE elicitation method.

The questionnaires were drafted in English but given the low literacy rate in rural Ghana, they were translated by the field officers to the farmers. To ensure quality, the questionnaires were pre-tested on 50 respondents for possible review after professional reviews by supervisors. The purpose of this pre-test was to determine the effectiveness of the questionnaire in terms of wording and the sequence of questions and its ability to answer the main objectives of the thesis. It also ensured that the length of time for interviewing each respondent is not too long.

3.7.1 Interviewing procedure

The field survey was conducted in the month of April 2014. Given the low literacy rate, the questionnaires were administered face-to-face and was conducted in the Twi Language and where

respondents could not speak the Twi language, an interpreter was used to assist. The Twi language, though not official national language, can be spoken by majority of Ghanaians especially in the study areas. Given the large number of respondents used for the work, ten research assistants were recruited for the field survey. The research assistants were trained by the researcher based on the objectives and focus of the study. The interview was conducted in the farmers' houses with individual participant's permission. To get an idea about the marketing of the products, especially tomatoes and Yam, observatory missions was carried out in the local markets at the designated market days at market centers.

All completed questionnaires were manually inspected and then coded and entered into the stata software.

3.7.2 Data limitations

Due to lack of records keeping by smallholder farmers, the values of output in the previous year as well as expenditures were recalled from memory, which might not be entirely accurate. To minimize this potential problem, efforts were made to ensure that as many members of the households were available during the interviews so that other members could assist in giving the figures that the household head might have forgotten.

3.8 Procedures for eliciting farmers' utility and the certainty equivalence values

The main procedure adopted for the elicitation of risk attitude is the Equally Likely Certainty Equivalent, as used by Aditto (2011), Dadzie and Acquah (2012). The ELCE is considered the most common and efficient method used to elicit individual utility functions (Binici et al., 2003; Torkamani & Haji-Rahimi, 2001). The ELCE, which is a modified version of the von NeumannMorgenstern (N-

M) model is designed to avoid bias caused by probability preferences through the use of ethically neutral probabilities (i.e., P = (1-P) = 0.5). The ELCE method begins with a simple hypothetical lottery of 0.5/0.5 probabilities, which include the best and worst possible outcomes of the decision problem presented to the decision maker (Anderson et al., 1977). The decision maker is asked for a sure prospect also referred to as Certainty Equivalence (CE) that he or she would accept to make him/her indifferent between the sure sum and a risky prospect. The upper and lower boundaries of the utility function are set at good and bad possible attribute levels (Ananda & Herath, 2005). So depending on whether the certain amount was greater than, equal to, or less than the expected value of the risky prospect, each participant could be classified as risk preferring, risk neutral or risk averse. If the certain amount is more than the expected value of the lottery, then the participant is classified as risk loving. If the certain amount is less than the expected value, then the participant is classified as risk averse. If they are the same, then the participant is risk neutral. Expected value is the weighted average of all possible values. Mathematically, if x is a random variable distributed as x_j with associated probabilities α_j (where $\sum'_{(}=1.0$), the expected utility of the risky prospect to the individual is given by

)*+(,)-=Σ(’(+(,(). The expected value of x is given by ,* =Σ(’(,(and the difference between

+(,*) and)*+(,)- can be used to define risk attitudes as

+(,*)>)*+(,)- → under risk aversion,

+(,*)<)*+(,)- →under risk preference, +(,*)=)*+(,)-→under risk

neutrality.

From this, the certainty equivalent can be defined as the sure sum of money x_o which gives the same level of utility as the random prospect ***x.*** Thus, the certainty equivalence is the amount x_o, such that

+(,0)=)*+(,)-.

In this study, each farmer is asked to indicate the certain income that he or she would need to be indifferent between receiving certain amount and a lottery with the highest possible win of GH¢10,000.00 and the lowest of GH¢1000.00, each with a probability of 0.5 (50%). The upper amount of 10,000 is the best possible outcome and thus the utility of that is set at 1, that is (10,000)=1. The worst possible outcome is 1000 and thus the utility is zero, thus(1,000)=0.
The expected value of this possibility is GH¢5,500.00. its derived by summing the best and worst possible outcomes and dividing by two. That is (1000+10,000)/2=5,500

The elicitation procedure involved asking the respondent to choose between alternative I, a lottery ticket, and alternative II, a sure sum of money (*A**). The lottery tickets would be assumed to offer a chance to win either GH¢10,000, maximum potential win (A_{max}) or GH¢1,000, minimum potential win (A_{min}) with a 50:50 probability. *A** is arbitrarily selected along with A_{max} and A_{min} which are considered the upper and lower decision boundary between alternative I and II. Following this, the respondents are asked to choose which alternative they preferred. If the respondent choses cash, then *A** is decreased by some amount and process is repeated. In contrast, if the respondent chose a lottery ticket, then *A** is increased by some amount and the process is repeated. The value of *A** changes until the respondent feels indifferent between the alternatives. That value of A* at which the respondents feel indifferent is the Certainty equivalence. After the first CE is obtained, the same procedure as described above is repeated. We continued to present the respondent with another lottery ticket in accordance with several different max *A* and min *A* scenarios until the nine CE values are completely elicited and the process is completed.

The respondents are then classified according to their choice into three groups as below

- Risk-Loving: GH¢5500.00 < certain amount

- Risk-neutral: GH¢5500.00 = certain amount

- Risk-averse: GH¢5500.00 > certain amount

After the certainty amounts are determined, then we proceed to the calculation of the utility values as shown in the table below.

Table 3.5 A: Procedure for Eliciting Certainty Equivalence

step	Elicited CE	Utility calculation
A Initial Scale: U(1 ,000) = 0; U(ı0,000) =1 b		
1	(;1.0)~(, ;0.50,0.50)	( )=0.50 ( )+0.50 ( )=0.50
2	(;1.0)~(, ;0.50,0.50)	( )=0.50 ( )+0.50 ( )=0.75
3	(3;1.0)~(, ;0.50,0.50)	(3)=0.50 ( )+0.50 ( )=0.875
4	(5;1.0)~(3, ;0.50,0.50)	(5)=0.50 (3)+0.50 ( )=0.9375
5	(8;1.0)~(5, ;0.50,0.50)	(8)=0.50 (5)+0.50 ( )=0.96875
6	(h;1.0)~(, ;0.50,0.50)	(h)=0.50 ( )+0.50 ( )=0.250

7	(<;1.0)~(h, ;0.50,0.50)	(<)=0.50 (h)+0.50 ( )=0.125
8	(=;1.0)~(<, ;0.50,0.50)	(=)=0.50 (<)+0.50 ( )=0.0625
9	(>;1.0)~(=, ;0.50,0.50)	(>)=0.50 (=)+0.50 ( )=0.03125

Adopted from Hardaker, Huirne et al. (2004), and Moses, (2010)

The first step involves the setting of the appropriate scale. As indicated earlier, the unity of the upper and lower lottery payouts are 1 and 0 respectively. Once the respondent chooses the first CE, indicated as c in the table, the utility is calculated and that is approximated as the utility of the lottery. After, the boundaries are set at c and b. The respondent now makes a new CE and the utility of that is calculated as the approximation of the utility of the new lottery with the new boundaries. This is repeated till the process is completed up to g. after, the boundaries of the lottery is set at c and the initial lower boundary of b and the process continues till it is completed. The calculation from the values of GH10000 and 1000 set for the work would be calculated as

Table 3.5 B: Procedure for Eliciting Certainty Equivalence

step	Elicited CE	Utility calculation
Initial Scale: U(GH¢1,000) = 0; U(GH¢10,000) =1		
1	(;1.0)~(1000,10000;0.50,0.50)	( )=0.50 (1,000)+0.50 (10,000)=0.50
2	(;1.0)~(,10000;0.50,0.50)	( )=0.50 ( )+0.50 (10,000)=0.75
3	(3;1.0)~(,10000;0.50,0.50)	(3)=0.50 ( )+0.50 (10000)=0.875
4	(5;1.0)~(3,10000;0.50,0.50)	(5)=0.50 (3)+0.50 (10000)=0.9375
5	(8;1.0)~(5,10000;0.50,0.50)	(8)=0.50 (5)+0.50 (10000)=0.96875
6	(h;1.0)~(,1000;0.50,0.50)	(h)=0.50 ( )+0.50 (1000)=0.250
7	(<;1.0)~(h,1000;0.50,0.50)	(<)=0.50 (h)+0.50 (1000)=0.125

8	(=;1.0)~(<,1000;0.50,0.50)	(=)=0.50 (<)+0.50 (1000)=0.0625
9	(>;1.0)~(=,1000;0.50,0.50)	(>)=0.50 (=)+0.50 (1000)=0.03125

3.9 Data Analysis

3.9.1 Examination of the livelihood security and determinants

The question of rural livelihood security is addressed using livelihoods security approach. A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household (Ellis, 2000).

According to the Sustainable Livelihood Approach, livelihood hinges on five types of household assets, Natural, Social, Financial, Physical and Human capital (Chambers and Conway, 1992). This approach is used to examine and assess the ability of households to withstand shocks such as epidemics or conflicts and also used to design development programming at the community level (Hahn, et. al. 2009).

3.9.2 Livelihood Security Index

The calculation of the livelihood security index is inspired by the livelihood vulnerability index, which is used to study the impact of climate change on the vulnerable. For instance, Halm et al (2009) combined previous methods to construct a Livelihood Vulnerability Index (LVI) to estimate the differential impacts of climate change on communities in two districts of Mozambique. The LVI is expressed as a composite index of components that makes up the livelihood of the household.

In this work, we deviate a bit from the LVI idea, construct livelihood Security Index, and examine its determinants in the three districts in Ghana. Following Rahman and Akter,(2010), five security

indicators are constructed for the respondents, communities and the districts. These indices are Economic Security, Food Security, Health Security, Educational Security and Empowerment (Lindenberg 2002). Household level HLS indices are then constructed following Hahn et al. (2009). The framework is discussed as follows. The calculation of the livelihood security index is adopted from calculation of the Livelihood Vulnerability index, used by development agencies to assess the impact of climate change on the vulnerable.

The LVI uses a balanced weighted average approach (Sullivan et al., 2002) where each subcomponent contributes equally to the overall index even though each major component is comprised of a different number of sub-components.

Because each of the sub-components is measured on a different scale, the first step is to standardize each as an index. The equation used for this conversion is adapted from that used in the Human Development Index to calculate life expectancy index, which is the ratio of the difference of the actual life expectancy and a pre-selected minimum, and the range of predetermined maximum and minimum life expectancy (UNDP, 2007):

$$? @ A_{BC} = DD_{FHAC} == DD_{FGFG} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

where S_b is the original sub-component for household *b*, and S_{min} and S_{max} are the minimum and maximum values, respectively, for each sub-component determined using data from the districts. For instance if the per person average income of the household range from GH¢50 to GH¢5000, then the minimum and maximum values for the income sub-component of the Economic Component of livelihood are respectively GH¢50 and GH¢5000.

The second step involved in the calculation of the security index is averaging of the subcomponents calculated in equation one. That is after each was standardized, the sub-components are averaged using Eq. (2) to calculate the value of each major component, eg economic security index.

∑GJ G @ AB@G
……………………………………..! IDG =

Where CS_i is one of the five major components for the household, which are Economic Security (ES), Food Security (FS), Health Security (HS), Education Security (EDS) and Empowerment Security (EPS). $Index_{sdi}$ represents the sub-components, indexed by i, that make up each major component, and n is the number of sub components in each major component.

Once values for each of the five major components for a household are calculated, they are then averaged to give the Livelihood Security Index for each household. Thus, the Household Livelihood Index (HLI) is computed using the formula:

∑NGJ MGIDG
……………………………………..O KLD?G = ∑NGJ MG

Where $HLSI_i$, is the Household Livelihood Security Index for household i, and this equals the weighted average of the five major components. The weights (W) of each major component, w_i, are determined by the number of sub-components that make up each major component and are included to ensure that all sub-components contribute equally to the overall LVI (Sullivan et al., 2002).

Household Livelihood Index (HLI) = average value of individual indices. This can be expressed as:

KLD?G =M____PDPDG
+MMQDPDQD+GM+QPM+KDMKDKDG ++MMPRDPRDPRD+MGPSD+MPSDPSDG

The five security indices calculated are Economic, Food, Education, Health and Empowerment. Following the work of Rahman and Akter (2000), the following livelihood indicators and components are used.

Table 3.6: Components of Livelihood

Security Indicator	Components
Economic Security	Per person income Per person value of livestock Household assets per person Ratio of the active population to the total population (dependency ratio) Current household saving Household loan portfolio per person
Food Security	Dietary diversity: number of food groups consumed per day by the family Food frequency (number of meals per day) Household food stock (GH¢) Number of food convenient months in the year

Health Security	Body mass index of Household head Body mass index of spouse Body mass index of under 5 children in the household Per person incidence of malaria, diarrhea in the last 30 days Household members having valid NHIS per person
Educational Security	Years of Education of Household Head Years of Education of Spouse Average years of education of other household adults Boys 6-15 enrolled in school Girls 6-15 enrolled in school Boys 16-23 enrolled in school Girls 16-23 enrolled in school 7+ population who can read and write (literacy)
Empowerment	number of community participation household head have access to an organization that provides service other household members have access to an organization that provides service household head/member holds position in the ruling party

Adopted and modified from Rahmnan and Akter, 2010 and CARE international To test the differences of the various components of livelihood security and the overall livelihood security based on respondents' locations and crop type, the Kruskal-Wallis test was used. The Kruskal-Wallis test evaluates whether the population medians on a dependent variable are the same across all levels of a factor (Green and Salkind ,2008). The Kruskal-Wallis test is the nonparametric test equivalent to the one-way ANOVA, and an extension of the Mann-Whitney U test and it allows the comparison of more than two independent groups (Boduszek, 2010). In other words, it is used in testing for difference between several independent groups.

To conduct the Kruskal-Wallis test, the independent or grouping variable divides individuals into two or more groups, and the dependent variable assesses individuals on at least an ordinal scale. If the independent variable has only two levels, no additional significance tests need to be conducted beyond

the Kruskal-Wallis test. In cases where there are more than more than two levels like locations (Techiman, Sefwi Wiawso, and Offinso North), and the overall test is significant, followup tests are conducted. These follow-up tests involve comparisons between pairs of group medians.

The hypothesis that is to be tested are:

H_0: All the means are the same

Ha: Not all the means are equal.

One important advantage of the Kruskal-Wallis test is that it allows us to compute the effect size that is proportion of variation in the dependent variables due to the independent variables tested. Since the Kruskal-Wallis test uses the chi-squared statistics, the effect size, assume that to be eta squared (η) is computed from the chi-squared value as the ratio of the chi-squared value to the sample less one. η= ___^{TU} where N is the total number of sample.

VW

To establish how household characteristics affect the various components of livelihood security and the overall livelihood security, linear regression models are estimated using Ordinary least square approach. Following the work of Rahman and Akter who studies the livelihood security of poor households in Bangladesh, and modifying his model, the following models are estimated.

$$ID_G = X_G + Y_G ZID_G + Z[_{G\backslash}]_{G\backslash} + ^_G \ldots \_F' \_ aB \_b\ cGd\ cGe\_\_@\ B\ fghGai \ldots \quad Pj$$

GJ \J

$$KLD?_G = X_G + Z[_{G\backslash}]_{G\backslash} + ^_G \ldots\ldots\ldots \_d\ hHcc\ cGd\ cGe\_\_@\ B\ fghGai\ Pj\ !$$

\J

CS_i represents each of the five security indices as discussed above and $HLSI_i$ is the overall security index for the i^{th} household, the X's are the exogenous variables representing household economic circumstances as well as community level attributes.

For the overall livelihood security, the actual model estimated is

$$KLD?_G = X_G + [\ k + [_I Hk + [_O Hk_{BjgHh} + [_l FBaHa + [_N eeBGm + [_n Ih\_`_{b\_@}$$

$$+ [_o Ih\_`_{fHBe} + [_p c\_f_{a\ feGFH} + [_q c\_f_{Dr} + \wedge_G \ldots\ldots\ldots\ldots Ej\ O$$

The variables that were put in the model and their expected signs are shown in the table 3.7 below

Table 3.7: Definitions and signs of variables for the regression

Variable	Description	Expected Sign
gen	Gender of the household head: male=1 female=0	+
age	Age of household head	+ but should be declining
mstat	Head is currently married and living with spouse = 1	+ more labour supply
famsize	Family size (number of persons in the household)	+ or – depending on the age
$Ih\_`_{fHBe}$	Household primarily produce plantation crop	Sign to be tested

Ih_‘b_@	Household is primarily produce food crop	Sign to be tested
c_f_a feGFH	Household is located at Techiman	Sign to be tested
c_f_Dr	Household is located at Sefwi Wiawso	Sign to be tested

Adopted and modified from Rahmnan and Akter, 2010

3.9.3 Risk Perception, Socio-economic determinants and impact on Livelihood.

3.9.4 Risk identification and Rankings

In order to find out the perception of risk and likelihood of occurrence, several sources of risk were presented to the farmers and they were asked to express their perception about the importance of these risks to their activities using five point Likert scale. The information on the perception of the sources of risk obtained is then analyzed.

To rank the risk based on location and crop types, the Kruskal-Wallis test was applied. This is to test whether the individual and the overall risks sources differ among farmers based on location and the type of crop the farmer produces.

In the second part of the analysis, Exploratory Factor Analysis (EFA) is used to capture the information on the interrelationships among the set of variables. The basic aim here is meant to find out the type of risk that is most critical to the farmers in the rural areas of Ghana. Factor analysis is an interdependence technique in that an entire set of interdependent relationships is examined without making the distinction between dependent and independent variables (Trachtenberg, 2009).

Factor analysis enables the researcher to manage and reduce the number of original variables into a smaller group of a new correlation dimensions (factors), which are linear combinations of the original variables (Hair, 2006; Pallant, 2007). The FA is used to summarize and reduce the 30 variables involved with the perception of risk sources likelihood of occurrence responses in this study. The

Kaiser-Meyer-Oklin (KMO) method measured the appropriateness for factor analysis of both data sets. The KMO index varies from 0 to 1, with results of 0.6 or greater being suitable for factor analysis. Also, the latent root criterion (eigenvalue > 1) was estimated to identify how many factors in each data set to extract. After the number of factors had been identified, the orthogonal (varimax) rotational approach was performed in order to minimize the number of variables that have high loadings on each factor. A factor loading of ±0.4 was employed as a cut off criterion to determine the inter correlation among the original variables. In addition, Cronbach Alpha was employed to evaluate the internal consistency of each factor (Hair, 2006).

3.9.5 Socio-Economic Determinants of Risk Perception and impact of risk perception on livelihood

To examine the socioeconomic impact on risk perception, multiple regression is employed to evaluate the influence of farm and farmer characteristic variables on the farmers' risk perception, with the weighted mean of responses of each farmer used as the dependent variable with socioeconomic characteristics of individual farmers as the independent variables. To compute the weighted mean of each respondent, the frequencies of responses for the farmers' risk perceptions are multiplied by the scores on the 4-point Likert scale. The weighted mean of responses of each farmer is computed as:

$$\frac{Q\,B\times l+QB\times O+QFB\times !+Q\,B\times u=}{}$$

where w is the weighted mean of responses of each farmer, and the notations used for the weighted frequencies are respectively F*es* (extremely severe), F*s* (severe), F*ms* (moderately severe), F*ns* (not severe) and N is the number of respondents.

The regression model used is stated as:

$$u_G = X_G + Z[_{G\backslash}]_{G\backslash} + \hat{}_G \ldots\ldots\ldots\ldots\ldots Pj\ l$$
$$\backslash J$$

where u_G is the weighted mean of responses of each farmer and $]_{G\backslash}$ is the vector of household's socioeconomic characteristics.

The specific model estimated is:

$$u = X_G + [\ k + [_{!}Hk + [_{O}Hk\ _{BjgHh} + [_{l}\ @g + [_{N}eeBGm + [_{n}G\ f\_F + [_{o}M\ Hcae$$

$$+ [_{p}bFBGm + [_{q}c\_f_{a\ feGFH} + [_{x}c\_f_{Dr\ y\ [}\qquad\qquad Ih\_`b\_@ + [\ Ih\_`fHBe$$

$$+ \hat{}_G \ldots\ldots\ldots\ldots\ldots Pj\ N$$

Variable	Description
gen	Gender of the household head: male=1 female=0
age	Age of household head
Age_squared	Squared age of the household head
Edu	Educations (Years) of the household head
hhsize	Family size (number of persons in the household)
Income	Total household income for the past one year
wealth	Total household wealth
Fmsize	Farm size
$Crop_{}$	Household primarily produce plantation crop
Crop	Household is primarily produce food crop
loc_techiman	Household is located at Techiman
loc_SW	Household is located at Sefwi Wiawso

3.9.6 Risk Attitude, Socio-economic determinants and impact on Livelihood.

This part of the analysis focuses on the measurement of risk attitude of rural farmers in Ghana and the socioeconomic determinants. In the first part of the analysis, the procedure for the measurement of risk aversion coefficient is computed, using the arrow-Pratt risk aversion coefficient approach. .

3.9.7 Utility function and the calculation of the Arrow Pratt risk aversion coefficient

As defined by Hardaker and Huirne, et al. (2004), risk aversion measures a person's willingness to accept a bargain with an uncertainty payoff rather than another bargain with more certainty with the probability of a lower expected payoff. This indicates that the shape of a person's utility function affects risk aversion. The risk aversion coefficient is derived directly from the utility function. The second derivative of a utility function, or the change in marginal utility as the level of income or wealth increases, is a commonly used measure of risk aversion. Given the utility function in terms of wealth or income, that is , U(w), where w is income or wealth, then the first and the second derivatives are given as +( ) and + ( ) respectively. Its sign is used to classify a decision maker's attitude toward risk. Specifically, + ( )<0 implies risk aversion, + ( )=0 implies risk indifference, and + ( )>0 implies risk preference.

Utility generally is measured on an ordinal scale. To make it practical in mathematical modelling, it must be transformed into a quantitative measure of risk aversion. This is solved by using a measure that is constant for any positive linear transformation of a utility function. This measure is known as the coefficient of absolute risk aversion, $r_a(w)$. It was defined by Pratt (1964) and Arrow (1964) as

$$=-+'( ) +( )$$

Absolute risk aversion can be interpreted as a change in marginal utility per unit of outcome space (Raskin and Cochran, 1986). This coefficient is positive for risk aversion and diminishes (increases) for increasing in wealth/income if there is diminishing (increasing) risk aversion.

There are different forms of the utility functions and the value of the absolute risk aversion coefficient depends on the utility function used. Five of such functions most commonly used utility functional forms and corresponding type of risk measures are introduced.

Quadratic Utility Function

Early applied researchers often used quadratic utility function in practice. This function is tractable computationally and lends itself nicely to empirical studies. Quadratic utility function, however, may not be appropriate when the decision involves reasonably moderate changes in wealth because it assumes the increase of wealth causes the increase in risk aversion which is not appropriate assumption on real life (Binici, Koc and Bayaner, 2001).

The quadratic utility function has the form:

$$+( )=' +' +'$$

Where u denotes utility and w refers to wealth or income. Parameter restrictions of the utility function are $' >0$ $' <0$

The first and second derivatives are respectively $+( )= +2$ and $+'( )=2$. Therefore, the absolute risk aversion coefficient for quadratic utility function is:

$$( )=-^{+ ( )}=-*+( ) \quad \_\_\_\_\_ +2^{2} \ -$$

As explained before, this coefficient increases in wealth or income, and therefore, it makes the quadratic utility function an implausible functional form in real life situations.

Cubic Utility Function

Cubic utility function can be written as follows:

$$+( )=' +' +' \qquad +'$$

The first and second derivatives are respectively $+( )= +2 +3$ and $+ ( )=2 +6$. Therefore, the absolute risk aversion coefficient for quadratic utility function is:

$$( )=-^{+ ( )}=-*+( ) \qquad \frac{(2a_3 + 6a_4 w)}{(+2 +3 \qquad)}-$$

Where A(w) denotes the absolute risk aversion coefficient that can be positive or negative depending on the second derivative of utility function.

Negative Exponential Utility Function

The negative exponential utility function exhibits constant absoluter risk aversion (CARA). It implies changes in the location of initial wealth do not alter decision (Pope and Just, I 991). Though this utility function's use in applied situation has been criticized by Arrow (1964) because of CARA, it has been widely used in empirical analysis (Hardaker, Huirane, and Anderson; 1997).

The negative exponential utility function can be written as follows:

$$+( )=1-3^{W}$$

Where u(w) denotes utility, 3 is exponential, a positive constant that represents the degree of absolute risk aversion and w refers to wealth or income. This utility function implies diminishing marginal utility for wealth or income because second derivative.

The first and second order derivatives are respectively $+( )=’3^{W}$, $+( )=-’3^{W}$. From this, the risk aversion coefficient is given as

$$( )=-\frac{u}{u}=-\frac{’3^{W}}{}=’$$

This shows that the absolute risk aversion coefficient A(w), is equal to ’ which is constant and positive.

The sequences of data points elicited from the ELCE for each respondent would be regressed using the non-linear least square (NLS) method to fit four different utility functions. The statistical goodness of fit assessment, R^2, would be tested to verify the best fit. Any violation of parameters’ restrictions in each functional form would also be tested.

Last section involves two regression estimations. The first one is to test the effects of family and household characteristics on the risk aversion coefficient. The regression equation is adopted from the one used by Satit Aditto (2011), in his thesis. The regression, modified to include other variables is of the form.

$$G = C_x + C\,KK\,P + C_!KK\,P_{DjgHh\,@} + C_OKK\,P + C_IKD? + C_NPR + C_n? \,I\,SP$$
$$+ C_orP\,L\,K + C_pQSD?\,P + [_qIh\_‘_{b\_@} + [_xIh\_‘_{fHBe} + [\,c\_f_{a\ feGFH}$$
$$+ [_!c\_f_{Dr} + \boldsymbol{e_i} \text{ **********} \boldsymbol{Eqn\ 6}$$

CHAPTER FOUR

ANALYSIS OF LIVELIHOOD SECURITY AND DETERMINANTS AMONG RURAL FARMERS IN GHANA

4.1 Introduction

The measurement well-being at the household level has been extensively explored. For instance, Belcher and Sewell began developing scales for measuring levels of living at the household levels in the 1950s (Belcher, 1951; 1972 as cited by Lindenberg, 2002).

The calculation of the livelihood security index is inspired by the livelihood vulnerability index, which is used to study the impact of climate change on the vulnerable. For instance, Halm et al (2009) combined previous methods to construct a Livelihood Vulnerability Index (LVI) to estimate the differential impacts of climate change of communities in two districts of Mozambique. The LVI is expressed as a composite index of components that makes up the livelihood of the household.

It has been suggested that dependency on subsistence agriculture, a real phenomenon in Ghana, is a major cause of poverty and environmental degradation (Grant and Bhandari 2007). So it important to examine the extent of livelihood security among rural farmers in Ghana in order to know their real standard of living. Therefore, following Rahman and Akter,(2010), five security indicators are constructed among rural farmers in Ghana. These indices are Economic Security, Food Security, Health Security, Educational Security and Empowerment (Lindenberg 2002). In this section, the various components of these indices are discussed.

4.2 Summary statistics of respondents

As discussed in the methodology, the data for the work covered 30 rural farming communities in three districts in Ghana. The data was collected by 10 research assistants and the researcher. The

questionnaires were administered to household heads, with most household members around. This ensured that information were verified and corroborated.

4.2.1 Gender

As expected, most households had males as heads. Sefwi Wiawso has the highest proportion of the household heads being males. This might be because of the nature of the agricultural activities there. Most of the farmers are into cocoa production. The table 4.1 below gives the gender division.

Table 4.1: Gender of Household head

District	Male		Female		
	Frequency	Percentage	Frequency	Percentage	Total
Offinso North	293	73.25%	107	26.75%	400
Techiman	296	74%	104	26%	400
Sefwi Wiawso	312	78.39%	86	21.61%	398
Total	901	75.21%	297	24.79%	1,198

Source: Author's Field Work, 2014

Table 4.1.2: Marital Status

District	Single/Never Married		Married		Widow/ Widower		Divorced		Total
	No	%	No	%	No	%	No	%	
Offinso North	27	6.75	333	83.25	26	6.5	14	3.5	400
Techiman	18	4.5	321	80.25	29	7.25	32	8.0	400
Sefwi Wiawso	0	0	362	90.95	22	5.53	14	3.52	398
Total	45	3.76	1,016	84.81	77	6.43	60	5.0	1,198

Source: Author's Field Work, 2014

As indicated, greater proportion of the household heads are married. This is not surprising because of the trend in farming around the world. According to the Food and Agricultural Organization of the United Nations (2014), family farming is the predominant form of agriculture both in developed and developing countries. It further states that farmer's rural activities are managed and operated by a family and rely predominantly on family labour. Thus married farmers are better placed to have larger family and thus larger family labour. It is therefore no surprising that most rural farmers are married in Ghana.

4.2.2 Main Crop Cultivated by the Household

The rural farmers in the study areas cultivate many crops. These crops range from food such as Yam, Plantain, and cocoyam; to vegetables such are tomatoes, garden eggs and pepper; to plantation crops such as cocoa, oil palm and cashew. It must however be noted that farmers generally interplant these crops, especially the food crops and vegetables.

Notwithstanding, this section sought to find out the farmers who generally saw themselves as generally food crop or plantation crop or vegetable farmers. The results are presented in the table 4.3 below.

Table 4.3: Main crop that the household produces

District	Plantation crop		Food Crop		Vegetable Crop		No Particular Crop		Total
	No	%	No	%	No	%			
Offinso North	49	12.25	158	39.50	141	35.25	52	13.00	400
Techiman	84	21.00	219	54.75	26	6.50	71	17.75	400

Sefwi Wiawso	258	64.83	66	16.58	7	1.76	67	16.83	398
Total	391	32.64	443	36.98	174	14.52	190	15.86	1,198

The table shows that about one third of the surveyed farmers regard themselves as food crop farmers while 14.52% of the farmers regard themselves as vegetables farmers. Most of the plantation crop farmers, as expected, were from rural areas at Sefwi-Wiawso as they produce mostly Cocoa. Most of the food crop farmers are from the rural communities in the Offinso North. However, about 16% of the farmers did not regard any particular crop as their main crops. They regarded the three crop types as equally important to them. Thus they didn't view themselves as having any single crop as their main farming business.

4.2.3 Educational status

As indicated by Sharada Weir (1999), education may enhance farm productivity directly by improving the quality of labour, by increasing the ability to adjust to disequilibria, and through its effect upon the propensity to successfully adopt innovations. Education is thought to be most important to farm production in a rapidly changing technological or economic environment (Shultz 1964; 1975). Given the fact that farming methods in Ghana are largely traditional, we do not expect farmers in the rural areas to be highly educated. The table below gives the educational breakdown of the educational level of rural farmers in the study areas.

	Table 4.4: Level of education of the household head										
District	No Education		Primary		JHS		SHS		Tertiary		Total
	No	%	No	%	No	%	No	%	No	%	
Offinso North	183	45.75	60	15	130	32.50	24	6.00	3	0.75	400
Techiman	177	44.25	70	17.50	108	27.00	42	10.50	3	0.75	400

Sefwi Wiawso	166	41.71	56	14.07	130	32.66	34	8.54	12	3.02	398
Total	526	43.91	186	15.52	368	30.72	100	8.35	18	1.50	1,198

Source: Author's Field Work, 2014

As predicted, most of the respondents had little or no education. It was realized that about 43.91% of the respondents reported that they have no formal education. However, 15.52% of the respondents completed primary school education. One thing that was striking was the fact that more respondents have completed Junior High School (30.72%) than those who have completed only Primary School (15.52%). This may mean that most people in rural Ghana who start school continue until they complete the entire Basic School that starts from Primary One to Junior High School 3.

4.3 Livelihood Security

In this section, the livelihood security status of rural farmers in the study areas are computed using the formula outlined in the methodology. Five livelihood indicators are computed and analysed.

4.3.1 Economic Security:

For most rural farmers in Ghana, economic security is of paramount importance. Six components were used to measure the economic security index. These are Income per Person, value of livestock loan portfolio of the household, household assets per Person, savings, and active population per household.

4.3.1.1 Income for the past one year

Rural farmers earn income from several sources. Aside farm income, they earn other incomes from other sources. These are summarized in the table 4.5 below:

Table 4.5 shows that farm income is the major source of income in the communities under study. This is not surprising since most of the respondents are farmers. However, farmers in the various communities earn income from other sources such as labour income from the farm work as well as non-farm work such as teaching, vocational work, trading, and other labour work. According to the farmers, they try to earn income from other source so that in cases where households do not earn enough money from their farm produce, they are still able to survive. According to the farmers, they rely mostly on their farm produce to survive, however given the nature of their business, it takes time from planting to harvesting and finding buyers for their produce, and therefore non-farm labour income is able to fill this gap and allows them to smooth out their purchases. It also allows them to buy little things like soap, meat, salt and others. In the literature, several researchers have looked at the importance of non-farm income on rural farmers. Reardon et al. (1998) finds that nonfarm income as a share of total household income averaged 42 per cent for Africa, 32 per cent for Asia and 40 per cent for Latin America. In Ghana, non-farm employment is an equally important source of income for rural households. Reports indicate that non-farm income as a share of total household income in rural Ghana increased from 35 per cent in 1998 to 41 per cent in 2006 (Senadza, 2010).

Table 4.5: Summary of Income Sources over the past one year

District	Income Source	Obs	Mean	Std. Dev.	Minimum	Maximum
Offinso North	Farm income	399	2,706.40	1,161.75	190	19,400
	Farm and Non-Farm labour Income	227	1,274.60	460.33	60	9,400
	Net Transfer	69	299.8551	42.42	10	2,400
	Other income	13	252.3077	46.48	10	650
	Farm income	400	3,117.15	461.42	200	30,400
	Farm and Non-Farm labour Income	203	2,046.35	644.15	32	16,300

Techiman	Net Transfer	93	418.49	50.73	20	2,400
	Other income	31	548.71	177.92	10	2,000
Sefwi Waiwso	Farm income	398	4,378.06	581.54	600	75,000
	Farm and Non-Farm labour Income	211	2,453.11	381.03	20	19,650
	Net Transfer	69	817.39	329.17	30	6,000
	Other income	10	714	73.57	100	2,000

Source: Author's Field Work

Another source of income to the rural households in the study areas is transfers. These are monies sent by relatives who do not stay in the villages as the heads of the households. According to the respondents, these monies are received regularly (monthly) but sometimes occasionally.

Notwithstanding the importance of the other sources of income, farm income remains the single most important sources of income among farmers in the study rural communities, as shown clearly in table 4.5 above

Data from the studied communities show that the average income among rural farmers at Sefwi Wiawso is higher than those from Offinso North and Techiman. On average, the annual average income among rural farmers at Sefwi Wiawso is GH¢5,374.93 the maximum income of GH¢ 75,200 and minimum income of GH¢900. This compares sharply with the average incomes of GH¢3,620.57 and GH¢2,567.08 among rural farmers at Techiman and Offinso North respectively

Using the Hotelling T^2 we test the hypothesis that the three mean incomes among the rural farmers in the three study districts are the same. Hotelling's T-squared statistic is a multivariate generalization of the univariate t statistic. Given the Prob > F = 0.0000, we reject the null hypothesis of equal mean income among the rural farmers in the three study districts.

Table 4.6: Average income of households

District	Obs	Mean	Std. Dev.	Minimum	Maximum
Offinso North	400	3,482.90	2,567.08	500	19,400
Techiman	400	3,753.00	3,620.57	500	30,400
Sefwi Wiawso	398	5,838.226	5,374.925	900	75,200
Test that all means are the same: Hotelling T^2 = 65.07 Hotelling F(2,396) = 32.45 Prob > F = 0.0000					

Source: Author's Field work

It can therefore be concluded that the differences in the average incomes are statistically significant at 99%. Thus it can be concluded with 99% confidence there exists significant differences between average incomes among rural farmers at Offinso North, Techiman and Sefwi Wiawso

One plausible reason for the differences in the average incomes is the type of crops produced in the various communities. At Sefwi Wiawso, majority of the farmers are into plantation crop production, mostly cocoa. According to the data from the research, nearly all the plantation crop farmers are cocoa farmers. In Ghana, cocoa is the major plantation crop with many government interventions and therefore many people who engage in them have relatively stable income since it does not suffer from price fluctuations as other crops do. Two basic government interventions that the cocoa sector enjoys

that other farming sectors do not is the mass cocoa spraying exercise and the price control. Government fixes the local price of cocoa from the beginning of the farming season and therefore cocoa farmers enjoy stable price for their products, irrespective of the harvest. Aside stable price, they also have ready market. These two conditions contrast sharply with vegetable and food crop farmers who have to find their own buyers and also battle with unstable price all year round. During the harvest season, vegetable and food crop farmers sell their produce at very low prices and sometimes may not even have buyers for their produce. It is a common sight to see tomato farmers throwing their produce out or selling them cheaply. It is therefore evident that in rural Ghana, plantation crop farmers are more likely to have better income than farmers who engage in other farming activities. This point is buttressed by Barret (2001), who found out that there is an existence of distinct, wealth differentiated diversification behaviors in rural Africa, with the poor more reliant on farm wage labor and the wealthy drawing more heavily on income from plantation crop and livestock production and on non-farm earnings.

To confirm how important crop type is to income among rural farmers, we summarize the average income among the various crop producers. This is shown in table 4.7

Table 4.7: Summary of Income among Crop Types

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Plantation crops	392	5,236.112	974.391	500	75,200
Food Crops	443	3,669.406	988.634	600	23,350
Vegetable Crops	173	3,691.867	795.93	500	19,400
Hotelling T^2 = 8.95		Hotelling F(2,171) = 4.45		Prob > F = 0.0131	

Source: Author's field work

The results show clearly that the average incomes among plantation crop farmers are higher than those among food crop and vegetable crop farmers. The Hotelling T^2 statistic shows that the differences are statistically significant at 95% confidence level. Thus, a farmer that engages in plantation crop production is likely to have higher income than those engaged in other crops.

Table 4.8 summarizes the six components that are used to calculate the economic security index. Out of the six indicators, only two of them show statistical differences among the communities in the three study districts. As shown earlier and confirmed now, the average income per person is different statistically among the various communities in the three districts. The differences in the amount the average saving figures among the households are also statistically significant.

One striking result worth mentioning is the value of the income per person. In table 4.6, it was found out that the average income among rural farming households in Sefwi Wiawso was the highest, and statistically significant. However, the income per person is highest among households at Techiman. This means that the average households in Sefwi Wiawso are higher than that of Techiman. Thus though the total income level among rural farming households at Sefwi Wiawso are highest, the per-person income is higher at Techiman. This implies that on average households at Sefwi Wiawso are on average richer than that of the other communities from the other districts, individual members of the households are richer at Techiman than the communities from the other two districts.

Table 4.8: Economic Security Indicators

Indicator	Offinso North		Techiman		Sefwi Wiawso	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Per Person Income	802.7088	236.2399	1,303.588	319.355	1,174.55	146.919
Per Person Value of Livestock	69.06788	20.5152	94.97465	29.2536	106.5656	61.6195
Household Loan Portfolio Per Person	11.0385	4.55299	12.9503	3.4615	16.60151	3.7054
Household assets per person	885.4117	87.399	1,032.848	34.237	1001.002	64.721
Household Monetary Saving Per Person	92.70243	13.8489	125.057	21.8162	131.7712	24.3059
Household Active Population per Person	0.563175	0.0258044	0.59085	0.2352011	0.583576	0.214635

Test Statistics that the various means are equal

	Income	Livestock	Loan	Assets	Saving	Population
	Hotelling T2 = 28.88 Hotelling F(2,395) = 14.40 Prob > F = 0.0000	Hotelling T2 = 1.39 Hotelling F(1,397) = 1.39 Prob > F = 0.2385	Hotelling T2 = 0.85 Hotelling F(2,396) = 0.42 Prob > F = 0.6564	Hotelling T2 = 2.29 Hotelling F(2,396) = 1.14 Prob > F = 0.3205	Hotelling T2 = 9.57 Hotelling F(2,396) = 4.77 Prob > F = 0.0089	Hotelling T2 = 3.14 Hotelling F(2,396) = 1.57 Prob > F = 0.2100

Source: Author's field work

Livestock per person is highest among the households at Sefwi Wiawso than the other districts. As indicated by Fafchamps, Udry, and Czukas (1996), it has long been hypothesized that households keep livestock as a buffer stock to insulate their consumption from fluctuations in farm income. That

is if there is any unexpected fall in the income of the households due to say bad harvest, they either sell or eat their livestock to make up for the loss. However, they found only very limited evidence that livestock inventories serve as buffer stock against large variations in crop income induced by severe rainfall shocks in West Africa. In this work, the emphasis was on whether the livestock kept by the rural households in the study districts are statistically different from each other. This was to find out if the ability of the rural farmers to insulate their consumption from income fluctuations are equal. To do this, the differences among the average livestock values were tested. However, these differences were not statistically significant. Similar conclusions can be made for Loan portfolio per person, house, land and household Assets and active population per person. The differences among the values for the households are not statistically significant.

The saving stock among rural households at Sefwi Wiawso is highest compared to rural households at Offinso North and Techiman. This means that the saving culture among rural communities at Sefwi Wiawso is higher. However, it must be noted that the saving used here was the total stock of household saving, but not the proportion of income.

Having discussed the various components of the economic security, the next step is to compute the economic security index. The economic security index was calculated using the standardized values of the above discussed indicator variables; standardization was done using their ward level maximum and minimum values. The table 4.9 below summarizes the economic security index for the communities in the study districts.

Economically, the rural communities from the three districts are not the same. The Hotelling T^2 statistics reject the null hypothesis that all the communities are the same economically. This means that there are differences in the economic security statues among the rural communities in the studied districts. However one striking observation is that the economic security status is statistically the same among rural communities in the Offinso North and Techiman municipality.

Economic security index is statistically the same and low in the rural communities in both districts compared to those in Sefwi Wiawso.

Table 4.9: Economic Security Status

District	Observation	Mean	Std. Dev.	Minimum	Maximum
Offinso North	400	0.083	0.043	0.006	0.167
Techiman	400	0.087	0.062	0.010	0.421
Sefwi Wiawso	398	0.139	0.089	0.023	0.886
Test that all three mean are the same Hotelling $T^2 = 135.15$ Hotelling F(2,396) = 67.40 Prob > F = 0.0000		Mean differences btn Offinso North and Techiman Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T| >|t|) = 0.2389	Test of Mean differences btn Offinso North and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T| > |t|) = .0000	Test of Mean differences btn Techiman and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠0 Pr(|T| > |t|) = 0.0000	

However it is evident from the table that the average economic security values are very low. With the exception of communities at Sefwi Wiawso, the values are less than 0.1. It can thus be concluded that rural farming population in Ghana is economically extremely insecure. Location of the farmers does not matter to economic security. This indicates policy intervention is equally necessary in all farming communities to help farmers in Ghana irrespective of their locations

4.3.2 Health security

Given the labour intensive nature of farming in Ghana, health is an important issue to rural households. This means healthy families are likely to be better in terms of livelihood compared to less healthy families.

Seven components were used to measure the health statues of the households. These are Body Mass Index (BMI) of household heads, BMI for spouses, average BMI of under 5year olds, Proportion of household members who have health insurance, incidence of Malaria, farm accident and Cholera; number of days household member have suffered from other sickness; and distance to health Centre. Using the USA centre for Disease Control (CDC) ranges for weight classification using BMI, adults with BMI less than 18.5 is classified as underweight; those with BMI from 18.5 to 24.9 are classified as having normal weight. Overweight people are those with BMI from 25.0 to 29.9. Anyone with BMI above 30 is classified as obese. Based on these BMI classifications, 42 household heads at Offinso North were classified as Underweight, while that of Techiman and Sefwi Wiawso were respectively 24 and 23. Two hundred and Seventy two household heads at

Offinso North were classified as having normal weight while the figures for Techiman and Sefwi Wiawso were 295 and 289 respectively. The numbers of overweight respondents were 79, 77 and 85 at Offinso North, Techiman and Sefwi Wiawso Respectively. The classification of children's health status using BMI was slightly different from that of adults. While that of adults are stable, those of children vary by age and gender. However, in this work, the averages of the scales are used. Using the child BMI range by the Australian Bureau of Statistics, Appendix 4, children underfives with BMI less than 14.6 are classified as underweight, those from 14.6 to 17.79 are normal weight and those above 17.79 to 19.53 are overweight and above 19.53 are obese. From the data gathered, 133 under-fives in the Offinso North, 75 at Techiman and 60 from rural areas at Sefwi Wiawso classified as underweight. This means that all other things equal, there are more underweight children at the rural areas at Offinso North compared to those at the rural areas of Techiman and Sefwi Wiawso. This means that any child policy aimed at enhancing child health in the rural communities in Ghana should be intensified at the rural communities in the Offinso North

district.

The table 4.10 below summarizes the health security components used to measure the health index. The table indicates that the average BMI is higher among rural farmers at Techiman municipality than the other two. However, the differences are not statistically significant. This means all things equal, the BMI are statistically not different among rural farmers in Ghana. The average under five BMI is higher at Sefwi Wiawso rural communities than the others, and these differences are statistically significant. This means that on average, the children under five years of rural farmers at Sefwi Wiawso are healthier than that of the rural farmers at Techiman and Offinso North.

Table 4.10: Health Security Components

Indicator	Offinso North		Techiman		Sefwi Wiawso	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
BMI.. Household Head	23.313	3.071	22.851	2.898	23.015	2.679
BMI.. Spouse	22.867	2.290	22.602	2.017	22.787	1.981
BMI…. Under 5 yrs	15.271	1.317	15.872	1.514	16.115	1.520
Per Person registration of NHIS	0.604	0.384	0.735	0.309	0.710	0.344
Per person incidence of Malaria, diarrhoea in last 30 days	0.314	0.370	0.229	0.373	0.178	0.293
Per person days of other sickness in last 30 days	2.004	0.548504	0.020	0.00885	1.729	0.295
Inverse of Distance to Health Center	0.016	0.009	0.023	0.018	0.015	0.007

On average, about 73% household members among rural farmers in Techiman have valid health insurance while the figures for Sefwi Wiawso and Offinso North are respectively 71% and 60%. This means that the national health insurance coverage is very high among rural households at Techiman municipality compared to the other two districts.

The health security indexes are presented in the table 4.11 below. The test statistic shows that there are significant differences between the health statuses of other rural farmers in the three study districts. The health status of rural farmers at Sefwi Wiawso is highest compared to those at Offinso North and Techiman. However, the t-test statistics shows that there are no statistical differences between the mean health security of rural farmers at Techiman Municipality and those of Sefwi Wiawso. Thus in terms of health, those at Techiman municipality and Sefwi Wiawso municipality are statistically the same

Table 4.11: Health Security Status

District	Observation	Mean	Std. Dev.	Minimum	Maximum
Offinso North	400	0.391	0.100	0.016	0.625
Techiman	400	0.429	0.097	0.089	0.667
Sefwi Wiawso	398	0.429	0.084	0.162	0.617
Test that all three mean are the same Hotelling T^2 =41.18 Hotelling F(2,396) = 20.54 Prob > F = 0.0000		Mean differences btn Offinso North and Techiman Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T| >|t|) =0.0000	Test of Mean differences btn Offinso North and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T| > |t|) = 0.0000	Test of Mean differences btn Techiman and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠0 Pr(|T| > |t|) = 0.409	

4.3.3 Food Security

Food is important to every living human being. It's the source of energy to the human body. Four components were used to calculate food security status of the households. These are Food Frequency, Dietary Diversity, Household Food Stock per Person, and Food Convenient Months in the Year. Dietary diversity here refers to the number of food groups consumed per day by the household on

average. Food stock per person measures the monetary value of food stock held by the household per person in the household as at the time of the questionnaire administration. It is found by the value of the household food stock divided by the household size. Food Convenient Months in the Year is defined as the number of months within the year that the household is able to meet its food needs exclusively from its own farms. Food frequency is defined as the number of times the family eats food within the day. The summary of Food frequency is presented in the table 4.12 below.

Table 4.12: Household food frequency

Food Frequency	Offinso North		Techiman		Sefwi Wiawso	
	Freq.	%	Freq.	%	Freq.	%
Once a day	8	2	2	0.50	9	2.26
Twice a day	173	43.25	153	38.54	110	27.64
Thrice or more	219	54.75	242	60.96	279	70.10
Total	400	100%	397	100%	398	100%

Source: Author's Field Work, 2014

The table shows clearly that most rural people eat least twice a day. This is very important for their health and the physical nature of farming, which is their main occupation.

Table 4.13 summarizes means and the standard deviations of the components used to compute the food security index. All the differences among the means are statistically significant at 95% confidence level. All the components are highest among the rural communities at Sefwi Wiawso compared to the rural communities in the other two districts. At Sefwi Wiawso, the rural communities reported that on average they are able to meet their food needs from their own farm for 11 months

within the year. This means that its only one month within the year that they struggle to meet their food needs. This compares with 9.7 months for Offinso North and about 10.4 months for Techiman rural communities.

Table 4.14 summarizes the computed food security indexes for the rural communities in the three districts.

Table 4.14: Food Security Components

Indicators	Offinso North		Techiman		Sefwi Wiawso	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Food frequency (meals and snacks per day)	4.120	1.065	4.237	0.990	4.410	1.051
Dietary diversity: no. of food groups consumed per day	10.425	1.987	9.980	0.290	9.397	2.10892
Household food stock (GH¢ per person)	165.920	21.130	193.380	88.400	149.140	84.870
Number of food convenient months in the year	9.713	0.238	10.388	1.200	10.776	1.049

Table 4.15: Food Security Status

District	Observation	Mean	Std. Dev.	Minimum	Maximum
Offinso North	400	0.490	0.107	0.146	0.856
Techiman	400	0.533	0.105	0.186	0.810
Sefwi Wiawso	398	0.541	0.101	0.173	0.811

Test that all three mean are the same Hotelling $T^2 = 60.52$ Hotelling F(2,396) = 30.19 Prob > F = 0.0000	Mean differences btn Offinso North and Techiman Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T| >|t|) =0.0000	Test of Mean differences btn Offinso North and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T| > |t|) = 0.0000	Test of Mean differences btn Techiman and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠0 Pr(|T| > |t|) = 0.2682

As expected, the food security is high among the rural communities at Sefwi Wiawso compared to those at Offinso North and Techiman. In addition, the multivariate mean statistics shows that the hypothesis that the means are the same is rejected at 1% error level. However, the mean difference between those at Sefwi Wiawso and Techiman was found to be statistically insignificant. Thus statistically, all rural communities at Sefwi Wiawso Municipality are more secured in terms of food security than those at Offinso North and but not different from those at Techiman. The high food security index at Sefwi Wiawso is not surprising as it is well noted for the high farming at those areas.

4.3.4 Educational Security:

Education is very important to the rural households in Ghana if they are to break away from chronic poverty. When a household is well educated, they are known to be able to work better and produce better. As indicated by Sharada Weir (1999), education may enhance farm productivity directly by improving the quality of labour, by increasing the ability to adjust to disequilibria, and through its effect upon the propensity to successfully adopt innovations. Well educated farmers are able to keep proper records of their activities and manage their farms better.

Table 4.16: Education Status components

	Offinso North	Techiman	Sefwi Wiawso	Hotelling T_2

Indicators	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Tests Of mean equality
Years of Education of Hse. Hold head	4.658	1.518	4.853	0.635	5.261	1.794	Prob > F = 0.1578
Years of Education of Spouse	0.620	0.0258	4.119	1.990	4.785	1.080	Prob > F = 0.0504
Years of Education of other Household adults	7.463	1.767	7.688	1.410	8.462	1.214	Prob > F = 0.0000**
Boys 6-15 enrolled in Sch	0.236	0.097	0.244	0.005	0.263	0.109	Prob > F = 0.1471
Girls 6-15 enrolled in Sch	0.242	0.079	0.345	0.164	0.228	0.162	Prob > F = 0.0000**
Boys 16-23 enrolled in Sch	0.398	0.021	0.372	0.145	0.374	0.186	Prob > F = 0.1507
Girls 16-23 enrolled in Sch	0.410	0.221	0.353	0.130	0.375	0.199	Prob > F = 0.0023*
7+ population read and write (Literacy)	0.417	0.204	0.456	0.217	0.392	0.160	Prob > F = 0.0000**

Source: Author's Field Work, 2014

Eight indicators were used to measure the educational status of the households; Years of education of the household head, years of education of spouse, average years of education of other adult household members, boys between 6 and 15 years enrolled in school, girls between 6 and 15 years enrolled in school, boys between 16 and 23 years enrolled in school, girls between 16 and 23 years enrolled in school and household above 7 years who can read and write. The means of the various indicators used to measure the educational security status of the households and their standard deviations are summarized in table 4.16 above. With the exception of Years of Education of other Household adults, Girls 6-15 enrolled in School and 7+ population read and write (Literacy), the differences among the means of the other components of educational security are not statistically significant at 5% error level.

The educational security status of the rural households are summarized in the table 4.17 below

Table 4.17: Educational Security Status

District	Observation	Mean	Std. Dev.	Minimum	Maximum
Offinso North	400	0.351	0.113	0.056	0.696
Techiman	400	0.365	0.132	0.060	0.702
Sefwi Wiawso	398	0.362	0.104	0.055	0.699
Test that all three mean are the same Hotelling T^2 =3.03 Hotelling F(2,396) = 1.51 Prob > F = 0.2220		Mean differences btn Offinso North and Techiman Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T|>|t|) = 0.1124	Test of Mean differences btn Offinso North and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T| > |t|) = 0.1920	Test of Mean differences btn Techiman and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠0 Pr(|T| > |t|) = 0.6332	

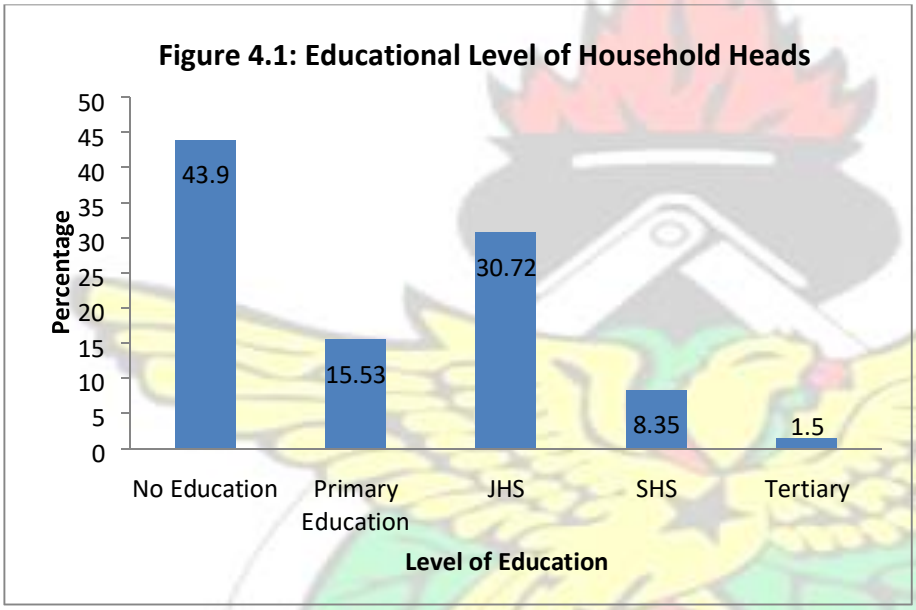
One striking finding from the table is that the average years of education of household heads and spouses are very low. In Ghana, it takes six years for one to complete primary school (Class one to Six). The mean number of years of education for the rural communities at Offinso North, Techiman and Sefwi Wiawso are respectively 4.6575, 4.8525 and 5.2513. This means that on average, none of the household heads have completed Junior High School. This is due to the fact that lots of the household heads have no education. Detail analyses of the data gathered indicate that about 44% of household heads do not have any education. Cumulatively about 90.2% of the households surveyed either have no education or have only completed Junior High School, Details are given in table in 4.18 and figure 4.1 below:

Table 4.18: Education level of respondents

Level of education of the household head	Frequency	Percentage

No Education	526	43.91
Primary Education	186	15.53
JHS	368	30.72
SHS	100	8.35
Tertiary	18	1.50
Total	1,198	100.00

Source: Source: Author's Field Work, 2014



The educational security status is relatively low in the rural communities in Ghana. The Hotelling tests show that there are no statistical differences between the educational statuses of rural households in Ghana. This has serious implication on their farming business. These farmers, with relatively low level of education mean they may not be able to keep proper records of their farming businesses. It could also affect the application of modern technology and application of pesticides and fertilizers. This may affect their output and quality of their farm produce.

4.3.5 Empowerment:

Empowerment is the rural households' abilities to enjoy other services and privileges that go to enhance the households' welfare. Four components were used to measure empowerment, number of community participation, household head have access to an organization that provides service, other household members have access to an organization that provides service and household head/member holds position in the ruling party. Number of community participation here refers to the number of community organization that the household head belongs to. The summary of these are presented in table 4.19 and the empowerment status are presented in table 4.20 respectively.

Table 4.19: Empowerment components

Indicators	Offinso North		Techiman		Sefwi Wiawso		Hotelling T_2 Tests
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	
number of community participation	0.378	0.826	0.453	0.938	0.477	0.927	Prob > F = 0.2082
household head have access to an organization that provides service	0.175	0.380	0.205	0.404	0.178	0.383	Prob > F = 0.5252
other household members have access to an organization that provides service	0.063	0.242	0.073	0.261	0.053	0.224	Prob > F = 0.4799
household head/member holds position in the ruling party	0.028	0.164	0.063	0.242	0.035	0.184	Prob > F = 0.0539

Source: Source: Author's Field Work, 2014

Table 4.20: Empowerment Security Status

District	Observation	Mean	Std. Dev.	Minimum	Maximum
Offinso North	400	0.098	0.019	0	1

Techiman	400	0.123	0.017	0	1
Sefwi Wiawso	398	0.106	0.019	0	1
Test that all three mean are the same Hotelling T^2 =853.51 Hotelling F(2,396)=425.68 Prob > F = 0.0000		Mean differences btn Offinso North and Techiman Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T|>|t|) = 0.085	Test of Mean differences btn Offinso North and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T| > |t|) = 0. 4836	Test of Mean differences btn Techiman and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠0 Pr(|T| > |t|) = 0. 3124	

Source: Author's Field Work, 2014

The empowerment statuses of the households are relatively low. The results from the work (table 4.20) shows that only 9.7% of the rural households in the Offinso North are empowered. The empowerment rate for Sefwi Wiawso is 10.64 with the highest rate recorded for Techiman, which is 12.3%. The differences in the averages are statistically significant at 99% confidence level. This means that rural households in the Techiman municipalities are more empowered followed by those at Sefwi Wiawso. The low empowerment figures mean that rural households in Ghana do not generally participate in the decision making process in their communities and also have limited access to external services that are beneficial to their general wellbeing. The implications are that decisions that affect their well-being are generally taken without their inputs which might affect their willingness to help implement these policies.

4.4 Overall livelihood security status

Using the five security components discussed above; Economic, Health, Food, Education and empowerment, an overall security index is computed this is technically the average of the five components. This is done to measure crudely the level of living of the studied households. On an average, overall security is highest among rural households in the Sefwi Wiawso Municipality

followed by those at Techiman Municipality with the lowest at Offinso North District. This follows from the various components. Aside Health and Empowerment components, Sefwi Wiawso leads in all the components of livelihood security.

Table 4.21: Overall Security Status

District	Observation	Mean	Std. Dev.	Minimum	Maximum
Offinso North	400	0.289	0.055	0.104	0.464
Techiman	400	0.313	0.061	0.166	0.495
Sefwi Wiawso	398	0.322	0.048	0.202	0.512
Test that all three mean are the same Hotelling T^2 =80.62 Hotelling F(2,396)=40.21 Prob > F = 0.0000**		Mean differences btn Offinso North and Techiman Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T|>|t|) = 0.000	Test of Mean differences btn Offinso North and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠ 0 Pr(|T| > |t|) = 0.0000	Test of Mean differences btn Techiman and Sefwi Wiawso Ho: mean(diff) = 0 Ha: mean(diff) ≠0 Pr(|T| > |t|) = 0.0320	

The statistical test of significance shows that the differences between the averages are statistically significant at 1% error level. As we know, the highest value of the index is 1 and lowest is zero. The index is calculated based on the high and low values of the various components use to measure the five indices used to calculate the overall index. The value show that livelihood of rural farmers is quite low. By comparing them to themselves, none of the areas recorded an average of more than

0.50. This means that even by peer comparisons, the livelihood of rural farmers are very low and thus rural people are very unsecured. Out of 400 households surveyed in the rural areas of Offinso North, none recorded an index of 0.50 or above with only 8 households recording values above 0.40. In the rural areas at Techiman, just like Offinso North, none was above 0.50 with only 28 households recording index values above 0.40. However, two households recorded figures above 0.50 and 27 between from 0.40 to 0.50. This means that though the statistical tests show differences in the livelihoods status of the studied households, the differences are very small relative to each other meaning that policies that are needed to improve the lives of rural farmers should not be area specific but should be targeted at all areas.

4.5 Determinants of livelihood security

4.5.1 Introduction

This section discusses the effects of households' characteristics on the livelihood security in the studied areas. Using the various components of livelihood security, namely Economic, Health, Food, Education, and Participation as well as the overall security index as dependent variables, seven OLS regressions are run to examine the effect of household characteristics on the various components of livelihood of rural farmers. The results are presented in table 4.21 below. Two variables are of importance aside the others. These are locations and crop type. This is to find out whether where a farmer stays and the type of crops a farmer engages in affect their economic and overall livelihood.

4.5.2 Determinants of Components of Livelihood Security

For the economic security status, seven of the variables are significant. Gender and age have no effects on the economic security status of the households. This means that all things equal, there is no statistical difference between female headed households and those of male headed households.

The same goes for age. The results indicate that a farmer's age has no significant impact on the economic security of rural farmers. However, the square of age is significant, which means that initially, farmer's age have no impact on livelihood, but beyond a certain age, age begins to have positive impact on economic security. This may be because after farmers attain certain age, they might have had more experience with farming thereby improving their farm income and might have also accumulated more assets which are important components of economic security.

Table 4.21: OLS Estimation of Livelihood Determinants

	(1) Economic Security	(2) Food Security	(3) Health Security	(4) Education Security	(5) Empowerment Security	(6) Overall Security
Gender	3.573	-10.335	-5.692	2.059	7.636	0.667
	(4.618)	(7.784)	(6.324)	(7.035)	(14.911)	(3.629)
Age	0.0107	0.901	3.521	4.570**	10.062**	3.412**
	(0. 903)	(1.515)	(1.234)	(1.376)	(2.906)	(0.708)
age_sq	0.178*	-0.012	-0.047**	-0.066**	- 0.081**	-0.037**
	(0.009)	(0.016)	(0.013)	(0.014)	(0. 030)	(0. 007)
Years of Edu.	0.983*	1.842*	0. 826		0 .607	
	(0.419)	(0.720)	0.313		(1.348)	
Marital Status	11.069*	15.299	120.459**	70.805**	9.654	43.38**
	(6.275)	(9.723)	(7.906)	(8.811)	(18.605)	(4.543)
Dum_Cash	36.294**					5.501**
	(5.745)					(0.453)
Household size	-9.928**	-0.00313*	5.089**	18.703**	1.144	4.358**
	(0.780)	(0.00131)	(1.069)	(1.191)	(2.542)	(0. 616)
Dum_Food	11.382*	22.117**				-1.581
	(5.547)	(6.762)				(0. 453)

Loc_Sefwi W.		35.651**	84.033**	22.424**	-4.660	31.628**
		(7.121)	(6.440)	(7.149)	(15.134)	(0.4.470)
Vocation		1.536	-24.653			3.469
		(9.752)	(7.801)			(4.471)
Loc_Techiman			93.782**	41.955**	26.890	35.729**
			(6.433)	(7.166)	(15.128)	(3.936)
Constant	129.694**	487.465**	180.263**	106.889**	-188.742**	157.102**
	(20.713)	(34.149)	(27.553)	(30.646)	(65.566)	(15.908)
Observations	1134	1134	1134	1134	1134	1134
Adjusted R^2	0.264	0.036	0.362	0.315	0.029	0.284
	F=46.20**	F=5.73**	F=81.50**	F=75.55**	F = 5.18**	F = 37.28**

Standard errors in parentheses ** and * Means sig at 1% and 5% respectively

All the indices for Economic, Food, Health, Education and Participation were scaled up by 1000, before they were included in the regressions. This means that all the coefficients should be divided by 1000 before interpreted.

Years of education has positive and significant impact on economic security. It has a coefficient of 0.00098 and significant at 5% error level. This means that at 95% confidence level, an additional year of education improves economic security by 0.00098 units. Thus more educated farmers have better economic security than uneducated farmers. Educated farmers are able to apply better methods of farming and use more modern farming inputs and might also be able to negotiate better for the prices of their output. In Ghana, aside few farming products, farmers have to negotiate their own prices with middlemen who go to the villages to buy for the markets in the cities. More educated people are able to do this better.

Marital status was found to be statistically significant at 10% error level, meaning that married farmers are better off in terms of economic security compared to those who are not married (single, widowed, and divorced). The coefficient of 0.01107 means that all things remaining constant, married farmers

have economic security higher than those unmarried by approximately 0.01107 units. Thus it pays to be married in the village. This might be due to the pilling of labour resources and also land assets.

One of the controversial issues of economic security is the impact of household size on economic security. Large household size means that more family labour is available for farming and likely to improve economic security. However if the household is made up of young people in school, then it might be detrimental to the economic status of the household. The second case seems to hold among the rural farmers studied in this work. The coefficient of household size is negative (-0.000993) and significant at 1% error level. This means that an additional person in the households in the rural areas of Ghana reduces their economic security by approximately 0.000993 points.

To test whether crop type has any impact on the economic security of rural farmers in Ghana, we include two proxies for plantation crop and food crops which are respectively dum_cash and dum_food. Both are significant, with that of plantation crop at 1% and that that of food crop at 5% error level. The proxy for plantation crop (dum_cash) is positive (0.03629) and significant at 1% and that of food crop (dum_food) which is also positive (0.01138) is also is significant at 5%. This means that plantation crop farming and food crop farming have greater impact on the economic security of rural farmers than that of vegetable crop farming. The two proxies being significant means that crop type plays important role on the economic security of farmers. Rural farmers producing plantation crops or food crops have different livelihood status compared to those producing vegetable crops.

For food security, only education and household size were found to be statistically significant. Education is positive meaning that more educated people are more secured in terms of food less educated ones. The coefficient of household size is negative meaning that higher household sizes means less food security as more mouths are to be fed than their ability to work and produce more food. For the location proxies, being at Sefwi Wiawso improves the food security of rural farmers compared to the other locations. As expected, food crop farmers have better food security status than those who produce other crops.

For health security of rural farmers, only Gender, Years of Education were not significant. Thus household characteristics are very important in determining the health status of rural farmers in Ghana.

Age, marital status, Household size are the significant determinants of education security among rural farmers in Ghana. For participation security status, only age was found to be statistically significant aside the proxy for location. This means that age is very important in determining a rural farmer's participation in rural governance. This is not surprising though since rural people in Ghana generally put premium on age in appointing people into prominent positions in the rural areas. The location coefficient for both Sefwi Wiawso and Techiman are not significant at 5%. Thus being located at Techiman municipality or Sefwi Wiawso does not change farmers' participation of rural governance compared to that of Offinso North.

4.5.3 Overall Livelihood Status

The last column (column 6) gives the results for the overall livelihood security status. Gender is statistically insignificant for the overall livelihood security. This confirms that the gender of a household has no effect on their livelihood contrary to expectations. We would have expected that male headed households would have better livelihood status due primarily to the nature of land inheritance in Ghana. Most lands are inherited by males rather than females. This result is similar to those found by Rahman and Aktar (2010) who found no significant impact of gender on livelihood of rural poor settlements in Bangladesh.

Both age and marital status are statistically significant at 1% error level. The coefficient of age is positive meaning that as farmers become older, their livelihood improves by approximately 0.0034 units. Thus older farmers are better off in terms of livelihood compared to younger rural farmers in Ghana. This may be because of experience and accumulation of wealth and for plantation crop

farmers, their farms would have matured with time thereby improving their income and their overall livelihood levels. However, the negative coefficient of the age-square variable means that the impact of age on livelihood does not go on forever. As farmers grow beyond a given age level, their livelihood starts to decline. This is very unusual since we would have expected that at this age their children would have grown and then remits them. This result however means that very old rural farmers are generally very poor and vulnerable and therefore any intervention at alleviating rural deprivation should look more closely at the aged in the rural areas of Ghana.

Married rural farmers have better livelihood security status compared to unmarried rural farmers as the coefficient of marital status is significant at 1% error level. As found in the economic security analysis, married rural households have improved livelihood of approximately 0.046 higher than that of unmarried households. This meets a priori expectations as married farmers have better labour and are able to pool resources together to improve their lives and that of the entire household.

Even though household size had negative impact on economic security, its impact on the overall security status of the household is positive and significant at 1% error level. This means that larger household size enjoys better livelihood than those with smaller household size. The coefficient of 0.0034 means that an additional person in the household means livelihood increases by approximately 0.0034 units. This is consistent with the assertion that larger family is preferred to smaller families in the rural areas. However, larger family with less land access and less education and training may end up being detrimental to the livelihood of the household. Another important element of rural life is vocation. It is generally advised that rural farmers must have additional training in order to improve family income. However, the coefficient of vocation, which measures whether the household head has any useable vocational training or not. This means that rural farmers with vocational training have no significant effect on their livelihood compared to those who don't have. However, this work did not test whether the training of spouse or children have impact on the livelihood of the rural household.

The final part of this analysis is to test the impact of location and crop type on the livelihood. Since three districts were chosen, and the crops produced by the farmers were grouped into three, one was used as control. Three locations, Offinso North, Sefwi Wiawso and Techiman were used as proxies for locations with Offinso North being the control. This is to test whether the livelihood status of Sefwi Wiawso and those of Techiman differ from that of Offinso North. The coefficients show by how much the livelihood of the farmers in these locations differ from that of Offinso North. The coefficients for the dummy used to represent Techiman and Sefwi Wiawso both are both positive and significant at 1%. The coefficient of Sefwi Wiawso is 0.03206 and that of Techiman is 0.03217. This means that where a rural farmer is determines their level of livelihood. Rural farmers at Techiman and those at Sefwi Wiawso are different from those at Offinso North. Rural farmers at Sefwi Wiawso have livelihood that is 0.03206 different from those at Offinso North whereas those at Techiman have livelihood status that is 0.03217 different from those at Offinso North. Thus, livelihood status in Ghana is critically determined by the location of the person aside the household characteristics of the household. Thus interventions aimed at improving the livelihood of rural farmers in Ghana should be designed based on location. In other words, any intervention aimed at improving the lives of rural people in Ghana should take into considerations where farmers are located, since livelihood deepens on the location of a rural dweller in Ghana.

The coefficient of crop type that represents food crop farmers is not significant. This means that the livelihood status of food crop farmers is not statistically different from that of vegetable crop farmers. However, the coefficient of plantation crop is significant at 1%. This simply means that the livelihood status of plantation crop farmers is statistically different from that of vegetable crop farmers. The coefficient of 0.01562 means that all things equal, the plantation crop farmers are significantly different from that of vegetable crop farmers by about 0.01562 units. This means that in rural Ghana, it pays to be a plantation crop farmer than being a food crop farmer.

CHAPTER FIVE

ANALYSIS OF RISK PERCEPTION AND LIVELIHOOD

5.1 Introduction:

Risk is the possibility of adversity or loss and refers to the "uncertainty that matters" (Tru and France, 2009). An agent's perception about risk is important element in the decision making process and risk management choice of that individual. This is because risk management approach, which involves choosing among alternative management process to reduce the effect of risk, depends largely on what the agent sees and perceives as important risk to their activities.

In the rural areas of Ghana, most people engage in farming. According to the population and housing census, this is found to be 45.8%. In other words, approximately 45,8% of households in Ghana are engaged in farming. However, farming in Ghana is basically reliance on rainfall (Namara et. el. 2010). The risk and uncertainty associated with rain-fed farming thus make farming in Ghana highly risky. Farmers are exposed to the possibilities of losses in production and uncertainty of return on their investment. Risk, which is regarded in this study as the chance of falling below a critical (i.e., minimum or subsistence) income level, plays a vital role in the farmers' production decisions related to choices and levels of inputs and outputs (Marilou and Isabelita, 2007). Empirically, how farmers decide under risky conditions is best analysed by taking into account their risk perceptions and risk attitudes or preferences (i.e., risk-averse, risk-taker, or risk-neutral) (Marilou and Isabelita, 2007)

In rural farming communities, which are the focus of this work, risk perception is very critical. These farmers depend largely on nature and market and economic environment over which they have no control. For instance, rural farmers do not have any control over inputs prices and the market prices of their farm produce leaving them to the mercy of middlemen and unfair market conditions. These phenomena have huge impact on their activities, income and livelihood. This is because the more risk

averse a farmer is, the more the farmer is likely to make farming decisions that emphasize reducing variation in income and food security rather than the goal of maximizing income (Turan et el. 2003). For instance, expectation about erratic rain may prevent farmers from engaging in large scale farming that has the potential of raising income and improving welfare.

This chapter looks at risk from two main points. First, this work looks at the farmers' perception towards some risk that they face and then examine their attitude towards risks. In this section three main analyses are done. First we examine the results of the risk perception results using basic rankings. This is aimed at understanding the important risk pertaining to the farmers. In the second analysis, we employ factor analysis to determine the risks that are most critical to rural farmers in the study communities. The last part of the looks at the impact of socio-economic characteristics of households on risk perception and how risk perception affects livelihoods.

5.2 Risk Perception and Determinants

As indicated, risk perception is an important concept in the rain fed farming and especially among rural farmers in Ghana. To elicit rural farmers risk perception, the respondents were presented with several statements regarding the risks associated with their farming activities. They were determined through questions answered using a four-point Likert scale. The respondents were to indicate whether they perceived them as severe or not and select the appropriate scale or numerical category as perceived. The descriptive categories used were Extremely Severe= 4, Severe = 3,
Moderately severe = 2, Not Severe = 1

The analysis starts with the frequencies of the various responses relating to the various sources of risks. It looks at the various percentages of respondents that perceive each of the sources of risk as not severe or otherwise. The results are presented in Table 5.1 below. The results show that most rural farmers view the various risks they face as moderately severe to severe. 32.2% and 31.1% of the respondents perceived credit availability and disease and pests respectively as extremely severe. This

means that rural farmers in Ghana perceive credit unavailability as impediments to their farming business as well as diseases and pests that affect their production. Overall, on average, about 36.2% of the rural farmers perceive the various risks as moderate with 36.3% of the respondents perceiving them as severe. At the extreme points, 15.3% of the respondents perceive the various risks not being severe with 12.2% perceiving them as extremely severe. The implication is that since the farmers do not really perceive these risks as very serious, they may really try and live with them rather than find ways of solving them. It is against this that most rural farmers continue to adapt the same method and inputs in production

Table 5.1: Farmers' ratings of their risk perceptions by Location

Offinso North		Techiman		Sefwi Wiawso	
Risk Source	Score	Risk Source	Score	Risk Source	Score
Inaccessibility to the market	3.01	Credit unavailability	3.16	high Cost of labour	3.24
Diseases and Pests	2.99	Variability of yields	3.13	Credit unavailability	3.2
Bush Fires	2.89	Output Prices	3.07	Diseases and Pests	3.2
Rain Deficiency	2.85	high Cost of labour	3	Variability of yields	3.04
Output Prices	2.84	Diseases and Pests	2.99	Output Prices	2.95
Credit unavailability	2.79	Rain Deficiency	2.89	under financing by own capital	2.91

Variability of yields	2.78	under financing by own capital	2.87	Rain Deficiency	2.85
Input prices	2.75	Inaccessibility to the market	2.83	Inaccessibility to the market	2.83
high Cost of labour	2.72	Input prices	2.8	Bush Fires	2.62
Health	2.54	Ghana's economic and political situation	2.53	Injury or illness head	2.59
under financing by own capital	2.54	Hired labour and contractors	2.51	Input prices	2.59
Hired labour and contractors	2.46	Health	2.5	Ghana's economic and political situation	2.56
Excess rainfall	2.44	Injury or illness head	2.47	Limited knowledge about chemical usage	2.55
Ghana's economic and political situation	2.43	National government laws and policies	2.47	Natural disasters	2.49
Injury or illness head	2.39	Bush Fires	2.43	Excess rainfall	2.45
Limited knowledge about chemical usage	2.39	Limited knowledge about chemical usage	2.41	method of harvesting	2.44
Theft	2.38	Excess rainfall	2.4	National government laws and policies	2.39
Natural disasters	2.37	Theft	2.36	Low awareness of disease prevention	2.39
method of harvesting	2.32	World economic and political situation	2.32	Health	2.38
Inputs Quality	2.3	Land prices	2.31	Theft	2.38
Land prices	2.23	Inputs Quality	2.31	Hired labour and contractors	2.34
National government laws and policies	2.03	method of harvesting	2.31	Inputs Quality	2.21
World economic and political situation	2	Natural disasters	2.3	Land prices	2.2
Interest rates	1.96	Low awareness of disease prevention	2.27	World economic and political situation	2.14
Low awareness of disease prevention	1.96	Debt	2.01	Debt	2.07
Changes in family relation	1.94	Interest rates	1.99	Changes in family rel.	2.02
Debt	1.93	Changes in family relation	1.96	Interest rates	2.02
Changes in family labour force	1.85	Changes in family labour force	1.9	Changes in family labour force	2
meeting contracting obligations	1.16	meeting contracting obligations	1.31	meeting contracting obligations	1.56
Overall	2.46		2.47		2.39

Source: Author's Field Works, 2014 It should be noted that higher values means high perception about the risk source and low values mean low perception about risk. Values higher than 3 means extreme perception about risk and values less than 2 means very low perception about risk.

To examine the extent to which location affect the risk perception of the rural farmers, the weighted mean values of the various sources of risks are computed and the results are presented in table 5.2. For the farmer-provided answers in this study, higher ratings (high values in table 5.2) signify that they perceived farming as risky considering the various sources of risks; lower ratings suggest otherwise. Holding the type of crop produced by the farmers constant, the general perceptions among the farmers in Offinso North, Techiman and Sefwi Wiawso about the various sources of risk were rated as moderately severe with the overall mean value of 2.37 which is closer to moderately severe (2) than severe (3). This means on average, the rural farmers in the study areas do not perceive the various risks they face as very serious to them. This might be due to the fact that these rural farmers see farming as their way of life and perceive these risks conditions as "normal" to them and therefore do not perceive them as that serious that impact on their willingness to farm or enter into other ventures.

Notwithstanding the source of risk, the mean response of the rural farmers at Sefwi Wiawso was highest followed by those at Techiman with the lowest mean response recorded among the rural farmers at Offinso North. This indicates that rural farmers at Sefwi Wiawso are more likely to perceive farming as risky. This may be due to the fact that most rural farmers at Sefwi Wiawso are plantation crop producers who see farming more as a business than those in the other areas and thus invest more in that and therefore regard the various risks they face as important to them other things equal.

Table 5.2: Farmers' ratings of their risk perceptions, by Crop Type		
Plantation crop	Food Crop	Vegetable Crop

Risk Source	Score	Risk Source	Score	Risk Source	Score
Diseases and Pests	3.17	Variability of yields	3.04	Inaccessibility to the mkt	3.02
high Cost of labour	3.17	Diseases and Pests	3.04	Output Prices	2.92
Credit unavailability	3.16	Credit unavailability	3.02	Variability of yields	2.91
Variability of yields	2.95	Output Prices	3.02	Diseases and Pests	2.87
Output Prices	2.88	Rain Deficiency	2.94	Rain Deficiency	2.87
Inaccessibility to the mkt	2.84	Inaccessibility to the mkts	2.91	Credit unavailability	2.83
under financing by own capital	2.82	high Cost of labour	2.91	Input prices	2.8
Rain Deficiency	2.76	Input prices	2.87	Bush Fires	2.75
Bush Fires	2.67	under financing by own capital	2.82	high Cost of labour	2.75
Injury or illness head	2.53	Bush Fires	2.6	Health	2.54
Limited knowledge about chemical usage	2.52	Ghana's economic and political situation	2.59	under financing by own capital	2.54
Input prices	2.49	Health	2.5	Injury or illness head	2.47
Ghana's economic and political situation	2.46	Excess rainfall	2.49	Excess rainfall	2.42
Health	2.42	Hired labour and contractors	2.49	Ghana's economic and political situation	2.4
Hired labour and contractors	2.41	Injury or illness head	2.44	Theft	2.37
Natural disasters	2.39	Limited knowledge about chemical usage	2.43	Hired labour and contractors	2.36
Theft	2.39	Natural disasters	2.41	Limited knowledge about chemical usage	2.35
method of harvesting	2.38	National government laws and policies	2.4	Inputs Quality	2.34
Excess rainfall	2.36	Theft	2.36	Land prices	2.32
Low awareness of disease prevention	2.3	method of harvesting	2.35	Natural disasters	2.31
National government laws and policies	2.29	Inputs Quality	2.32	method of harvesting	2.31
Inputs Quality	2.19	Land prices	2.28	Low awareness of disease prevention	2.06
Land prices	2.18	World economic and political situation	2.23	National government laws and policies	2.03
World economic and political situation	2.13	Low awareness of disease prevention	2.18	World economic and political situation	2.01
Debt	2.07	Changes in family relation	1.95	Debt	1.99
Interest rates	2.03	Interest rates	1.95	Interest rates	1.98
Changes in family labour force	2.02	Debt	1.94	Changes in family relation	1.94
Changes in family relation	2.01	Changes in family labour force	1.90	Changes in family labour force	1.71

meeting contracting obligations	1.48	meeting contracting obligations	1.29	meeting contracting obligations	1.14
Overall	***2.46***		***2.47***		***2.39***

Note: higher values mean the risk is more critical to the responded and low values mean low less critical risk. Values higher than 3 means extreme perception about risk and vales less than 2 means very low perception about risk

Meanwhile, across the sources of risk, rural farmer in the three study areas considered the various risks differently. Some risks conditions were perceived as more extreme than others. Credit availability risks, risk associated with output variability and cost of labour were scored above 3 (Severe to extremely severe) among rural farmers in Techiman and Sefwi Wiawso with output price variability scored above 3 among rural farmers in Techiman and disease and pests risk is scored above 3 among rural farmers at Sefwi Wiawso. This means for farmers at Sefwi Wiawso, credit availability, disease and pests, output yield variability and high cost of labour are perceived as the most important risks they face in their farming activities. For those at Techiman, the most important risks perceived to be important to them are credit availability, variability in output yield, output prices and cost of labour. Two important and outstanding information from the results are about the output price and access to market. Most farmers in the Techiman farming areas are food crop producers (as shown in table 4.3 in chapter 4), whose prices are determined by forces of demand and supply and therefore the farmers are always concerned about the prices of their output in the market. High output price variability has serious implication for their business and income as well as their general welfare and therefore it is not surprising that they value output price variability as important to them. For farmers at Offinso North, the most important risk is access to the market.

As indicated earlier in this work, majority of the rural farmers in the district are vegetable farmers (mostly tomatoes) which is highly perishable and therefore quick access to market is of paramount importance if they are to make any gain from their farming business. It is therefore not surprising that they perceive access to market as important source of risk to their farming business.

In terms of crop type, similar results are observed. For plantation crop producers, the most important risks faced by the farmers are Credit unavailability, Diseases and Pests and high Cost of labour. This is consistent with the results obtained from the location. Since most plantation crop farmers are from Sefwi Wiawso, it is not surprising that rural farmers from Sefwi Wiawso have similar risk perceptions to that of plantation crop farmers. For the food crop farmers, the most important risks are Credit unavailability, Diseases and Pests, and Output Prices. These risk sources have weighted scores above 3 (meaning Severe to extremely severe). For vegetable crop farmers, the highest ranked source of risk is Inaccessibility to the market. This has a weighted mean score of 3.02 (meaning Severe to extremely severe). For all the farmers, the least risk perceived was meeting contracting obligations, ranked less than 2. Its mean score is 1.48 (not severe to moderately severe) among plantation crop farmers, 1.29 (not severe to moderately severe) among food crop farmers and 1.14 (not severe to moderately severe) with the overall score of 1.34 (not severe), since the value is less than 1.5. This implies that farmers do not generally make pre-production arrangements with buyers or landowners. Thus on average rural farmers do not undertake their activities with any contract arrangements and therefore are not generally under pressure to take decisions to satisfy these contractors. In an interaction with the farmers, some indicated that sometimes when they make arrangements with buyers, they come under pressure to produce to satisfy these buyers. From the information, it is clear that the respondents do not perceive pre-production contract as a serious risk to their farming business. It is therefore safe to say that farmers take their decisions without external recourse. Therefore their maximization decisions are based on their market assessments and the demand for their produce.

Overall however the food crop producers have higher ratings for the various sources of risks followed by the plantation crop farmers and least ranked in terms risk perception is vegetable crop farmers. However, it is important to note that these results are not tested. The mean differences are taken at their levels and therefore the interpretations are not concise, this is because the differences among the mean values have not been tested statistically.

To examine the differences among the farmers in terms of the various risks sources, the KruswalWallis test, which as explained in the methodology, is a non-parametric alternative to the Analysis of Variance (ANOVA). The test is meant to test differences between the groups. First we test and find out of the various sources of risks are the same among the locations or not. Then the second involves testing whether the various risks conditions are the same in terms of the kinds of crops. The most important aspect of this analysis is to understand whether ranking of risk perception by type of crop among the rural farmers are the same or not and to examine whether those rankings in terms of locations are the same or not.

5.2.1 Ranking of Risk Perception by Crop Type

First we test the overall mean ranking based on the type of crop produced by the rural farmers. This is to establish and confirm whether differences in the overall risk perceptions are the same or different across the rural farmers. The results in Table 5.4 show that the mean score of food crop farmers is highest (536.8), followed by those of plantation crops (508.22) and least is the Vegetable Crop farmers (429.50). The chi-square value of 17.07 means that these differences are statistically significant at 1% error level or 99% confidence level. This means we reject the null hypothesis of equality among the mean score of the overall risk perception and accept the alternative that there is at least some differences in the mean perception scores. This means that overall the rural farmers engaged in different crop farming do not perceive the risks they face equally, implying that they differ among them. One advantage of the Kruskal-Wallis test is that it allows us to compute effect size estimate, which is proportion of the variations in the dependent variable attributed to the variables compared. This is because the Kruskal-Wallis test is done with Chi- Square that allows one to compute effect size estimates. With the Chi-Square value, it is easy to calculate the variability in the mean Rank

values that are attributed to the crop type. In other words, we can find the percentage variability (differences) in the mean rank values caused by the different crop types.

Thus, ¡< 5 <553 3 3¢ £ < ¡< +¢3 / ¡/ 3=¥ℎ<−ƒ§+ 3'(¤−1)×

100. This gives 1.7% (17.073/1012 *100%). Thus, approximately 1.7% of the differences in the risk perception among rural farmers are accounted for by the type of crops grown by the rural farmers. However, these variations is very low meaning that though various crop farmers perceive risks associated with their farming activities differently, the differences are not very high. This may be due to the fact that though the farmers have been grouped into various types of crops, it is important to note that these farmers mostly interplant these crops and thus the differences among the risk perceptions is low.

The Kruskal-Wallis test is an omnibus test that looks for at least one difference among the groups under study (in this case, crop types). Thus it is important to further examine which of the two pairs of crop types cause the differences.

Table 5.3: Overall Ranking of Risk Perceptions by Crop Type

Crop Type	Number	Total Mean Rank
Plantation crop	392	508.22
Food Crop	444	536.82
Vegetables	177	429.50
Total	1013	

Chi-Square: 17.073 df: 2 Asymp. Sig: 0.000

This will allow us to conclude if for instance the mean rank values for plantation crop farmers is statistically different from each other. The specific comparison test results are shown in table 5.5 below. The results show clearly that the differences in the overall mean rank is due to the differences

in the risks perception among vegetable farmers and the other farming groups. The test statistics in table 5.4 show clearly that the rank mean differences between plantation crop and food crop farmers is not statistically significant. This means that the risk perception among plantation crop and food crop producers are the same statistically. Thus any policy aimed at assisting farmers to increase production that must take into consideration the risk perception among farmers in Ghana could be designed for both plantation crop and food crop farmers, all other things constant. However, there is enough evidence to reject the hypothesis that the mean rank values of risk perception are the same among vegetable crop producers and other farmers. Thus, any policy should be made specific for vegetable crop producers since their perception about risks are different from those of food crop and vegetable crop producers.

Table 5.4: Specific Comparison Test of Overall Ranking of Risk Perceptions by Crop Type

Crop Type	Total Mean Rank	Test Statistic
Plantation crop Food Crop	406.64 428,98	Chi-Square: 1.785 Sig: 0.182
Plantation crop Vegetables	298.08 256.03	Chi-Square: 7.994 Sig: 0.005
Food Crop Vegetables	330.35 262.47	Chi-Square: 18.153 Sig: 0.000

Table 5.5: Ranking of individual Risks by Crop Type

Risk Source	Crop Type	Mean Rank	K-W Test
Rain Deficiency	Plantation crop	473.75	11.506***
	Food Crop	535.30	
	Vegetables	509.64	
Credit unavailability	Plantation crop	550.51	23.973***
	Food Crop	498.97	

	Vegetables	430.79	
Changes in family relation	Plantation crop	520.01	2.066
	Food Crop	503.81	
	Vegetables	486.20	
Injury or illness of operator	Plantation crop	523.26	2.657
	Food Crop	492.03	
	Vegetables	508.53	
Changes in family labour	Plantation crop	545.78	23.744***
	Food Crop	503.85	
	Vegetables	429.00	
Excess rainfall	Plantation crop	485.26	4.697*
	Food Crop	526.85	
	Vegetables	505.35	
Natural disasters	Plantation crop	507.78	1.406
	Food Crop	514.89	
	Vegetables	485.48	
Bush Fires	Plantation crop	512.32	0.3930
	Food Crop	490.06	
	Vegetables	537.70	
Diseases and Pests	Plantation crop	544.60	17.972***
	Food Crop	499.67	
	Vegetables	442.13	
Variability of yields	Plantation crop	495.13	3.931
	Food Crop	525.86	
	Vegetables	485.98	
Output Prices	Plantation crop	480.59	8.003**
	Food Crop	533.46	
	Vegetables	499.12	
Input Prices	Plantation crop	434.35	45.990***
	Food Crop	560.16	
	Vegetables	534.54	

***, ** and * are statistically significant at probability level of 1 percent, 5 percent, and 10 percent, respectively

Table 5.5: Ranking of individual Risks by Crop Type (Con't)

Interest rates	Plantation crop	523.80	2.898
	Food Crop	492.21	
	Vegetables	506.88	
Debt	Plantation crop	534.64	7.810**
	Food Crop	482.49	
	Vegetables	507.28	
World economic and political situation	Plantation crop	503.13	5.534*
	Food Crop	525.85	
	Vegetables	468.29	
Ghana's economic and political situation	Plantation crop	496.56	7.452**
	Food Crop	531.28	
	Vegetables	469.21	
National government laws and policies	Plantation crop	507.66	22.313***
	Food Crop	539,68	
	Vegetables	423.55	
Land prices	Plantation crop	487.18	3.686
	Food Crop	516.00	
	Vegetables	528.31	
Risk from low quality of inputs	Plantation crop	475.58	9.030**
	Food Crop	526.24	
	Vegetables	528.33	
Health	Plantation crop	489.99	2.694
	Food Crop	514.64	
	Vegetables	525.50	
Hired labour	Plantation crop	498.26	3.104
	Food Crop	523.19	
	Vegetables	485.75	
Theft	Plantation crop	508.30	2.016
	Food Crop	505.82	
	Vegetables	507.08	
meeting contracting obligations	Plantation crop	573.74	64.516***
	Food Crop	486.15	
	Vegetables	411.49	
Inaccessibility to the market	Plantation crop	488.35	

	Food Crop	515.97	3.196
	Vegetables	525.79	

***, ** and * are statistically significant at probability level of 1 percent, 5 percent, and 10 percent, respectively

5.5: Ranking of individual Risks by Crop Type (Con't)

under financing by own capital	Plantation crop	517.22	13.679***
	Food Crop	525.71	
	Vegetables	437.44	
High Cost of labour	Plantation crop	567.96	37.972***
	Food Crop	485.60	
	Vegetables	425.67	
Limited knowledge about chemical usage	Plantation crop	537.72	12.603***
	Food Crop	499.96	
	Vegetables	456.62	
Inappropriate method of harvesting	Plantation crop	515.22	1.9616
	Food Crop	509.25	
	Vegetables	483.13	
Low awareness of disease prevention	Plantation crop	543.80	16.272***
	Food Crop	497.46	
	Vegetables	449.43	

***, ** and * are statistically significant at probability level of 1 percent, 5 percent, and 10 percent, respectively

As observed above, the overall rankings of risk perceptions differ among different crop producers. It is important to look at the individual risk situations and observe if they differ among the various crop producers using the Kruskal-Wallis tests. The results are shown in the table 5.5 above

In the table 5.5, the last column gives the Kruswall-Wallis tests for each of the risk situation based on the crop type of the farmers in the study areas. The main objective here is to examine whether the

individual risk conditions are the same among the various crop producers or not. This is important so that various risk specific policies designed for farming activities in Ghana could be focused on the specific crop farmers that perceive the risk as uniform.

From the table, out of the 29 risks conditions, the hypothesis that all the various crop producers perceive the risks as the same are rejected at 1% error level for 11 of them. These are risk associated with Rain Deficiency, Credit unavailability, Changes in family labour, High Cost of labour, Diseases and Pests, Input Prices, National government laws and policies, meeting contracting obligations, under financing by own capital, Low awareness of disease prevention and Limited knowledge about chemical usage.

Also, the Kruskal-Wallis tests show that the hypothesis that different crop farmers view the individual risks as equal is rejected at 5% error level. These are risks associated with Output Prices, risk from debt, risk from low quality of inputs and risks arising from Ghana's economic and political situation. However, various crop farmers view risks associated with excess rainfall and World economic and political situations as different among them at 10% confidence level. Twelve of the risks conditions are perceived as same by the based on the types of crops. In other words, the hypothesis that perception of risks associated with changes in family relation, injury or illness of operator, natural disasters, bush fires, variability of yields, interest rates, land prices, health, hired labour, theft, inaccessibility to the market, and inappropriate method of harvesting are the same among the various rural farmers producing various crops are accepted. Thus for the farmers in Ghana, irrespective of the type of crop they produce, there is no differences among them in relation to the way they view the risks associated with Changes in family relation, Injury or illness of operator, Natural disasters, Bush Fires, Variability of yields, Interest rates, Land prices, Health, Hired labour, Theft, Inaccessibility to the market, and Inappropriate method of harvesting.

It can be concluded in this section that though there is clear evidence to show that the way farmers view the overall risks conditions differ among the different crop producers, there is clear evidence however that some individual risks are perceived equally among them while others are not. It is important therefore that whenever any policy is devised to help farmers, the implementers of the policy must understand the way the farmers view these risks in order to make it more meaningful and beneficial to the farmers. In other words one must understand how different farming groups view the views if any policy aimed at reducing the individual risks that farmers face are to succeed and help farmers earn decent income.

5.2.2 Ranking of Risk Perception by Location

Rural farmers in three locations were studied. These were Rural Areas in Offinso North, Techiman Municipality and Sefwi Wiawso. Since farmers are scattered around all the country, the study intended to find out among other things whether risk perceptions regarding the various sources of risks differ based on where farmers live. Based on the mean rank values and the Kruskal-Wallis test statistic, presented in table 5.7, overall the hypothesis that risk perception of rural farmers based on location is rejected at 99% confidence level. Put differently, all other things being equal rural farmers based on different locations do not view the overall risks they face in their farming business equally. That is a farmer at a rural area in Offinso North does not have the same risk perception about farming in the same way as a rural farmer located at Techiman or Sefwi Wiawso. Thus location has an important role in determining the risk perception of farmers in the rural areas in Ghana. To determine the proportion of the variation in rank score accounted for by location, we divide the value of the chi-square value by the total sample less one multiply by 100%.

Table 5.6: Overall Ranking of Risk Perceptions by Location

Crop Type	N	Mean Rank
Offinso North	349	433.77
Techiman	331	535.44
Sefwi Wiawso	333	555.48
Total	1013	

Chi-Square: 34.203*** df: 2 Asymp. Sig: 0.000

*** are statistically significant at probability level of 1 percent

That gives 3.4% [(34.203)/(1013-1)*100%]. This means that only 3.4% of the variations in the perception or risks among rural farmers in Ghana is accounted for by location. This is relatively small indicating that though location determines the variation in risk perception, the contribution is small meaning that other factors are important in determining the perception about risk among rural farmers in Ghana.

Given that there is enough evidence to conclude that there is difference among the risk perception based on the three locations studied, it is important to do pair-wise investigation to determine the source of the differences are coming from. In other words, we want to determine individually whether the mean rank values between Offinso North and Techiman; Offinso North and Sefwi Wiawso; and Techiman and Sefwi Wiawso; are the same or not statistically based on the KruskalWallis Tests. The individual pair-wise results are shown in table 5.7 below.

Table 5.7: Specific Comparison Test of Overall Ranking of Risk Perceptions by Location

Crop Type	Mean Rank	Test Statistic
Offinso North Techiman	306.55 376.30	Chi-Square: 21.463**** Sig: 0.000
Offinso North Sefwi Wiawso	302.22 382.67	Chi-Square: 28.465*** Sig: 0.000
Techiman Sefwi Wiawso	325.14 339.82	Chi-Square: 1.974 Sig: 0.324

*** are statistically significant at error level of 1 percent

The table shows that the hypotheses that the mean rank values being equal between Offinso North and Techiman as well as between Offinso North and Sefwi Wiawso are rejected at 1% error level. In other words, that at 99% confidence level we can conclude that, there is no difference among the mean rank values of risk perceptions among the rural farmers in Sefwi Wiawso and those in Techiman. This shows that though location counts in terms of risk perception, it should be emphasized that rural farmers in different locations may have the same level of risks and therefore policies designed for farmers that is focused on locations should take into considerations that fact that different locations may have different risks perceptions to avoid policies not having any effects on the farmers.

As indicated earlier in the ranking of risk perception based on crop type, it was realized that only about 1.7% of the variations in risk perceptions among the rural farmers in Ghana was accounted for by crop type. In terms of location, the proportion of the variation that it causes is just 3.4%. These results mean that, though farmers in rural areas in Ghana may face different levels of risks, the extent to which location and crop type determines these levels of risk perceptions is relatively small and therefore it could be said that rural farmers in Ghana based on their locations and crop type perceive risks as equal with little variations. Therefore it is safe to say that general policies, like farming loans,

marketing policies, land reforms and others can be made for farmers in Ghana, but bearing in mind the little variations about the level of risk perceptions among the farmers located in different locations and producing different crops.

The last aspect of this section looks at the Kruskal-Wallis tests results for the individual risks perceptions based on the location. Here we test the individual risk perceptions and examine if there are differences based on the location of the rural farmers. This is to provide insight into the possibility of farmers from different locations in Ghana reacting to different situations they perceive as risk to their farming activities. This is meant to advise policy makers in the agricultural sector as to the best way to design policies that are effective and focused on issues paramount to farmers in different locations in Ghana.

The ranking of the individual risks by locations using the Kruswall-Wallis tests shows that, there are no differences in risk perception among the farmers based on locations for 7 or the risks conditions. These are risk associated with Rain Deficiency, Changes in family relation, Excess rainfall, Theft, Land prices, Risk from low quality of inputs and Interest rates. One peculiar finding here is that issues about rainfall are of interest to all farmers from all locations. Since farming in Ghana is mostly rain-fed, it is not surprising that issues about rainfall is equally perceived as important. Thus as far as this study is concerned, statistically there is no difference in the in the way farmers in Ghana perceive the risks associated with Rain Deficiency, Changes in family relation, Excess rainfall, Theft, Land prices, Risk from low quality of inputs and Interest rates based on where they live.

Table 5.8: Ranking of individual Risks by Location

	Location	Mean Rank	K-W Test
Rain Deficiency	Offinso North	494.59	1.852
	Techiman	521.80	
	Sefwi Wiawso	505.30	
Credit unavailability	Offinso North	418.48	55.990***
	Techiman	546.92	

	Sefwi Wiawso	560.10	
Changes in family relation	Offinso North	496.90	1.880
	Techiman	501.31	
	Sefwi Wiawso	523.24	
Injury or illness of operator	Offinso North	484.14	7.409**
	Techiman	498.08	
	Sefwi Wiawso	539.82	
Changes in family labour	Offinso North	480.08	8.217**
	Techiman	504.06	
	Sefwi Wiawso	538.13	
Excess rainfall	Offinso North	512.04	0.648
	Techiman	496.94	
	Sefwi Wiawso	511.72	
Natural disasters	Offinso North	505.79	6.556**
	Techiman	479.80	
	Sefwi Wiawso	535.31	
Bush Fires	Offinso North	575.31	39.817***
	Techiman	440.72	
	Sefwi Wiawso	501.29	
Diseases and Pests	Offinso North	483.46	16.898***
	Techiman	481.45	
	Sefwi Wiawso	557.06	
Variability of yields	Offinso North	440.51	34.051***
	Techiman	557.97	
	Sefwi Wiawso	526.02	
Output Prices	Offinso North	469,88	14.344***
	Techiman	548.98	
	Sefwi Wiawso	504.18	
Input Prices	Offinso North	521.76	12.216***
	Techiman	534.11	
	Sefwi Wiawso	464.58	

***, ** and * are statistically significant at probability level of 1 percent, 5 percent, and 10 percent, respectively

Table 5.8: Ranking of individual Risks by Location (Con't)

Interest rates	Offinso North	495,06	1.263
	Techiman	508,57	
	Sefwi Wiawso	517,95	
Debt	Offinso North	482,92	6.512**
	Techiman	503,92	
	Sefwi Wiawso	535,30	
World economic and political situation	Offinso North	460,46	19.922***
	Techiman	555,80	
	Sefwi Wiawso	507,28	
Ghana's economic and political situation	Offinso North	478,59	5.860*
	Techiman	518,39	
	Sefwi Wiawso	525,46	
National government laws and policies	Offinso North	420,24	53.505***
	Techiman	563,99	
	Sefwi Wiawso	541,28	
Land prices	Offinso North	504,19	2.712
	Techiman	525,65	
	Sefwi Wiawso	491,40	
Risk from low quality of inputs	Offinso North	518,48	3.547
	Techiman	517,39	
	Sefwi Wiawso	484,64	
Health	Offinso North	528,36	6.227**
	Techiman	514,00	
	Sefwi Wiawso	477,66	
Hired labour	Offinso North	519,22	8.140**
	Techiman	528,48	
	Sefwi Wiawso	472,84	
Theft	Offinso North	509,14	0.064
	Techiman	503,90	
	Sefwi Wiawso	507,84	
meeting contracting obligations	Offinso North	424,14	102.329***
	Techiman	495,78	
	Sefwi Wiawso	605,00	
Inaccessibility to the market	Offinso North	542,93	

	Techiman	489,67	9.388***
	Sefwi Wiawso	486,57	

***, ** and * are statistically significant at probability level of 1 percent, 5 percent, and 10 percent, respectively

Table 5.8: Ranking of individual Risks by Location (Con't)

under financing by own capital	Offinso North	439,41	31.736***
	Techiman	538,64	
	Sefwi Wiawso	546,39	
High Cost of labour	Offinso North	420,32	68.404***
	Techiman	511,75	
	Sefwi Wiawso	593,12	
Limited knowledge about chemical usage	Offinso North	475,27	15.548***
	Techiman	496,27	
	Sefwi Wiawso	550,92	
Inappropriate method of harvesting	Offinso North	489,62	8.516**
	Techiman	491,05	
	Sefwi Wiawso	541,07	
Low awareness of disease prevention	Offinso North	418,33	63.947***
	Techiman	530,11	
	Sefwi Wiawso	576,96	

***, ** and * are statistically significant at probability level of 1 percent, 5 percent, and 10 percent, respectively

However, as shown in table 5.9 above, the Kruskal-Wallis tests show that the hypothesis that the mean rank values are the same are rejected 1% error level for 14 of the risks conditions and 5% error level for 7 of the risks conditions and one is rejected at 10% error level. Those that show that there is no difference among the way the farmers perceive risks at 1% error levels are risks arising out of Credit unavailability, Bush Fires, Diseases and Pests, Variability of yields, Output Prices, Input Prices, World economic and political situation, National government laws and policies, meeting

contracting obligations, Inaccessibility to the market, Low awareness of disease prevention, under financing by own capital, High Cost of labour, and Limited knowledge about chemical usage. Risks perceived differently at 95% confidence level (5% error level) based on location are Injury or illness of operator, Changes in family labour, Natural disasters, Debt, Health, Hired labour, Inappropriate method of harvesting. The hypothesis that the risks associated with farming in the rural areas in Ghana based on location is perceived is equal is rejected at 10% error level for risk associated with Ghana's economic and political situation. Thus in terms of risks perceptions based on the location of farmers, it differs among the farmers. From the information, it is clear that with at most 5% error level, more than half of the risks perceptions differ among the rural farmers in Ghana based on the locations of the farmers. This shows that though location plays a role in determining the risk perception of farmers, as found earlier with 3,4% of the variations, there is enough evidence to show that individual farmers living in different locations have different risk perception for different individual risk conditions. Therefore, policies by government should understand the level of risk perceptions of farmers living in different locations so that the policies could be more effective and positive on the output and income of the farmers in the rural areas of Ghana.

5.3 Exploratory Factor Analysis of Risk Perception

In this section, Factor Analysis, precisely Exploratory Factor Analysis (EFA) is used to reduce the dimension of risks faced by rural farmers in Ghana. In other words, the analysis is geared towards distinguishing between serious and less serious risks faced by rural farmers in Ghana.

Generally, EFA is an iterative process in which the dimension of data is reduced by eliminating variables which weakly fit into the data (Suhr, 1999; Ringner, 2008). In each of the iterations, one or more variables are eliminated in the analysis until there is no more room to eliminate variables (Tipping and Bishop, 2007). This means that there are no iterations if no variable is to be removed.

In the context of this analysis, data is defined by risks faced by rural farmers in Ghana. As shown in Table 15 in the Appendix, there are 29 variables forming the data with the range V1-V29. Each variable is a potential risk faced by sampled rural farmers in Ghana. The EFA starts with Table 1 in the Appendix. This table shows the correlation among the 29 variables. In this table, most of the correlation coefficients are very weak. This suggests, technically, that most of the 29 variables weakly fit the data. It is thus likely that most of the variables will be eliminated in the first iteration.

Table 5.9 is diagnostic test of the first iteration of the EFA.

Table 5.9: KMO and Bartlett's Test – First Iteration

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.747
Bartlett's Test of Sphericity	Approx. Chi-Square	4374.494
	df	406
	Sig.	.000

Extraction: Principal Axis Factoring

Table 5.10 contains the KMO and Bartlett's tests. These tests verify the appropriateness of the sample in the context of EFA. These tests verify the validity of the EFA. The general rule of thumb is that the KMO Measure of Sampling Adequacy takes on a value closer to 1 while Bartlett's Test of Sphericity is significant at a chosen level of significance (Suhr, 1999; Ringner, 2008). From the table, the KMO measure of 0.747 is close to 1. Moreover, the Bartlett's test is very significant at the chosen level of significance, which 5% ($p < .05$). Hence, the EFA is associated with an appropriate sample size, and this reveals its validity.

A final assessment of the validity of the EFA is done using Table 1 (please see the Appendix), which contains the anti-image correlations. These correlations must be as close to 1 as possible to ensure that the EFA is sufficiently valid and reliable (Tipping and Bishop, 2007). More often than not,

between 0.50 and 1 are indicators of a strong and reliable EFA. As seen in Table 3, all the antiimage correlations fall in this range. Hence, there is ample evidence to say that the EFA, at least in terms of the first iteration, is strong and valid.

In Table… in the Appendix, values called communalities or extraction are shown. The values reveal variables which weakly fit into the data and would therefore need to be eliminated. These values are equivalent to "R Square" values in linear regression analysis. By principle, higher values indicate that the corresponding variable significantly fits into the data. The general rule of thumb is that, variables with communalities less than 0.50 are extracted (Suhr, 1999). Considering this rule of thumb, all variables are removed except V_{11} (market access), V_15 (output price), V_{16} (inadequate rainfall) and V_{17} (credit availability). This requires that V_{11}, V_{15}, V_{16} and V_{17} are taken into the next iteration, which starts with Table 5.10 and ends with Table 5.13.

Table 5.10: Correlation Matrix – Second Iteration 5

		V11	V15	V16	V17
Correlation	V11	1.000	.363	.243	.368
	V15	.363	1.000	.451	.516
	V16	.243	.451	1.000	.460
	V17	.368	.516	.460	1.000

Extraction: Principal Axis Factoring :

V11="Risk from inaccessibility to the market"

V15= "Risk from unexpected variability in product prices" *V16*="Risk from deficiency in rainfall causing drought".

V17="Risk from credit availability"

Table 5.11: KMO and Bartlett's Test – Second Iteration 6

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.743
Bartlett's Test of Sphericity	Approx. Chi-Square	832.189
	df	6
	Sig.	.000

Extraction: Principal Axis factoring

Table 5.12: Anti-image Correlations – Second Iteration 7

	V11	V15	V16	V17
Anti-image Correlation	.793	.730	.754	.724

Extraction: Principal Axis Factoring

Table 5.13: Communalities – Second Iteration 8

	Initial	Extraction
V11	.177	.225
V15	.351	.527
V16	.275	.363
V17	.360	.548

V11 and V16 are to be removed in second iteration

Tables 5.10, 5.11, 5.12 and 5.13 constitute findings of the second iteration of the EFA. These tables follow the same pattern with Tables .. in appendix. Table 5.10 shows the correlation matrix of the four variables taken into the second iteration. Unlike Table… in the Appendix, this table has larger correlation coefficients. It is therefore likely that most of the variables in this iteration would be

retained. Also in Table 5.10, the KMO and Bartlett's tests are significant and satisfy the general criteria revealed earlier. The anti-image correlations in Table 5.12 are also sufficiently large with respect to the general rule of thumb. Therefore the EFA, in terms of the second iteration, is valid. Table 5.13 shows the communalities or extraction values. Based on the general rule of thumb used earlier, V_{11} and V_{16} are removed in the second iteration. Hence V_{15} and V_{17} are taken into the next iteration.

Table 5.14: Correlation Matrix – Third Iteration

		V15	V17
Correlation	V15	1.000	.516
	V17	.516	1.000

Extraction: Principal Axis Factoring

Table 5.15: KMO and Bartlett's Test – Third Iteration

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.500
Bartlett's Test of Sphericity	Approx. Chi-Square	312.401
	df	1
	Sig.	.000

Extraction: Principal Axis Factoring

Table 5.16: Anti-image Correlations – Third Iteration

	V15	V17
Anti-image correlations	0.500	0.511

Extraction: Principal Axis Factoring

Table 5.17: Communalities – Third Iteration

	Initial	Extraction
V15	.266	.515
V17	.266	.536

Extraction Method: Principal Axis Factoring.

Tables 5.14, 5.15, 5.16 and 5.17 constitute findings of the third iteration of the EFA. In Table 5.15, V_{15} and V_{17} have significantly high correlation coefficients. It is therefore likely that all of them are retained. Also in Table 5.15, the KMO and Bartlett's tests are significant and satisfy the general criteria established earlier. The anti-image correlations in Table 5.16 also satisfy the general rule of thumb. Therefore the EFA, in terms of the third iteration, is valid. Table 5.17 shows the communalities of the third iteration. Based on the general rule of thumb, V_{11} and V_{16} are all maintained. Hence the EFA ends in three iterations, with two variables retained. This means that the final factor(s) formed would be primarily made up of the two variables. Table 5.18 shows the variation accounted by these 2 variables and the factor(s) formed by them.

Table 5.18: Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.516	75.784	75.784	1.029	51.471	51.471
2	.484	24.216	100.000			

Extraction Method: Principal Axis Factoring.

Table 5.19 shows the factor(s) formed by variables retained. Generally, a factor has an Eigen value not less than 1. Invariably, a factor cannot have an Eigen value to be less than 1. In this respect, 1 factor has been formed by the two retained variables. This factor accounts for 75.8% of the total variation. This means that V_{15} and V_{17} account for 75.8% of the total variation as risks faced by rural farmers in Ghana. Considering the fact the retained variables are 2 out of 29, the variation contributed by them represents a very high influence posed by them as risks faced in rural farming. V_{15} and V_{17} respectively stand for "Risk from unexpected variability in product prices" and "Risk from credit availability". These two risks are the most critical to rural farming, followed by variables removed in the second iteration (i.e. V_{11} and V_{16}) though they are not part of the risk factor formed. V_{11} and V_{16} respectively stand for "Risk from inaccessibility to the market" and "Risk from deficiency in rainfall causing drought".

The fact that only two variables are retained in the final factor does not mean that variables removed are not risks faced by rural farmers. Technically, variables removed in the EFA are also risks faced by rural farmers, but these risks are not as serious or influential as those retained in the factor. So the 29 risks can be conceptualized as: (1) less influential risks – these are risks removed in the first iteration; (2) fairly influential risks – these are risks removed in the second iteration (i.e. V11 and V16); and (3) highly influential risks – risks retained in the factor.

The analysis show that rural farmers would have loved to increase their farm sizes in order to improve their welfare level. It is also important to note that rural farmers are concerned with the prices that they receive for their products as an important risk that they face. In Ghana as indicated earlier, farmers do not have well defined markets for their products and therefore marketing of farming products have always been challenge to farmers. It is not surprising to see farmers throwing out their products for lack of market for them.

Another important challenge deemed as critical by the factor analyses is the problem of rain. Farming in Ghana is generally rain-fed and therefore, a change in the rainfall pattern is very crucial to the farmers.

5.4 Socio-Economic Determinants of Risk Perception

As indicated in the earlier discussions, the mean score values of risk perception based on location and crop types differ greatly among the rural farmers. It was further realized that proportion of the variation in risk perception caused by location and crop type were respectively 3.4% and 1.7% respectively. This simply means that other factors influence the risk perception behaviour of rural farmers in Ghana regarding their farming activities. The weighted mean of responses of each farmer regarding the various risks condition is the dependent variable and the various socio-economic characteristics of each farmer are used as the independent variables. The regression results are shown in the table 5.19 below.

Table 5.19: Regression estimates of risk perceptions and socioeconomic characteristics

Variables	Estimates of coefficients

Age	0. 938* (0.379)
Age_Square	-0.01024** (0.004)
Gender	-1.603 (1.880)
Household Size	0.781* (0.309)
Educations (Years)	0.289* (0.173)
Income	0.006** (0.0002)
Wealth (Assets)	0.00027 (0.0001)
Farm Size	-0.352* 0.162)
Location Techiman	9. 360** (1.940)
Location Sefwi Wiawso	7.908** (1.921)
Plantation crop	4.226* (1.81)
Food Crop	6.286** (1.76)
Constant	214.0537** (8.637)
R^2 0.0949**	F(10, 976) = 7.90 Prob > F = 0.0000
** and * are statistically significant at probability level of 1 percent and 5 percent respectively ***(the figures in parenthesis are standard errors)***	

The values for risk perceptions were scaled up by a factor of 100 before they were used for the regressions, and therefore all the coefficients are divided by 100 for interpretation.

The value of the R^2 for the regression is 0.0949 which mean that on average; about 9.5% of the variations in risk perception regarding rural farming in Ghana is explained by the socio-economic characteristics of the farmers. This is relatively small but the value is not different from what has been found in the literature. For instance, Satit Aditto (2011) and Flaten et al. (2005) found out that socioeconomic characteristics explain only about 6% of 3% respectively the variations in the risk perception of rural farmers in Thailand and Norway, though Lucas and Pabuayon (2011) found the R^2 to be a bit higher at 19%. The writers argue that the lower R^2 of the regression models implies that

the farmers' perceptions of sources of risk and risk differed from farmer to farmer. All the farmers' socio-economic characteristics included in the model were statistically significant at, at least 5% error level except gender of the household head and wealth. This means that statistically, there is no difference between the risk perception of male headed households and female-headed households. This means that all things being equal, the way farmers perceive the various risks pertaining to their farming business is independent of their gender. Also, the wealth of the households does not influence their risk perception position.

Age has positive impact on perception of risk and it is statistically significant at 5% error level. This means that a rural farmer's perception about risks conditions regarding farming increases with age. This result contradicts that obtained by Lucas and Pabuayon (2011) and Sattit Aditto (2011) who found the coefficient of age to be negative, though insignificant. Younger farmers have low perception about risks compared to older farmers. However, the coefficient of the age-square variable is negative and significant meaning that risk perception increases with age but a decreasing rate. It should be pointed out that larger value of risk perception means that the rural farmers view the various risks conditions as more and more severe. This means that as a farmer gets older, they view the various sources of risk as more and more severe, but this increase in risk perception occurs at reduced rate with age. This might be because as they get older and older beyond the threshold age, they become more and more familiar with these risks and might have found ways of dealing with them and therefore do not view them as being severe again. Thus as farmers become older and more experienced in farming, they begin to accept the inevitable risks that they face and become used to these problems and therefore do not regard them as severe anymore. In Ghana, most farmers take farming as a way of life and that as they grow beyond certain age, they become more and more used to the idea of farming and therefore their perception about risk falls.

Family size is positively related to risk perception meaning that as a rural farmer's household size increases, they become more and more concerned about their family's welfare and therefore their perception about risks increases.

Education has positive impact on risk perception and it is significant at 5% error level. This means that educated rural farmers have higher perception about risks compared to uneducated rural farmers which indicates that more educated farmers perceive these sources of risk as significantly more important in farming. The reason may be due to the more educated farmers having found that the family farm situation and the changes in farm business environment, such as high labour wages and relatively high prices of agricultural land, may indirectly affect their farm operations. Also more educated farmers may view other ventures as alternative to farming and therefore view these risk sources as severe and thus may leave when the conditions become unbearable. However, for the less educated farmers, they see farming as their only source of livelihood and therefore do not regard these risks as that important since they have no choice but to continue farming irrespective of these risks.

Income has positive and statistically significant effect on risk perception among rural farmers in Ghana at 5% error level. Thus, statistically income is an important determinant risk perception, all other factors remaining constant. The results mean that as farmers gets more income, (from their previous harvest and other sources), their perception about risks pertaining to their farming activities rises. This may be due to the fact that as they become richer they become more concerned about losing their investment in their farming and therefore regard these risks as important as they have potential of reducing their income and wealth as well as their investment. In other words, the results suggest that farmers who have high income are very concerned about those risks that can disrupt their income and wealth and also might have other opportunities elsewhere and therefore their perception rises. It is not surprising therefore to find that in the rural areas, then farmers "make it big", they leave farming and enter into trading. At a focus group discussion, most farmers gave several examples that when farmers (especially young ones) have good harvest and good income, they mostly abandon farming

and use the money to open shops or leave for the big cities to engage in other businesses. One farmer that was interviewed at Techiman during the questionnaire administration said that after having unprecedented income the previous year, he has decided to open a shop and stop farming. These go to show clearly that rural farmers' perception about risks rises as they become richer and wealthier.

Farm size has negative and significant impact on risk perception. This means that rural farmers with large acreage have lower risk perception about risk than those with smaller farm size. This is contrary to expectation. We would have expected that farmers with large acreage should be more concerned about the risks they face than those with small farms, however the findings go contrary. However, O. Flaten et al. (2005) found mixed results, while some risks conditions were positively related to farm size, others were negative. The reason for the positive results obtained in this work may be due to the fact that since farming takes time to mature, as farmers might have invested heavily already in the large farms and there is little they can do about these risks, they might regard them as unimportant anymore.

All the location dummies are statistically significant at 1% error level and also positive. Thus with regard to the farmers' location variable, the regression result showed a strong relationship with the risk factors. This finding indicates that the sources of risk on of rural farmers differ significantly between locations in Ghana. The same is said about the crop type dummies. The significant coefficients of the dummies mean that there is strong evidence to conclude that risks perceptions differ significantly among different crop farmers.

5.5 Effect of Risk Perception on livelihood security of Rural Farmers

In this section, the impact of risk perception on livelihood security of rural farmers in Ghana is analysed. This is aimed at determining whether rural farmers' high perception about risk has any impact on their livelihood. As explained in the chapter four of this work, it was explained that five security variables were used to compute the livelihood security variable. These were Economic

Security, Food Security, Educational Security, Health Security and Participation Security. These were averaged to compute the overall security status of the rural farmers in the studied communities. In the first part of this analysis, the pairwise correlation coefficients between the variable of interest, risk perception and the various components of the livelihood security index as well as the overall security index. The results are presented in the table 5.21 below

Table 5.20: Correlation between Risk Perception and Components of Livelihood Security

	Risk Perception	Economic Security	Food Security	Health Security	Education Security	Participation Security	Livelihood Sec
Risk Perception	1.0000						
Economic Security	0.0471**	1.0000					
Food Security	0.0662**	0.0271	1.0000				
Health Security	0.0758**	-0.1855***	0.1720***	1.0000			
Education Security	0.1360***	-0.3538***	0.0451	0.3400***	1.0000		
Participation Security	0.0222	0.2002****	-0.0439	0.0070	0.0225	1.0000	
Livelihood Sec	0.1353***	0.0809****	0.3259***	0.5653***	0.6418***	0.5696***	1.0000

***, ** means significance level at 1% and 5% respectively

The table shows that risk perception among the rural farmers correlate significantly with four of the five components of livelihood security index and the overall security index. Though the risk perception is correlated positively with the participation index, the value is not significant statistically at 5% error level. This means that all things being equal, there is no correlation between rural farmers' perception about the risks that they face in their farming business and their participation in the community governance and groupings. It was expected that rural participation would be strongly

correlated with risk perception as high risk perception about farming would have encouraged them to participate more as a way of mitigating the effects.

Among the four components of the livelihood security index, the strongest that correlate with risk perception is education security. The correlation coefficient is statistically significant at 1% error level. This may be to the fact that when rural farmers have high perception (extreme perception) about risk, they may view education as a safe haven and the other alternative available to them and might seek more educational security. In the same way, farmers who have high educational security may view the farming as more risky than those that are less educated.

The second most important component to correlate with risk perception is Health followed by food security and the least being economic security. The correlation coefficients for health security, food security and economic security components are 0.0758, 0.0662 and 0.0471 respectively, which are all significant at 5% error level. All the coefficients are positivity correlated to risk perception. This means that as rural farmers' economic, health, food, and educational conditions improve, they see farming as more and more risky. It is not surprising therefore that as people get more educated and their economic conditions improve, they relocate to the cities and abandon farming.

The overall Livelihood security index correlates positively with the risk perception coefficient, with correlation coefficient of 0.1353 which is significant at 1% error level. This means that higher livelihood means goes with higher perception about risks relating to farming. In other words as farmers become more secured in terms of livelihood, they perceive farming as more and more risky and thus might be more likely to abandon farming for more secured ventures, mostly trading or migrating to the cities for non-existing jobs.

Having established that there exists some correlation between risk perception and the components of livelihood security, we then proceed to run the multivariate regression of the impact of risk perception on the economic and the overall livelihood of rural farmers in Ghana. In addition to the household

characteristics, we add risk perception mean value to test whether the coefficient is statistically significant. The results are presented in table 5.22 below.

Table 5.21: Effect of Risk Perception on Livelihood

Variables	**(Model 1)** Economic Security	**(Model 2)** Overall Livelihood Security
Gender of Hse hold head	-1.0113	-1.610
	(4.918)	(4.128)
Age of Household head	1.741*	3.160***
	(0.962)	(0.807)
age_sq	0. 0032	-0.031 ***
	(0.0099)	(0.0083)
Years of Education	0.570	
	(0.434)	
Marital Status	18.13***	49.352***
	(6.718)	(5.147)
Total Household size	-9.651***	3.048***
	(0.789)	(0.656)
Risk Perception	23.359***	27.779***
	(7.880)	(6.602)
Vocation		5.051
		(5.795)
Constant	40.769	108.41***
	(28.160)	(23.54)
Observations	991	991
Adjusted R^2	0.253	0.162
F-Values	42.99***	28.25***
Standard errors in parentheses	* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$	

The possibility of endogeneity was tested ad was found to be very low. Thus, we proceeded to use OLS to establish the relationship between risk perception and livelihood. It should again be pointed out that the values for economic security and overall livelihood security indices were scaled upward by a factor of 1000 and therefore the coefficients for the independent variables is divided by 1000 for the interpretation of effects.

The most important variable of interest here is the coefficient of risk perception. The main objective here is to test whether risk perception has any effect on the economic as well as the overall livelihood of rural farmers in Ghana. The overall model is statistically significant at 1% error level. However, the adjusted R^2 is small, similar to the findings on the determinants of livelihood in chapter four of this work. The value of the R^2 means that only approximately 25% of variations in the economic security of rural farmers are explained by their household characteristics and that of risk perception. However, only about 16% of the variations in overall livelihood security are explained by household characteristics. This means that while the household characteristics to a large extent explain the changes in economic livelihood, overall livelihood are explained by factors that are outside the domain of the individual rural households.

The table shows that risk perception risk perception positively and significantly determines both economic and overall livelihood security. The coefficient is significant at 1% error level and also positive. The coefficient of the economic security model is 0.02336 which means that an increase in risk perception leads to increase in economic security. This may be due to the fact that when rural farmers view farming as riskier, they may take precautions about the kinds of investment they do in order to avert any losses that might arise out of their farming business.

The coefficient of risks perception for the overall livelihood model is also positive and significant at 1%. This means rural farmers who have high perception about the various risks that they face are better off than those who underrate the risk that they face in their farming business and therefore might take decisions that are detrimental to their farming business. For instance a farmer that has low perception about risks related to rainfall may plant at the time that they are not to plant and they might end up having crop failures and becoming poorer. However, farmers who perceive rainfall variation as substantial risk to their business would take precautions as to when and the type of crop to plant and end up having good harvest and better economic and overall security in terms of livelihood.

CHAPTER SIX

ANALYSIS OF LIVELIHOOD SECURITY AND RISK ATTITUDE

6.1 Introduction:

In this section, the results of the risk aversion coefficients of the rural farmers are analyzed. In the first part of the analysis, the descriptive of the results are discussed. In the second part of the discussions, we examine the influential factors that affect risk attitudes of rural farmers with special emphasis on crop types and location.

6.2 Measurement of the absolute risk aversion coefficients

As pointed out and discussed in the methodology, individual certainty equivalent (CE) values elicited from the farmers using the Equally Likelihood Certainty Equivalence (ELCE) method were employed to derive each farmer's utility function. A sequence of 10 CE points and 10 corresponding utility values were obtained for each of the farmers who participated in the survey. The CE values obtained were then regressed on the farmers' utility values for the functional forms of the utility function. As noted in the methodology, there are several functional forms of the utility functions used in empirical work of risk attitudes, however in this work, three functional forms are used, Quadratic, Cubic and Negative Exponential Functions. The risk aversion coefficient was then computed using the mean values of the Certainty equivalence values. Out of the 1198 who participated in the entire survey, only 1,134 participated in the lottery that elicited the CE values. Thus in all 3,402 regressions were estimated (three for each of the 1,134 respondents). However, due to space, all the individual regressions and the computations of the risk aversion coefficients cannot be presented here. The summaries of the results are presented and analyzed.

As argued by Binici, Koc, Zulauf and Bayaner (2003), because a curve is being fitted, the significance of the equation given by the F-Statistic and the value of the R^2, have more statistical importance than the significance of the individual coefficients. The overall statistics of all the equations were statistically significant at at least 10% error level with the R^2 values ranging between 85% and 98%. However, in terms of the significance of the individual parameters, a number of the parameters were not statistically significant even at 10%, mostly for the cubic and quadratic functions. This is not surprising since this problem is similar to previous studies relating the choice of utility function to the classification of risk preferences. Similar results were obtained by Binici et al., (2003) Torkamani & Haji-Rahimi, (2001) and Aditto (2011). This problem as explained by the above writers is due to small numbers of observations to estimate each equation. Notwithstanding the above problems, it have been realized that the values of the risk aversion coefficients are not greatly affected by the insignificant nature of the individual parameters. Thus estimated parameters, subsequently, are used to evaluate the farmers' risk attitudes using the Arrow-Pratt risk aversion coefficient formula discussed in the methodology.

Since three different utility functions were used to derive the risk aversion coefficients for the respondents, the first part of the analysis involves testing the notion that classification of risk aversion of respondents is influenced by the choice of the utility function. Thus we test the means of the risk aversion coefficients of the various functional forms. The results are presented in tables 6.1A, 6.1B, 6.1C and 6.1D. It should be noted that a larger value of the r (risk aversion coefficient) implies a stronger aversion to risk and a lower value means a weaker or lower aversion to risk. The results for Offinso North rural farmers (Table 6.1A), Techiman Municipal rural farmers (Table 6.1B), and Sefwi Wiawso rural farmers (Table 6.1C) show that the hypothesis that all the risk aversion coefficients means are the same for the three functional forms of the utility functions are rejected at 1% error level. In other words, we can conclude at 99% confidence level that risk aversion coefficients differ depending on the type of utility function used to derive the aversion coefficients. As shown by

Torkamani and Haji-Rahimi (2001), and other previous studies, the choice of utility function is an important aspect of risk attitude analysis. Alternative utility functions may classify farmers' risk attitudes in different ways. From the tables, the average risk aversion coefficient for quadratic functional form is biggest for each individual district followed by the value for the cubic function with the least value obtained from the exponential functional form.

Table 6.1A: Risk aversion coefficients evaluated by three different utility functional forms for Offinso North Rural Farmers

Functional Form	observation	Mean	SD	Minimum	Maximum
Exponential	356	0.0004011	0.0000371	0.0002576	0.0005128
Cubic	356	0.0021591	0.0066681	-0.0315863	0.02682
Quadratic	356	0.0082764	0.008315	-0.041999	0.0200523
Hotelling T2 = 423.49		Hotelling F(2,354) = 211.15		Prob > F = 0.0000	
Note: Test hypothesis that all means are the same					

However, it should be pointed out that all the utility functions on the average classified all the respondents as risk averse. From the table 5.12D, the mean value for the overall risk aversion for each functional form is positive meaning that all the respondents are on average risk averse. This is consistent with previous studies by Binici et.at (2003) who found out that rural farmers in Turkey are on average risk averse. The results are also consistent with the study by Lucas and Pabuayon (2011) who found that rural rice farmers in Philippines are generally risk averse, irrespective of the functional form of the utility function. As argued by Lucas and Pabuayon (2011), the results conform with the safety-first rule, which suggests that a farmer normally seeks to meet the needs of his household before anything else.

Table 6.1B: Summary of the absolute risk aversion coefficients evaluated by three utility functional forms for Techiman Rural Farmers

Functional Form	observation	Mean	SD	Minimum	Maximum
Exponential	385	0.0003848	0.0000332	0.0002703	0.0005154
Cubic	385	0.001591	0.0056924	-0.0237052	0.0255098
Quadratic	385	0.0088733	0.0061263	-0.0233013	0.0229712
Hotelling T2 = 842.95		Hotelling F(2,383) = 420.38		Prob > F = 0.0000	
Note: Test hypothesis that all means are the same					

Table 6.1C : Summary of the absolute risk aversion coefficients evaluated by three utility functional forms for Sefwi Wiawso Rural Farmers

Functional Form	observation	Mean	SD	Minimum	Maximum
Exponential	393	0.0003829	0.0000208	0.0003281	0.0004738
Cubic	393	0.0007996	0.0066195	-0.0487436	0.0449782
Quadratic	393	0.0077142	0.0069439	-0.0275246	0.0182887
Hotelling T^2 = 505.63		Hotelling F(2,391) = 252.17		Prob > F = 0.0000	
Note: Test hypothesis that all means are the same					

Table 6.1D: Summary of the absolute risk aversion coefficients evaluated by three utility functional forms for All Farmers

Functional Form	observation	Mean	SD	Minimum	Maximum
Exponential	1134	0.0003893	0.0000319	0.0002576	0.0005154
Cubic	1134	0.0014951	0.0063548	-0.0487436	0.0449782
Quadratic	1134	0.0082842	0.0071622	-0.041999	0.0229712

Hotelling T^2 =	1642.49	Hotelling F(2,391) =	820.52	Prob > F =	0.0000

Note: Test hypothesis that all means are the same

In this part of the analysis, we examine to find out if risk aversion differs among rural farmers in Ghana from each of the functional forms of the utility functions. Tables 6.2A, 6.2B and 6.2C give the mean values, standard deviations and the test statistics for the risk aversion coefficients of each of the three functional forms of the utility functions of the rural farmers. Table 6.2A gives the results for the cubic function, 6.2B gives the results for the quadratic function and that of the exponential function is given by table 6.2C. For the cubic function, the hypothesis that all the means values of the risk aversion coefficients are equal among the rural farmers is rejected at 1% error level. This means that from the cubic functional form, the rural farmers risk aversion coefficients are different. The table shows that rural farmers in Offinso North are more risk averse followed by rural farmers at Techiman with Sefwi Wiawso farmers being least to aversion. This means rural farmers at Offinso North are least likely to undertake risky ventures to enhance their farming business than those at other areas in the studied districts.

Table 6.2A: Summary of the absolute risk aversion coefficients for rural farmers based on the Cubic Functional Form

Functional Form	observation	Mean	SD	Minimum	Maximum
Offinso North	356	0.0021591	.0066681	-.0315863	.02682
Techiman	385	0.001591	.0056924	-.0237052	.0255098
Sefwi Wiawso	393	0.0007996	.0066195	-.0487436	.0449782

Hotelling T2 = 5.31	Hotelling F(2,354) = 2.65	Prob > F = 0.0722

Note: Test hypothesis that all means are the same

For the Quadratic functional form, the means are statistically different from each other at 1% error level with highest figure recorded for rural farmers at Techiman followed by those at Offinso North with the least figure recorded for the rural farmers at Sefwi Wiawso. This result goes to confirm the earlier findings that the choice of a utility functional form has influence on how people respond to risk in terms of aversion. While the risk aversion coefficients from the cubic function shows that rural farmers at Offinso North are more risk averse than those at Techiman, the quadratic functional shows otherwise.

The comparison of risk aversion for the rural farmers from the exponential functional form is given in table 6.2C. The test statistic shows that we can reject the notion of equal risk aversion means at 1%. This means that there is differences among the mean values of the risk aversion coefficient among the three studied areas are statistically significant. The mean values show that rural farmers from Offinso North are the most risk averse followed by those at Techiman with rural farmers at Sefwi Wiawso being least averse to risk. The three results conclusively show that irrespective of the functional form of the utility function, rural farmers at Sefwi Wiawso are least to aversion to risk.

Table 6.2B: Summary of the absolute risk aversion coefficients for Rural farmers based on the Quadratic Functional Form

Functional Form	observation	Mean	SD	Minimum	Maximum
Offinso North	356	0.0082764	0.008315	-0.041999	0.0200523
Techiman	385	0.0088733	0.0061263	-0.0233013	0.0229712
Sefwi Wiwso	393	0.0077142	0.0069439	-0.0275246	0.0182887

Hotelling T2 = 11.44	Hotelling F(2,383) = 5.70	Prob > F = 0.0036

Note: Test hypothesis that all means are the same

Table 6.2C: Summary of the absolute risk aversion coefficients for Rural farmers based on the Exponential Functional Form

Functional Form	observation	Mean	SD	Minimum	Maximum
Offinso North	356	0.0004011	0.0000371	0.0002576	0.0005128
Techiman	385	0.0003848	0.0000332	0.0002703	0.0005154
Sefwi Wiwso	393	0.0003829	0.0000208	0.0003281	0.0004738

Hotelling T^2 = 59.12 Hotelling F(2,391) = 29.48 Prob > F = 0.0000

Note: Test hypothesis that all means are the same

Since it has been proven that the classification of risk aversion depends to a large extent on the chosen functional form, we then proceed to classify the rural farmers according to their aversion to risk based on the three functional forms. The results of the classifications are presented in table 6.3. As expected, the exponential function classified all the farmers as risk averse. This is consistent with theory that says the exponential functional form assumes constant aversion to risk.

Table 6.3: Classification of Risk Attitude

Location	Quadratic Function		Cubic function		Expo fn	
	Risk Averse	Risk Preferring	Risk Averse	Risk Preferring	Risk Averse	Risk Preferring
Offinso North	305	51	261	95	356	0
Techiman	355	31	284	101	385	0
Sefwi Wiawso	364	29	276	117	393	0
Total	1,024	111	821	313	1,134	0

It should also be emphasized that the value of the risk aversion coefficient for the exponential utility function is independent of income. Thus, irrespective of the level of farmers are ready to play safe instead of taking a gamble. This is one weakness of the exponential functional form of the utility function.

The classification of the respondents based on the quadratic and cubic functional forms are however mixed. While some respondents are classified as risk averse under the cubic function, the same may be classified as risk preferring under the quadratic function. For the rural farmers at Offinso North, while the Quadratic Function classified 305 respondents as risk averse and 51 as risk preferring, the cubic function classified 261 as risk averse and 95 as risk preferring. For the rural farmers at Techiman, the quadratic function classifies 355 as risk averse while 31 are classified as risk preferring whereas the cubic function classifies 284 as risk averse and 101 as risk preferring. The quadratic function classifies 364 respondents as risk averse and 29 as risk while the cubic function classifies 276 as risk averse and 117 as risk preferring. Overall, the quadratic function classifies 1,024 of the rural farmers as risk averse and 111 as risk preferring whereas the cubic function classifies 821 of the respondents as risk averse and 313 as risk preferring. This results show strongly that classification of risk aversion is dependent on the choice of the utility function. While some respondents are classified as risk averse by one utility functional form, another classifies the same as risk preferring. The results of this study strongly support the findings of Ramaratnam et al. (1986), Zuhair et al. (1992) and Binici et al. (2003), who pointed out that the choice of utility functional form directly influenced the classification of the farmers.

This implies that one farmer, perhaps, can be classified as risk averse by one utility functional form and risk loving when another utility functional form is employed. Consequently, the choice of utility function is important because it can reveal opposite risk preferences (Aditto, 2011).

6.3 Effects of Farmers' Socio-Economic Characteristics on Risk Aversion

In this section, we discuss the impact of rural farmers' socio-economic characteristics on their risk aversion positions. Using seven socioeconomic variables of the rural farmers which were age, gender, education level, size of household, farm size, income and Wealth (proxied by total assets of the rural households), a multivariate regression was estimated with the risk aversion coefficients obtained from the negative exponential function. To test the hypothesis as to whether location and crop types have any impact on determining risk aversion of rural farmers, two models were run. In the first model, two dummies representing locations for Techiman and Sefwi Wiawso were added to the seven variables and in the second model, two dummies for crop types for plantation crop and Food crop were then added to the seven variables to determine if their coefficients are statistically significant or not. To make sure that spurious results are not obtained, a Pearson correlation analysis were done to make sure that the independent variables are not related. The results (not documented here) showed no valid correlation among the independent variables except the obvious case of the age and the age-squared variables. Satisfied that the multivariate results are reliable, the regression was estimated and the results are presented in table 6.4 below.

Table 6.4: OLS regression risk aversion coefficients and socioeconomic characteristics of Rural Farmers in Ghana

Variables	Estimates and standard errors

Age	0.01418*** (2.83)
Age-square	-0.00015*** (-2.87)
Gender	0.0186 (0.53)
Household Size	-0.00277 (-1.63)
Educations (Years)	-0.00445* (-1.76)
Income	-0.000035** (-2.00)
Wealth (Assets)	0.0000005 (0.27)
Farm Size	0.000002 (0.94)
Location Techiman	-0.172*** (-6.84)
Location Sefwi Wiawso	-0. 181*** (-7.13)
Plantation crop	-0.111*** (-3.60)
Food Crop Constant	-0.0777** (-2.57)
	3.687*** (33.17)
F(10, 977) = 8.48	Prob > F = 0.0000
R^2 = 0.0799***	
The values in the parenthesis are the t-values	

The values for risk aversion was scaled upward by a factor of 10000 and therefore the coefficients are scaled down by 10,000 before interpreting them

The F-statistic is statistically significant at 1% error level. This means that the R^2 of both regression models is statistically significant, though small. The value is 0.0799, which means that the variables included in the model explained roughly eight per cent of the total variations in the risk attitudes values of the respondent. This result is not surprising as the same was found by several writers. For instance Satit Aditto (2011) found out that only 6% of variations in risk attitudes of Thailand Small holder farmers are explained by their socio-economic characteristics. However, results obtained by

Lucas and Pabyuayon (2011) found that for rice farmers in Philippines, the R^2 was approximately 54%. The low value of the R^2 means that rural farmers attitude to risk is less explained by their socio-economic characteristics. Other factors such as religion and personal experience with farming and others could well be more reasonable in explaining rural farmers' attitudes to risk.

The results show that age has positive impact on risk aversion. This means that risk aversion rises with age. That is older one gets, the higher the person's aversion to risk. This results confirm that of Moscardi and Janvry (1977), Lins, Gabriel and Sonka (1981) and Gómez-Limón et al. (2003) who argued that younger generation farmers would be less risk averse than the older generation. However, increase in the aversion to risk with age does not go on indefinitely. The negative value of the age-square variable in the regression results means that risk aversion rises with age at a decreasing rate. Put differently, as a rural farmers advance in age, they are less likely to take risks with respect to uncertain income from farming and more likely to take decision that give creation income, however, the increase in aversion to risks occurs at a decreasing rate with age. This may be due to the fact that beyond a certain age, the farmer might have gained more experience in farming and might have had a large family and therefore are more likely to continue farming rather than taking other ventures even if they give certain income.

The coefficient of gender is not statistically insignificant. This means that aversion to risk does not depend on the gender of the respondent. That is there is no evidence to show that there are significant differences in risk aversion between male headed households and female headed households. The results is similar to those found by Satit Aditto(2011) among Thailand farmers. Also using logit regression, Dadzie and Acquah (2012) found similar results among food crop farmers at Agona Duakwa in Agona East District of Ghana. Their results show that the impact of gender on risk aversion is statistically insignificant. However the results contradict that of found by Binswanger (1980) who found statistically significant negative relationship between gender and risk aversion among the Indian farmers, which indicated that women farmers were less willing to assume risk than men.

Contrary to findings by Dadzie and Acquah (2012) among food crop farmers at Agona Duakwa in Agona East District of Ghana, and that of Satit Aditto (2011) among Thailand farmers, the results from the regression show that household size has no significant impact on risk aversion. It was expected that, as argued by Satit (2011), farmers with smaller households are likely to be more risk averse than the larger household farmers which is consistent with the findings of Moscardi and Janvry (1977) who argued that farmers become less risk averse as family size increases. According to them, this may be because the larger household size is associated with increasing availability of agricultural and off-farm labour. Therefore, it could enhance the potential to generate more household income and increased risk seeking behaviour. However, in this work this is not the case. This means that a rural farmer's decision to or not to take risk does not depend on the size of the farmer's family.

Consistent with findings from several writers, education measured by the number of years of schooling by the household head has negative impact on risk aversion position of the household, though the coefficient is small and significant only at 10% error level. The Table 5.15 shows that education had an inverse relationship with farmer risk-averse attitude and was statistically significant meaning that the more educated respondents are, the more they would be willing to bear risk than the less educated. In other words, the less educated rural farmers tended to exhibit more risk-averse behaviour than those who are more educated. This assertion and findings confirm that found by Moscardi and Janvry"s (1977), Dadzie and Acquah (2012), Aditto (2011) and Binswanger (1980). However, Lucas and Pabyuayon (2011) found contrary results among rice-corn, ricemungbean and rice-sweet pepper farmers in the Philippines, though they were not significant.

The coefficient of wealth measured by both the monetary and non-monetary assets of the households was found to be statistically insignificant as well as farm size. In terms of farm size, this result is not different from those found by Lucas and Pabyuayon (2011) Dadzie and Acquah (2012), Aditto (2011). However, wealth was found to have a strong impact on risk aversion by Lucas and Pabyuayon (2011) among rural farmers in the Philippines contrary to the findings in this work.

As expected, income was found to be statistically significant determinant of risk aversion. It was found to be statistically significant at 5% error level with the coefficient being negative. This means that higher income reduces aversion to risk. That is as income increases, rural farmers are more willing to take risk and venture into things that are more uncertain. Thus richer people are less averse to risk than poorer households. This result is similar to those found by Satit (2011), though he found the coefficient to be statistically insignificant.

The dummies capturing locations were found to be negative and significant at 1% error level. The aim was to determine whether rural farmers located at Techiman and Sefewi Wiawso had aversion to risks different from those located at Offinso North. The negative values for the coefficients of Sewi Wiawso dummy and that of Techiman mean that rural farmers at Techiman and Sefwi
Wiawso are less averse to risk than those in Offinso North. Thus a farmer located at Sefwi Wiawso and Techiman is more likely to take an action that is riskier than those located at Offinso North. These means that rural farmers' aversion to risk differs based on their location, aside other socioeconomic characteristics of the farmers.

The last analysis involves the examination of the dummy capturing crop type. Using vegetable crops as a bench mark, we compare the risk aversion position of rural farmers producing plantation crops and food crops to that of vegetable crops. The coefficients are negative meaning that being a plantation crop farmer or food crop farmer reduces aversion to risk compared to those of vegetable crop.

The above analysis show clearly show that though all the rural farmers are classified as risk averse by the negative exponential functional form, there are clear differences among the level of aversion based on location and crop type. Though the multivariate regression did not yield satisfactory results in terms of predictive power as given by the low R^2, it can be concluded that the characteristics of risk aversion among rural farmers in Ghana can to some extend be explained by their socio-economic status.

6.4 Effect of Risk Aversion on livelihood security of Rural Farmers

In this section, we examine the impact of risk aversion on the livelihood of rural farmers in Ghana.

6.4.1 Correlation analysis of the relationship between risk aversion and socio-economic Characteristics

First, the correlation between the various components of livelihood security and risk aversion are examined and tested. This is to find out the extent to which the various components of livelihood relate to the risk aversion position of rural farmers in Ghana. The results are presented in the table below

Table 6.5: Correlation between Risk Perception and Components of Livelihood Security

	Risk Perception	Economic Security	Food Security	Health Security	Education Security	Participation Security	Livelihood Sec
Risk Perception	1.0000						
Economic Security	-0.0605**	1.0000					
Food Security	0.0372	0.0271	1.0000				
Health Security	0.0362	-0.1855***	0.1720***	1.0000			
Education Security	-0.0159	-0.3538***	0.0451	0.3400***	1.0000		

Participation Security	-0.0335	0.2002****	-0.0439	0.0070	0.0225	1.0000	
Livelihood Sec	-0.0081	0.0809****	0.3259***	0.5653***	0.6418***	0.5696***	1.0000

***, ** means significance level at 1% and 5% respectively

Out of the five components, only economic security index is correlated with risk aversion, using the exponential functional form. The correlation coefficient is negative (-0.0605) and significant at 5% error level. This means that with 95% confidence level, we can conclude that there is a negative relationship between economic security status of rural farmers and their risk aversion status. The negative value means that all things equal, as farmers become more and more economically secured, they become less and less risk averse. Thus, more economically secured households are likely to take decisions that are more risky than households that are less secured. This is based on the safety first theory which explicitly captures these aspects of peasant behavior in rural economies (Mendola, 2007).

Food and health security status of the rural farmers correlate positively with risk aversion with the correlation coefficients being 0.0372 and 0.0362 respectively, though not significant even at 10%. However, Education security and Participation Security coefficients correlate negatively with Risk attitude with correlation coefficients of -0.0159 and -0.0335 respectively, though not statistically significant.

The overall livelihood security index correlates negatively with risk aversion with the correlation coefficient of -0.0081 though not significant. This means that the more secured a rural household is in terms of livelihood, the less risk averse it becomes. Thus there is a probability that as households in the rural farming areas become more secured in terms of livelihood, it becomes more and more risk loving rather than averse. Less secured households are more and more risk averse. These results may indicate that richer households are more likely to engage in more unconventional farming methods

and also engage in businesses they are not familiar with. They are also more likely to accept new methods of farming and policies that they are not too conversant with as they become less and less risk averse.

6.4.2 Regression analysis of the relationship between risk aversion and socio-economic Characteristics

The next step in the analysis is to establish the causal relationship between risk aversion and livelihood security. Using a multivariate regression model, the results are presented in table 6.6 below.

The variable of in interest in table 6.6 is the risk aversion coefficient. The sign and their significance levels are analysed and discussed. It is meant to examine whether changes in the risk aversion position of farmers affect their economic as well as the overall livelihood security. The coefficient of risk aversion variable for the economic model is negative and significant at 10%. This means that there is negative relationship between risk aversion and economic security position of rural farmers. In other words, as farmers become more risk averse, their economic security level falls and as they become less risk averse, their livelihood improves. Thus, the more risk averse farmers are, the more economically unsecured they are. This is based on the assertion that when farmers are risk averse, they take decisions that are not maximizing. Risk averse farmers may not for instance be willing to borrow to expand their farmers and improve their lives with the fear of default. Also, risk averse farmers may not be willing to adopt new methods of farming that they are not familiar with. For instance during the mass spraying exercise in Ghana, many volunteers were chased out of cocoa farms since they were not about the potency of the chemicals and were not ready to take risks.

Table 6.6: OLS Estimation results of the impact of Risk aversion on Livelihood

	(Model 1) Economic Security	(Model 2) Overall Livelihood Security
Gender of Hse hold head	4.393 (4.716)	-0. 303 (3. 794)
Age of Household head	0.6448 (0.921)	3.807*** (0.739)
age_sq	0.0126 (0.009581)	-0.0396***
Years of Education	1.2037*** (0.4257)	
Marital Status	11.995* (6.379)	49.482*** (4.7019)
Total Household size	-10.565*** (0.792)	3.043***(0.6316)
Risk Attitude	-16.36 * (5.987780)	-55032.56 (48250.18)
Vocational training		6.826 (4.6626)
Constant	167.423*** (30.386)	185.756***(24.089)
Observations	1134	1134
Adjusted R^2	0.232	0.169
F(7, 1126) = 34.00	Prob >F=0.0000	
Standard errors in parentheses	* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$	

It is therefore important that the risk aversion position of farmers be assessed before any intervention is carried out in order to have the desired impact on the farmers. Ignoring the risk aversion position of the farmers may cause disaffection among the farmers and this may cause farmers to rebel against any policies that they are not familiar with.

The coefficient of the risk aversion on livelihood has the expected sign but not significant. This means that overall; there is no significant relationship between risk aversion and the overall security position of rural farmers in Ghana.

CHAPTER SEVEN

SUMMARY OF FINDINGS AND POLICY RECOMMENDATIONS

7.1 Summary

Agriculture plays important role in the economy of Ghana, especially in rural areas where it is the single most important source of employment and livelihood. The rural farmers in Ghana produce large proportion of the staple foods consumed in Ghana. Notwithstanding the importance of agriculture to the economy of Ghana, agricultural production faces a number of unpredictable risks. Several risk conditions such as variability of yields, unpredictable rainfall pattern, unstable input and output prices, changes in family conditions and others are important sources of risk that have serious impact on their farming business. It must however be emphasized that the severity of these risks on farmers vary from farmer to farmer and community to community depending on geographic location, crop type, government support policies, weather conditions, , farm prices and farm types. However, many times governments all over the years have implemented policies without regard to the differences among the farmers in term of risk aversion and perception. This makes some policies unworkable. It is therefore hoped that findings from this research will enhance the understanding of the important sources of risk that impact on the farming businesses of rural farmers in Ghana. It is hoped that the knowledge of the important risks sources will guide future policies on agriculture in Ghana, especially that of smallholder farmers. This is because risks play central role is all management and production decisions and therefore any policies on agriculture in Ghana must take into considerations what farmers view as important risk to them and their attitude to the risk.

The research had three thematic areas. The first part focused on the measurement and the determinants of livelihood status of rural farmers in Ghana. The second part of the work looked at the risk perception, how it differs among farmers based on location and crop type. It then looked at how farmer's socio-economic characteristics affect their risk perception and lastly looked at the impact of

risk perception on the economic livelihood and the overall livelihood of rural farmers in the study areas. The third thematic area looked at the risk attitudes, socioeconomic determinants and the effects of risk attitude on economic security and overall livelihood security. To measure livelihood security status of rural farmers in Ghana, five security components which were Economic, Food, Health, Education and Empowerment were chosen and indices were computed based on a number of components under each domain. In other words, several sub-components were used to compute each of the components of the livelihood indices.

The data for the research came from both primary and secondary data sources. The primary data were gathered from a field survey of rural farmers from three districts in Ghana selected from three different regions. These were Offinso North District from Ashanti Region, Techiman Municipality from Brong Ahafo Region and Sefwi Wiawso Municipality from Western Region. However, it should be noted that only rural communities were used for the study. Using the 2010 population census, only communities in the study districts with population of or less than 5000 were used. To make the sampling section unbiased, three processes were used to select the respondents from communities that were used for the survey. The first step involved dividing of the various district into the various administrative zonal councils. In the second step, ten communities were then randomly selected (two or three were selected from each zonal councils) from each district. In each community, ten households were then randomly selected for the questionnaire administration. The household heads were the main target for the questionnaire administration. Thus, in all four hundred (400) respondents were selected from each district giving total respondents of one thousand two hundred (1,200). Given the low literacy rate in the rural areas of Ghana, face-to-face interviews were performed to collect the relevant information from the respondents.

In terms of data analysis, several steps were involved. First, to measure the livelihood security of the rural farmers, five livelihood security indexes were computed. Since the various subcomponents of the security index were measured with different units, the various components were first standardized

and then averaged. This was done for each of the five components of livelihood. To examine how family characteristics affect rural livelihood, a multivariate regression was run, with the overall livelihood components as the dependent variable and the various socio-economic characteristics like age, vocational training, wealth, gender and others as the independent variables.

The sources of risk that rural farmers in the study areas perceive as most important to their farming business were measured using a four-point Likert scale. In all twenty-nine risk conditions were presented to the rural farmers and they were to rank them as Not Severe (1), Severe (2), Moderately Severe (3) and Extremely Severe (4). To examine the most important among the exploratory factor analysis (EFA) was applied to reduce the large number of sources of risk. To examine how the various sources of risks differ among the farmers in terms of location and crop type, the KruskalWallis tests was applied. In addition, the impact of household characteristics on rural farmers' risk perception was examined using multiple regression. Multiple regression was also used to examine the effect of risk perception on livelihood of the rural farmers.

In the last part of this work, rural farmers' attitudes towards risk were elicited using the equal likely certainty equivalent (ELCE) technique. The Arrow-Pratt risk aversion coefficient was computed for each farmer. Three alternative utility functional forms; Quadratic, Cubic and the negative exponential, were selected to calculate the absolute risk aversion coefficients. Based on the Arrow-
Pratt coefficients, the farmers were classified as risk averse, risk loving or risk neutral. The KruskalWallis test was then applied to see how risk attitude differ among the farmers based on crop type and location. This was to determine whether or not risk attitudes differ among the farmers located in different location in Ghana and farming different crops. Multiple regressions were used to examine the impact socioeconomic characteristics have on risk attitude and how risk attitudes affect economic and overall livelihood conditions of rural farmers.

7.2 Summary of Findings

7.2.1 Livelihood Security and determinants:

The overall security status shows that rural farmers at Sefwi Wiawso are the most secured in terms of overall security followed by those at Techiman with the rural farmers at Offinso North being the least secured. It was also realized that plantation crop farmers are the most secured in terms of livelihood followed by food crop farmers with vegetable crop farmers that least secured. The method used to compute the livelihood society index is similar to those used by development agencies to calculate development index among countries. For the purpose of this work, livelihood of each district was computed compared to the district itself. This was meant to show how economically secured rural farmers compared to themselves. The differences among the livelihood among different locations and crop types means that any poverty reduction strategy should take care of these differences. Failure to do so would cause areas like Offinso North and vegetable crop producers to benefit less from an intervention.

The livelihood index range from zero to one and the average for each district is less than 0.5 meaning that the overall livelihood security of rural farmers is low even comparing to themselves. Thus rural farmers in Ghana are said to be generally poor. And specific interventions are needed to lift them out of livelihood insecurity.

In terms of the individual livelihood indices, Sefwi Wiawso farmers recorded the highest economic index, with an average index of 0.139, followed by that of Techiman with an average index of 0.087 with the least recorded by Offinso North farmers with an average of 0.0825. the Kruskal-Wallis test confirmed that these differences are statistically significant at 1% error level. Thus, it is concluded that there is significant differences among the economic status of rural farmers in Ghana based on their location. In other words, rural farmers located at different locations in Ghana have differences in their economic statuses.

For the health security status, Sefwi Wiawso again recorded the highest value of 0.4293 followed by an average value of 0.4289 recorded by Techiman rural farmers with the least secured being farmers from Offinso North with an average index of 0.3905. The hypothesis that all the means are the same is rejected at 99% significance level. Thus, it is concluded that there are significant differences among the health security statuses of rural farmers in Ghana.

As expected, rural farmers at Sefwi Wiawso are the most secured with an average mean score of 0.5413 followed closely by those at Techiman scoring an average security index of 0.5329. Rural farmers at Offinso North are the least secured in terms of Food security. However, further tests showed that there are no significant differences between the food security status of the rural farmers at Sefwi Wiawso and those at Techiman. This means that although overall, there are significant differences among the food security statuses of rural farmers in Ghana, there are enough evidence to show that these differences could be limited to some areas with other areas recording similar statuses.

The most secured district in terms of education is Techiman with an average security score of 0.3654 followed by the rural farmers at Sefwi Wiawso with average score of 0.3617 with Offinso North recording the least value of 0.3515. However, the Kruskal-Wallis tests showed that these average values are statistically the same. This means that, all things being equal, there are no statistically differences among the educational statuses of rural farmers in Ghana. With the average values of less than 0.50, we can confidently conclude that the educational levels of rural farmers are generally low.

The empowerment index is meant to measure the extent to which the average household in the study areas participate on the decision-making processes in the communities where they live and the nation as a whole. The results of the empowerment index show that only 10.634% of rural households in the Sefwi Wiawso rural farmers are empowered followed by those at Techiman which has 12.27% of the rural households empowered. The least empowered district being Offinso rural farmers with empowerment rate of 9.77%. The Kruskal-Wallis test showed that these empowerment differences

are statistically significant at 99% significance level. The low empowerment rate clearly shows that only few households in the rural areas of Ghana participate in the day-to-day running of the rural communities. This means that they may not have enough say in the policy implementation processes in their communities.

The multiple regression that was run to study the impact of households' socioeconomic on economic security and overall livelihood show that gender has no significant impact on livelihood. This means that male-headed households in the rural areas of Ghana are not statistically different from female-headed households in terms of livelihood.

It was also found out that age has positive impact on overall livelihood. This means that as households' heads get older, their livelihood improves. However, the coefficient of the age square was negative and statistically significant meaning that the though overall livelihood rises with age, the this increase occurs at a decreasing rate.

The coefficient of years of education was positive in the multiple regression for the economic security index and significant at 5%. The coefficient 0.00098 means that an additional year of education improves economic security by 0.00098 points. Thus, educated rural farmers are likely to have better economic status than those that are less educated.

The coefficient of marital status was found to be positive and statistically significant for both the economic and the overall livelihood security status. The coefficient of marital status for the economic security regression of 0.01107, which is statistically significant at 5% means that married households' heads are 0.01107 better than those that are not married, all other things being equal. For the overall livelihood, the coefficient of marital status was 0.04690 and statistically significant at 99%. Thus, rural farmers with married household heads are approximately 0.04690 points better off in terms of overall welfare than those that are not married. This may be due to the availability of more farm hands for married people compared to those that are not married.

Household size was found to be positive and statistically significant at 99%. The coefficient is 0.00339, meaning that all things equal, one additional member to the household increase the overall livelihood by approximately 0.00339 points. However, for the economic security status, the coefficient was negative meaning that an additional member to the household reduces the economic security by approximately 0.000993.

To test for the effect of location on livelihood, two dummies were used, Techiman and Sefwi Wiawso with Offinso as the control district. The coefficients were both positive and at 99% significance level. This means that a rural farmer located at Techiman or Sefwi Wiawso has higher livelihood status than those from Offinso North.

In terms of crop type, the results showed that there is no significant difference between the livelihood of vegetable farmers, which was used as the control group and that of crop farmers. However, coefficient of plantation crop was positive and significant meaning that the livelihood of plantation crop farmers are statistically higher than those of plantation crop and food crop farmers in the rural areas of Ghana, all other things equal.

7.2.2 Risk Perception and impact on livelihood

The results from the risk perception ranking show that on average, 36.2% of the rural farmers perceive the risk that they face as moderately severe and 36.2% of the respondents perceive the various risk sources are severe with only 12.2% of them perceiving them extremely severe. Thus on average, the rural farmers in the study areas perceive the various risks that they face as severe, but not extremely severe.

By location, the five most important risks conditions are summarized in the table below:

	Offinso North	Techiman	Sefwi Wiawso	Overall

1.	Inaccessibility to the market	Credit unavailability	High Cost of labour	Diseases and Pests
2.	Diseases and Pests	Variability of yields	Diseases and Pests	Credit unavailability
3.	Bush Fires	Output Prices	Credit unavailability	High Cost of labour
4.	Rain Deficiency	high Cost of labour	Variability of yields	Variability of yields
5.	Output Prices	Diseases and Pests	Output Prices	Output Prices
Least	Meeting contracting obligation	Meeting contracting obligation	Meeting contracting obligation	Meeting contracting obligation

Offinso North farmers perceived inaccessibility to market for their produce as the most important risk that they confront, and view the least important risk as meeting contracting obligation.

Techiman farmers perceived Credit unavailability as the most important risk that affect their farming business with meeting contracting obligation as the least important risk.

Sefwi Wiawso farmers consider High Cost of labour as the most important risk that they face in their farming business and view meeting contracting obligation as the least important risk.

Overall, however, the most important risk source to the rural farmers for all the three study district is Diseases and Pests with meeting contracting obligation as the least important risk.

By crop type, the five most important risks conditions are summarized in the table below:

	Plantation crop	Food Crop	Vegetable Crop	Overall
1.	Diseases and Pests	Variability of yields	Inaccessibility to mkt	Diseases and Pests
2.	high Cost of labour	Diseases and Pests	Output Prices	Credit unavailability

3.	Credit unavailability	Output Prices	Variability of yields	High Cost of labour
4.	Variability of yields	Credit unavailability	Diseases and Pests	Variability of yields
5.	Output Prices	Rain deficiency	Rain deficiency	Output Prices
Least	Meeting contracting obligation	Meeting contracting obligation	Meeting contracting obligation	Meeting contracting obligation

Based on crop type produced by the rural farmers, the most important risk that plantation crop farmers perceive is diseases and pests. Thus for plantation crop farmers, diseases and pests are the most important risk source.

For food crop farmers, the most important risk condition is Variability of yields.

For the vegetable crop farmers, the most important risk that the farmers perceive is inaccessibility to markets,

The Kruskal-Wallis test show that, on average, rural farmers' perception of the risk that they face differ based on their location and the crop type that they produce, as the Kruskal-Wallis test rejected the hypothesis that risk perception is equal among rural farmers are the same. In other words, the way that rural farmers perceive risks that they face differs based on their location and the kind of crops they produce. The effect size estimate computed using the chi-squared from the KruskalWallis tests showed that approximately 3.4% of the variations in risk perception among the rural farmers in the study areas are due to the location of the farmer and 1.7% of the variations is due to crop type.

The regression results for the socioeconomic determinants of risk perception show that only about 10% of the variations in the risk perceptions among rural farmers is due to the socio-economic characteristics of the households.

Age of household head was found to have positive impact on the risk perception, but the coefficient of age-squared was negative. This means that risk perception increases with age, but at a decreasing rate.

The coefficient of gender was found to be statistically insignificant, which means that the risk perception of male-headed households and female-headed households are statistically the same.

The coefficients of household size, years of education and farm size were all found to be statistically significant at 5% error level. The coefficient of household size was positive meaning that larger households have higher perception about the risk sources than smaller household size. That of education was also positive meaning that the perceptions about risks sources rise with the years of education of the household head. Thus, more educated household heads have higher perception about the risk that affect their farming businesses compared to less educated household heads. However, the size of the household's farm has negative relationship with the risk perception.

The coefficient of farm size was negative which means that as the size of the household farm expands, their perception to risks falls by approximately 0.0035 points.

The coefficient of household income was found to be statistically significant at 1% error level. The sign was positive meaning that as the household's incomes improve their perception about risks rises. That is, they become more and more concerned about the risks that they face in their farming activities.

The effect of risk perception on livelihood was found to be positive and significant at 1% error level. The coefficient was 0.02778. This means that as the rural household's perception about risk rise by 1%, their overall livelihood improves by approximately 3%. Thus, households with higher perception about the risk they face, that is those who are more and more concerned about the various risks that they face as farmers are more likely to take decisions that improve their overall livelihood, all other things constant.

7.2.3 Risk Attitude, determinants and impact on livelihood

Using different utility functions yielded different risk aversion coefficients for the rural farmers. The mean values for the risk aversion coefficients for the Exponential, Cubic and the quadratic functions were respectively 0.0003893, 0.0014951 and 0.0082842. The differences were statistically significant at 1% error level.

The exponential function classified all the 1,134 farmers who participated in the ELCE eliciting procedure as risk averse. The cubic function classified 821 respondents as risk averse and 313 as risk preferring. However, the quadratic function classified only 111 respondents as risk preferring with 1,024 respondents as risk averse. Thus, the risk aversion position of farmers depends on the type of utility function that is adopted.

The regression results show that only about 8% of the variations in risk aversion was explained by the socio-economic characteristics included in the regression.

Gender, Household size, Assets and Farm size have no significant effect on risk aversion, as their respective coefficients were not statistically significant.

The coefficient of age was positive and statistically significant meaning that older farmers are more risk averse than younger farmers. However, the coefficient of age-squared was negative, which implies that though risk aversion rises with age, the rate of increases occurs at a decreasing rate.

An increase in years of education reduces the aversion to risk. The coefficient was -0.000000398 means that an additional year of education reduces the aversion to risk by approximately 0.000000398 points. Thus educated households are less averse to risk than uneducated households.

Income was negatively related to risk aversion. This means that farmers aversion to risk increases as their income improves.

The research also revealed that rural farmers at Sefwi Wiawso and Techiman are less risk averse than those located at Offinso North. Their respective coefficients were found to be positive and significant statistically at 1% error level.

It was also revealed that food crops farmers and plantation crop farmers have lower aversion to risk compared to those who cultivate vegetable crops. Thus plantation crop farmers and food crop farmers are more risk averse than those that produce vegetables.

The correlation analysis of the risk aversion coefficient with the five components of livelihood and the overall livelihood security show that Economic security, Education security, Participation security and the overall livelihood index are all negatively correlated with risk aversion. However,
Food security, health security are positively correlated with risk aversion.
However, the regression results show that the coefficient of risk aversion on the determinants of livelihood was found to be statistically insignificant. Thus, all other things equal, respondents' aversion to risk has no significant effect on the livelihood of rural farmers in Ghana, though the coefficient was positive for the economic security model. This means that while attitude towards risk has negative impact on economic security, its impact on overall livelihood security is statistically insignificant.

7.3 Recommendations

Based on the results from the study, the following recommendations are made.

Since government has made it a point to mechanize agriculture in Ghana, it is recommended that informal education should be strengthened in the rural areas in Ghana in order to raise the literacy rate of rural farmers in order to help apply the pesticides and other chemicals properly. This is based on the premise that low literacy may hinder rural farmers' ability to apply these chemicals properly thereby affecting their yields and the general health of consumers.

The results revealed that notwithstanding the differences in the livelihood status of the rural farmers in the study areas are low. Government must take the necessary policies to improve the agricultural income of farmers such as agricultural loan, irrigation and pricing policy to secure the income of farmers. However, these policies should not lose sight of the differences in the livelihood based on location and crop type as failure to do that will cause some rural areas to benefit less from an intervention than others.

The research showed that plantation crop farmers have better livelihood than food crop farmers and that of vegetable crop farmers. This is due to the stability of price of plantation crops in Ghana, cocoa that brings stability in income to farmers. Though government may not set minimum price controls in Ghana for farm produce, it is recommended that government assist and create the enabling environment for the establishment of small to large scale food processing and dotage companies to help stabilize the price of food crops to help stabilize and maintain the income of farmers

The risk perception results showed that the three most important risks to the rural farmers are diseases and pests, credit unavailability and high cost of labour. It is therefore recommended that pesticides should be made readily available to farmers to fight diseases and pests that farmers consider as important. Government must also introduce small-scale agricultural flexible loans for rural farmers devoid of politics to make cheap loans to farmers to produce and improve their livelihood.

Risk perception has positive impact on livelihood. This meant that households who consider the risk that they face in their farming activities highly are likely to be better off than those that that do not. It is important and therefore recommended that farmers become more and aware of the various risks that they face in order to take appropriate measures to deal with them.

The risk attitude results show that rural farmers are risk averse. This means that they will choose any farming method that they are comfortable with. This then implies that they would resist any policy that rural farmers are not familiar with. It is recommended therefore that any agricultural policies that

are new and unfamiliar with rural farmers should be well explained to the farmers rather than "imposing" it on them and expecting them to adjust and adopt.

Age was found to have positive impact on risk aversion. This meant that older farmers are more likely to resist new methods of farming that they are not familiar with. It is therefore recommended that the young should be encouraged to take up farming, as they are more likely to adopt new and unfamiliar methods of farming that are likely to improve their improve their welfare.

7.4 Limitation of the research

The research suffered from few limitations, though the efforts were made to minimize these limitations.

1. Most rural farmers interviewed did not keep data on output and income and therefore most of the data obtained from them were recalled from memory and this might have affected the quality of the data and the results. This problem was minimized by ensuring that as many of the family members as possible were around during the interview.
2. The data was collected in the month of April when farmers have not harvested their crops yet. This affected the data on food assets.
3. The risk aversion method relied on the ELCE for which the interview was conducted by the researcher and assistants who were trained by the researcher. In this research, the process of obtaining the risk attitudes position of the respondents was performed by the researcher and trained assistants. In the course of the interviews, some of the farmers refused to continue halfway through the process and some just gave answers without thinking through properly. This might have affected the quality of the work.
4. The use of Ordinary Least Squares for all the regressions is also a serious limitation for the work. Other methods might have yielded better results. In addition, the R-squared values for the

regressions were very low, most of them below 15%. This means that care should be taking in interpreting the how socioeconomic characteristics affect livelihood, risk aversion and risk perception.

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APPENDIX

QUESTIONNAIRES

Livelihood and Risk Analysis of Rural Households in Techiman, Offinso North and Sefwi Wiawso.

This exercise is purely for academic work only. All the information obtained would only be used for academic purpose only and would be treated with the strictest confidence. It is a survey as part of my Doctoral research project.

Community: District

Questionnaire Date of

Part One: Household General Characteristics

Enumerator's Name

1. Gender of respondent (HHH) Male Female

2. Age of Respondent (completed years) ……..

3. What is your Marital Status :

Single/Never Been married Married Widow/Widower

Divorced

4. Number of children (Alive

5. How many of them are staying with you are

Below 18 18 and Above

6. Aside your children, how many people do you stay with and look after and ages?

Gender	Number of Them	No. Working outside of the family Farms / Business
Males below 18		
Males above 18		
Females below 18		
Females above 18		

7. How many years have you been staying in this village?

Less Than 10 years 11-20 Years 21-30 Years

31-40 years Over 40 Years

8. Do you or your spouse have any vocational training that is being used?

No

Yes What type? Household Head

Spouse

EDUCATIONAL STATUS OF THE HOUSEHOLD

9.

HH member above 16	1 = No Education 2= Primary Education 3= JHS 4 = SHS 5 = Tertiary
HHH	
Spouse	
Male 1	
Male 2	
Male 3	
Male 4	
Female 1	
Female 2	
Female 3	
Female 4	

Note: All members who have JHS or Primary but can't read and write would be deemed as uneducated in the study

10. Children enrolled in school ..... Out of

No of boys btn 6-15 years enrolled in school

11. No of girls btn 6-15 years in school ..... Out of

..... out of

12. No of boys btn 16-23 years enrolled in school

13. No of girls btn 16-23 years in school ..... out of

HEALTH STATUS OF THE HOUSEHOLD

14. In the past 30 days, has any member of the family suffered from any of these conditions?	Condition	Yes=1 No=0	Days	Status 1=hsehold head 2=spouse 3=working age (18 and above) 4=child (below 18)	No of People in the household affected
	Malaria				
	Diarrhea				
	Farm accident				
	Other……				

15. In the past 12 months, has any Working member of the family been hospitalized	Yes=1 No=0	Days (if Yes)

16. In the past 12 months, has any Non-Working	Yes=1 No=0	Days (if Yes)
member of the family been hospitalized		

17.	Status	Yes=1 No=0	IF NO

Do the following household members have valid NHIS card			Have never Reg.	Have but not renewed in the past 12 months
	Household Head			
	Spouse			
	others			
	Children (No….)			
	Other members (No….)			

18. Have all the children (below 5 years) in the family had all the dose of the immunization **(UP TO THE NINE MONTHS)**?

☐ Yes

☐ No. if no, state reason

19. In the past 12 months, has any member of the family died?

☐ Yes. Age ☐ Working Status Working☐ Not Working☐

☐ No

20. Body mass index for the HH and Spouse

Weight…….	Height: ……..

Head

Spouse Weight……. Height: ……..

21. Body mass index for children below 5 years

i. Weight…… Height…… ii.

Weight…… Height…… iii.

Weight…… Height…… iv.

Weight…… Height…… v.

Weight…… Height…… vi.

Weight…… Height……

22. What is the main source of water supply for this household?

1 = Pipe 2 = tanker service 3 = well 4 = river

23. How far is the source of water from dwelling? M

24. How does your household dispose-off refuse?

Collected public dump dumped elsewhere burnt by household

25. Does the household pay for disposing? No Yes

26. What type of toilet is used by your household? WC Pit latrine free range

KVIP other specify……

27. Does the household pay for the toilet? No ☐ Yes ☐

28. What is the main source of lightening for your dwelling?

1 = electricity

2 = Solar powered lamp

3 = Generator

4 = kerosene lamp

5 = Gas lamp

6 = other, specify……

29. What is the main fuel used by the household for cooking?

1 = Wood 2 = gas 3 = electricity 4 = Charcoal 5 = other, specify……

HOUSEHOLD ASSETS and LIABILITIES

30. LIVESTOCK OWNED AND OTHER CONSUMABLE ASSETS					
Livestock Type	Current stock	Price per unit	Total Value (GH¢)	No. Sold in the past 12 months	Household consumption
Goats					
sheep					

cattle					
birds					
Other……					
Other……					
Other……					
Other……					
Other Assets					
Stock of Yam					
Stock of maize					
Stock of other food					

31. Household assets

House type	No of rooms	Estimated value	

	No. of units	Total value (current sales value of all units, not purchasing price)

Car/truck		
Tractor		
Motorcycle		
Bicycle		
Hand phone/phone		
TV		
Radio		
Cassette/CD/ VHS/VCD/DVD/ player		
Stove for cooking (gas or electric only)		
Refrigerator/freezer		
Fishing boat and boat engine		
Chainsaw		
Plough		
Wooden cart/wheel barrow/other carriers		
Shotgun/rifle		
Furniture		
Water pump		
Solar panel		
Others (worth more than approx. GH¢100		

32. Monetary Assets

	GH¢
How much does the household have in s avings in banks, credit associations or savings clubs?	
How much does the household have in saving in non-productive assets such as gold and jewellery?	
Other Monetary Assets …… ……	

33. Do you have any outstanding loans?

1 = Yes
0 = No

IF NO, MOVE TO QUESTION 40

34. What is the source of the loan? *(check all that apply)*

- ☐ The bank …….. Name the bank
- ☐ Corporative organizations
- ☐ Relatives/Friends
- ☐ Church
- ☐ Savings and Loans
- ☐ Money Lenders
- ☐ Cocoa Purchasing Clerks
- ☐ Other sources. Please Specify. ----------

35. What was the duration of the Loan? …… (months)

36. How much did you borrow and how much is left

Amount Borrowed GH¢……

Amount outstanding GH¢……

37. How much interest was charged? GH¢……

38. What was the primary aim of the loan?

- ☐ On-farm activities (for example purchased farm equipment, seed or fertilizer)
- ☐ Household expenses (for example spent for food, clothing or personnel expenses)
- ☐ Funeral expenses
- ☐ Medical Expenses for a family member
- ☐ Other reason. Please state. …….

39. What was the loan actually used for?

…… …….. %

…… …….. %

…… …….. %

FOOD STATUS OF THE HOUSEHOLD

40. For every week, on average, how many days do your household consume…			
	No. of days	Source: (1=farm 0=bought in the market/gifts	If from market, state reason 1=run out stock 2=don't produce 3=Didn't have enough
Maize, maize porridge			
Other cereal (sorghum, millet, bread, pasta etc)			
Rice			
Roots and tubers (cassava, potatoes,			
cocoyam)			
Sugar or sugar products			
Beans and peas			

Groundnuts or cashew nuts			
Fruits			
Beef, goat or other red meat and pork			
Poultry and eggs			
Fish			
Oils/fats/butter			

On the scale of 1-10, how much of your food needs do you meet from your farm in a day throughout the year?

How many months in the year that you struggle to meet the food needs of your family?

(Food Convenience)

Generally how many times do members of your household eat the following in a day throughout the week?

1 = Once a day without snack 2 = Once a day with snack

3 = twice a day without snack 4 = Twice a day with snack

5 = thrice a day without snack 6 = Thrice / more a day with snack

41. A	HOUSEHOLD INCOME				
	Type of income and benefit	Head	Spouse	Children	Other members
HOUSEHOLD INCOME FROM FARM ACTIVITIES					
	Note to enumerators: If the households are not involved in formal work where they can tell you the amount per year, ask them leading questions that would enable you to get the income… for instance how many bags of cocoa and the price they sell EACH ….				
	Crop farming				
	Animal rearing				
	Fish farming				
	Hunting				
	Gathering				
	Other				
	Sub-total				
B	HOUSEHOLD NON FARM INCOME				
1	Wage and Salary				
2	Artisan(eg.Carpentry, mansonry)				

3	Food vending/chop bars				
4	Dress making				
5	Baking				
6	Drinking bar				
7	Kenkey production				
8	Head portage(Kayeyei)				
9	Palm oil production				
10	Herbal medicine				
11	Stationary shop				
12	Repairs				
13	Hair salon(including barbering)				
14	Trading(wholesaling and retailing)				
15	Scrap metal				
16	Video center				
17	Internet café				
18	Other business activities				
	Sub-total				

C	TRANSFERS

1	Remittances(specify eg from son, daughter etc) 1 2				
2	Disability benefits				
3	Insurance(Old age, disability LEAP)				
4	Monetary allowance and gifts				
5	Pension				
6	Other.....				
	Sub-total				
D	OTHER INCOME SOURCES				
1	Income from rent of property				
2	Rent of other assets (eg. Trucks, wheelbarrows				
3	Interest on savings and loans				
4	Reward and prize				
5	Other specify				
	SUB-TOTAL.....				
	TOTAL (A+B+C+D)				
	OVERALL TOTAL				

42. HOUSEHOLD EXPENDITURE

	What is the total household expenditure	Total record of expenditure in the appropriate			
F	Expenditure pattern in the last 30 day	daily	weekly	monthly	other
1	Food(all foods, meat, fish fruits, egs, vegetables, sugar, jam etc) per day/week				
2	Water				
3	Exp on personal hygiene e.g soap, detergent, shampoo, pomade, barbering				
4	Expenses on telephone calls				
5	Expenses on transport				
6	Expenses on energy (firewood, al, kerosene) charco				
7	Recreation activities, cultural servic e. E.g funerals, out-dooring,				
8	Tobacco and alcohol				

9	Rent				
10	Hotel/guest house				
11	Miscellaneous: tooth paste and brush , comb and ear ring				
12	Newspaper, books				
13	Insurance				
14	Other				

	Sub-total				
G	OTHER EXPENDITURE OVER THE LAST MONTH				
1	Health (self-prescription. Pain killers)				
2	Transfer expenditure				
3	Clothing and footwear				
4	Home maintenance and repair				
5	Energy Expenditure				
6	Other				
	Sub-total				
H	OTHER EXPENDITURE OVER THE LAST 12 MONTH	Amount			

1	Furniture and furnishing, carpets and floor covering				
	Education				
2	Household electrical appliances				
	Health (hospital bills)				
	Clothing, shoes(excluding those required for school)				
3	Glassware, tableware, carpets				
	Cost of input for raising crops				
4	Home maintenance and repairs, painting, patching				
5	Raising livestock eg. (cost of buying livestock)				
	Equipment and tools and labor				
6	Taxes (TV licenses and property taxes)				
7	Contributions to self-help projects				
8	Debt repayment				
9	Other				
	Sub-total				
	Grand Total (e+f+g+h)				

Community Participation

43. Does the household head/spouse participate in any organization that is non-religious?

1 = Yes

0 = No

44. If yes, does the person hold executive position?

1 = Yes
0 = No

45. Does any member of the household participate in any organization that is non-religious?

1 = Yes

0 = No

46. If yes, does the person hold executive position?

1 = Yes
0 = No

47. Does the household head/spouse hold any position in the ruling party?

1 = Yes
0 = No

48. Does any member of the household hold any position in the ruling party?

1 = Yes
0 = No

49.

Do you or any member of your household participate in the planning process in the following levels	Yes =1 No=0
Assembly	
Unit Committee	
Palace	

HOUSEHOLD FARMING INFORMATION

50. Is Farming your household's main occupation?

1 = Yes
0 = No

(IF THE ANSWER IS NO, THEN THE INTERVIEW ENDS HERE, OTHERWISE YOU PROCEDE)

51. How many years have you been farming?

Less Than 10 years ☐ 11-20 Years ☐ 21-30 ☐

31-40 Over 40 Year ☐

52. Do members of your households work in your farm?

1 = Yes ☐

0 = No

53. If the answer in 54 is yes, who are they? (Tick as many as possible)

Spouse ☐

Children ☐

Brothers and sisters ☐

Parents ☐

Other relatives ☐

54. Aside your family members, give the number of people who work in your farm

Category	Planting	Harvest
Full time		
Part-time / casual		

How many acres of land do you farm on? ……...

55. What is the ownership of the land you farm on?

1 = Owner-self operated ☐

2 = Lease-self operated

3 = Family land for sharing

4 = Tenant

5 = Other State…….

56. What main crop does the household produce? ……..

57. How many farms do your household have?

No.	Size (Acres)	Main Crop
1		
2		
3		
4		
5		

Risks Sources and likelihood of occurrence

Below is a series of statements pertaining to sources of farm risks , please select one that which

	1 = not severe 2 = moderately severe 3 = severe 4 extremly Severe	1 = not likely 2 = moderately likely 3 = likely 4 extremly likely
Risk from deficiency in rainfall causing drought		
Risk from Credit unavailability		
Changes in family relation (Divorce, death		

of relation that changes the family standing)		
Injury, illness, of operator		
Changes in family labour force due to migration or marriage		
Risk from excess rainfall		
Risk from natural disasters such as heat, flood, storm		
Risk from Bush Fires		
Risk from diseases and pests that affect plants and animals		
Risk from unexpected variability of yields		
Risk from unexpected variability of product prices (the output)		

Risk from unexpected variability of input prices		
Risk from changes in interest rates		
Risk from high level of debt		
Risk from changes in the world economic and political situation		
Risk from changes in Ghana's economic and political situation		
Risk from changes in national government laws and policies		
Risk from changes in land prices		
Risk from low qualityy of inputs		
Risk from accidents or problems with health		
Risk from problems with hired labour and contractors		
Risk from theft		
Risk from being unable to meet contracting obligations		
Risk from Inaccessibility to the market		
Risk from under financing by own capital for the whole crop cycle		
Cost of labour too high		

Risk from Limited knowledge about usage of chemical and medicines		
Risk from Inappropriate method of harvesting causing reduction of Output quality and weight		
Risk from Low awareness of disease prevention by farmers		

Farmer's Utility Elicitation

This section attempts to measure respondent's risk aversion preferences. A series of hypothetical but realistic risky farm outcomes based on the ELCE method will be used to

We present two situations here. First, we increase the first CE chosen until four values are obtained and in the second situation, we reduce the first CE chosen till four values are obtained.

Situation 1

If you are given a choice between

a. A risky situation of uncertainty regarding income from your farm

b. a sure sum of money;

If your farm does well, you earn GH¢10,000 for the farming season; if it doesn't, you earn nothing.

If you are offered an amount of GH¢3,000, would you continue to farm or accept the GH¢3,000?

Farm outcome		Cash
Probability		
50%	GH¢10,000	GH¢3,000
50%	GH¢0	

First Certainty equivalence: GH¢……..

Note:

a) If the farmer chooses the cash, we pose the same question but lower the cash amount (e.g. GH¢2,500)

b) If the farmer chooses the farm prospect, we pose the same question but increase the cash amount

(e.g. GH¢3,500)

c) We will proceed with this line of questioning until the farmer becomes indifferent between taking the risky business or taking the cash amount.

d) Once we have found the cash amount that will make the farmer indifferent (e.g. GH¢5,500) we present to the farmer another farming outcome and repeat the procedure from Scenario I.

Farming outcome		Cash
Probability		
50%	GH¢10,000	GH¢6,000
50%	GH¢5,500	

Second Certainty equivalence: GH¢……..

Note:

If the farmer is indifferent between this outcome and for example GH¢7,000 then we present to the farmer farming outcome and repeat the procedure.

Farming outcome		Cash
Probability		
50%	GH¢10,000	GH¢7,500
50%	GH¢7,000	

Third Certainty equivalence: GH¢……..

Note:

If the farmer is indifferent between this new farming outcome and for example GH¢8,000 then we present to the farmer another farming outcome and repeat the procedure.

Farming outcome		Cash
Probability		
50%	GH¢10,000	GH¢8,500
50%	GH¢8,000	

Note:

If the farmer is indifferent between this new farming outcome and for example GH¢9,000 then we present to the farmer another farming outcome and repeat the procedure.

Fourth Certainty equivalence: GH¢……..

Note:

Once we have found the cash amount that will make the farmer indifferent between the new lottery and the cash we proceed to Scenario II.

Situation 2

If you are given a choice between

a. A risky situation of uncertainty regarding income from your farm
b. a sure sum of money

The farming outcome will yield to you either GH¢6,000 or GH¢0. If the sure sum of money is GH¢4,000, would you choose the lottery ticket or the GH¢4,000?

Farming outcome		Cash
Probability		
50%	GH¢6,000	GH¢4,000
50%	GH¢0	

Fifth Certainty equivalence: GH¢……..

Note:

a) If the farmer chooses the cash, we pose the same question but lower the cash amount (e.g. GH¢3,500)

b) If the farmer chooses the farming outcome, we pose the same question but increase the cash amount (e.g. GH¢4,500)

c) We will proceed with this line of questioning until the farmer becomes indifferent between taking the risky farming outcome, or taking the cash amount.

d) Once we have found the cash amount that will make the farmer indifferent (e.g. GH¢4,300 baht) we present to the farmer another farming outcome and repeat the procedure from Scenario I

Farming outcome		Cash
Probability		
50%	GH¢4,300	GH¢3,000
50%	GH¢1,000	

Sixth Certainty equivalence: GH¢……..

Note:

If the farmer is indifferent between this new farming outcome and for example GH¢3,500 then we present to the farmer another farming outcome and repeat the procedure.

Farming outcome	Cash
Probability	
50%	GH¢3,500
50%	GH¢2,500
	GH¢1,000

Seventh Certainty equivalence: GH¢……..

Note:

If the farmer is indifferent between this new lottery and for example GH¢1,800 then we present to the farmer another lottery and repeat the procedure.

Farming outcome	Cash
Probability	
50%	GH¢1,800
50%	GH¢1,000

Eighth Certainty equivalence: GH¢……..

Once we have found the cash amount that will make the farmer indifferent between the new farming outcome and the cash then we finish the process in this section.

Situation	Number	Amount (Certainty Equivalence)
Situation I	1	
	2	
	3	
	4	
Situation II	5	
	6	
	7	
	8	

The Table below is completed with values obtained in the processes above:

THANK YOU