A FARM LEVEL ANALYSIS OF RISK ATTITUDE, SOURCES AND RISK MEASUREMENT STRATEGIES AMONG FARMERS IN TRANS NZOIA COUNTY, KENYA.

BY

KITONYO CHRIS KITONYOH

SBE/PGA/008/10

A THESIS SUBMITTED TO THE GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS AND RESOURCE MANAGEMENT OF MOI UNIVERSITY.

SCHOOL OF BUSINESS AND ECONOMICS

2015.

DECLARATION

Declaration by the Student

This thesis is my original work and has not been presented for a degree in any other University. No part of this thesis may be reproduced without the prior written permission of the author and/or Moi University.

Signed ……Date: ……

Mr. Kitonyo Chris Kitonyoh

Declaration by Supervisors

This thesis has been submitted for examination with our approval as University Supervisors.

Prof. Mark Olluga Odhiambo
School of Business and Economics
Moi University

Signed……Date: …….

Dr. Alfred Serem
School of Business and Economics
Moi University

Signed……Date: …….

DEDICATION

To My Daughter,

Gabriella Kalekye

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to my academic supervisor, Prof. Mark Olluga Odhiambo and Dr. Alfred Serem for their constructive guidance, critism and encouragement.

May I also say thank you to the entire team of lecturers at Moi University, School of Business and Economics. Special mention is made of my colleague Mr. Oliver Wafula, with whom we started this journey and who constantly reminded me of the unfinished business that we had. I cannot forget the immense support of my enumerators and the farmers in Trans Nzoia County to whom am very much indebted.

To my wife Mercy Mumbua and my daughter Gaby thank you for your selfless and long-lasting love, together with constant care and motivation you accorded me throughout my education. Lastly, I am grateful to my parents Mr. Harrison Kitonyo and Mrs. Monica Kalekye for their support and prayers.

Above all, thanks are also due to the almighty God.

ABSTRACT

Understanding farmers' attitudes and responses to agricultural risks is important for designing risk management strategies and effective extension activities. Farmer's risk attitude is a critical barrier to adoption of new agricultural technologies, investment and production decisions in agriculture. The objectives of this study were; to examine the socioeconomic characteristics of the farmers; to elicit the risk attitudes of the farming households; to determine the socioeconomic characteristic affecting risk attitude and to document the risk sources and risk management strategies among the farming households in Trans Nzoia County. The data used in this study were collected by use of a structured questionnaire administered to 167 farming households randomly selected by a multi stage sampling technique. To determine the socioeconomic characteristics, a descriptive analysis was done (frequencies, percentages and means). To elicit responses of farm households towards risk attitude, Equally Likely Certainty Equivalent with Purely Hypothetical risky prospect (ELCE-PH) model was used. A logit regression analysis was further used to determine the influence of risk attitude on socioeconomic characteristics of the household. Data analysis was done using computer programme SPSS 20.0. The study revealed that 74.25% of the households were risk averse while 8.98% and 16.77% were risk seekers and risk neutral respectively. The results further revealed that socioeconomic characteristics may in turn affect the respondent's attitude towards risk. The coefficient for age, education, off-farm income and membership to farmers' groups were statistically significant at 1% while gender was significant at 5% in explaining farmers risk attitude. However, the coefficients for household size, access to credit and extension service were statistically insignificant at both 1% and 5% level of significance. Using factor analysis, seven factors explaining 65.53% of the variation were extracted for risk source while five factors explaining 64.53% were extracted for risk management. Factor analysis revealed that weather risks, market and price risks, biological risks, labor bottlenecks, financial risks, land bottlenecks and personal/human risks to be the most prevalent risks while enterprise diversification, risk sharing and cooperatives, off-farm investment, buffer stock index, and financial management were the most adopted risk management strategies among farmers. The study recommends on the need for policy formulation to address agricultural risk, development of agricultural insurance and forward agricultural markets in the study area.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ARA	Absolute Risk Aversion
APARA	Arrow Pratt Absolute Risk Aversion
CARA	Constant Absolute Risk Aversion
CI	Condition Index
DARA	Decreasing Absolute Risk Aversion
DM	Decision Maker

EUT	Expected Utility Theory
ELCE-PH	Equally Likely Certainty Equivalence with Purely Hypothetical
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
IARA	Increasing Absolute Risk Aversion
KNBS	Kenya National Bureau of Statistic
KMDP	Kenya Maize Development Programme
MLN	Maize Lethal Necrosis
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
RRA	Relative Risk Aversion
SFM	Safety First Model
SEUT	Subjective Expected Utility Theory
SHG	Self Help Group
SPSS	Statistical Programme for Social Scientist
VNM	Von Neumann and Morgenstern
WTP	Willingness to Pay

CHAPTER ONE

INTRODUCTION

1.1 Background

Agriculture is the mainstay of Kenya's economy and means of livelihood for most of the rural population. Agriculture is the single most important sector in the economy contributing 26 percent to the GDP directly and another 25 percent indirectly. The sector also accounts for 65 percent of Kenya's total exports and provides more than 18 percent of the formal employment and more than 70 percent of the informal employment in rural areas (GOK, 2010).

The economic performance of the agricultural sector is usually uncertain due to its biological nature in addition to over reliance on rain fed agriculture and livestock rearing under natural conditions. This type of production is inherently risky because of variability of rainfall, animal mortality due to livestock diseases and fluctuations of input-output prices. The agricultural environment in the developing countries is characterized by crop diseases, flooding, illness of household members and crime (Capitanio, 2008).

Being a climate sensitive sector, agriculture is potentially affected by climate change, both positively and negatively. Given that much of Kenyan agriculture is currently rain-fed; there are potentially wide ranging effects from the potential changes in precipitation. Moreover, there are a number of complex interactions with other factors such as extreme weather related events (heat, floods, and droughts), soil, pests and diseases, (SEI, 2009).

As a result of a combination of many factors, many households in low income countries including Kenya live in poverty and food insecurity. They face many risks and uncertainties which arise from natural, economic and socio-political environments. These risks and uncertainties easily trigger food shortages, deterioration in nutritional status and leads to destitution (Korir, 2011).

1.2 Problem Statement

Any farm production decision is typically associated with multiple potential outcomes with different probabilities (OECD, 2009). Intuitively, weather conditions, market environment, institutional factors and social events are beyond the control of the farmer but have direct incidence on the returns from farming.

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. Relatively, farmers are likely to be risk averse therefore preferring a sure return to uncertain return given the same level of expected return. Farmers' attitudes toward risk can be affected by broad variety of factors that range from cultural background to individual characteristics (Binswanger, 1980).

The high risk profile and risk attitude among farming households has resulted to inadequate investment in agricultural inputs such as high quality seeds, fertilizer and herbicide, machinery and innovation. This has further compromised the level of farm productivity that has negatively impacted on food security and economic welfare.

It is notable that in the recent past, Trans Nzoia County has recorded climatic changes in the form of changing rainfall patterns (i.e. incidences of insufficient precipitation), reduction in soil fertility and salinity, floods and the changing pattern of pests and diseases such as maize lethal necrosis (MLN). The change in climate coupled by insufficient certified seeds and variability in farm input and output prices has resulted into uncertainties in the production and marketing of farm produce thus leading to variability of farmer’s outputs, productivity and incomes.

The risk situation is complicated by the fact that the farming households operate in an environment with political uncertainties and weak risk management markets. In this context, the farmer has to manage risks in farming as part of the general management of the farming business. As a management practice, farmers tend to implement diverse risk management strategies in context of their production plans, available financial portfolio, physical and human capital and the degree of risk aversion.

In realization that there are no previous studies in this field carried out in Trans Nzoia County to the author's knowledge, the study aimed to determine farmers risk preference, to explore the possible relationship between farmers' risk attitudes and socio demographic characteristics and to determine the coping strategies adopted by farmers within the study area.

1.3 Objective of the Study

The general objective of the study was to examine the decision behavior of farm households in an uncertain environment and to determine the risk management approaches used by farmers in Trans Nzoia County.

1.3.1 Specific Objectives

i. To elicit farmers attitude towards risk in Trans Nzoia County,
ii. To describe the socio economic characteristics of the farming households in Trans Nzoia County,
iii. To examine how the socioeconomic factors influence farmers attitude towards risk,
iv. To identify the different sources of risk among farmers in Trans Nzoia County, and
v. To determine the risk management strategies adopted by the farming households in Trans Nzoia County.

1.4 Research Questions

i. What are the perceived attitudes toward risk among the farming household in Trans Nzoia County?

ii. What are the socioeconomic characteristics of the risk averse and risk preferring farming household in Trans Nzoia County?

iii. To what extent is the farmer's attitude towards risk influenced by socio economic characteristic of the farming households?

iv. What are the main sources of risk faced by the farming households in Trans Nzoia County?

v. What are the risk management approaches adopted by farming households in Trans Nzoia County?

1.5 Justification of the Study

Risk is an integral part in agricultural production and therefore affects the farmers decision making process, investment, productivity and general welfare. The changing climatic pattern, incidence of resistant pests and diseases, weak commodity markets and inadequate credit facilities necessitate the need to study attitude towards risk, and risk management strategies the farming households in Trans Nzoia County.

1.6 Scope of the Study

The study was limited to measuring the farmers risk attitude in Trans Nzoia County. In addition, the study determined the socio economic factors affecting farmers risk attitude and their coping response. The sampling unit was the farming household. The study was constrained by language barrier and the use of recall method by the respondents which was deterrents in the data collection process.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter reviews existing literature on risk, uncertainty and vulnerability. An elaboration of the sources of agricultural risks, climatic aspect in agricultural production and risk management strategies in agriculture are discussed. The chapter also presents theoretical

concepts in evaluating and ranking on-farm risk alternatives in section 2.5. The chapter concludes with conceptualization of the research in section 2.7.

2.1 Risk and Uncertainty

The distinction of risk and uncertainty has attracted a lot of debate among economist. Risk refers to the knowledge of numerical, objective probabilities of occurrence while uncertainty refers to a situation where the outcome of an event is uncertain and the probabilities are not known with certainty (OECD, 2004). This distinction is however seen as operative since probabilities are rarely known and there exist wide belief that probabilities are subjective.

Most authors find a more useful definition of uncertainty as imperfect knowledge and risk as the exposure to uncertain unfavorable economic consequence (Hardaker *et al* ., 2004). Though debate on the distinction of risk and uncertainty has generated useful insights on the complexity of risk assessment, it has not yet stimulated much empirical analysis. As a result, sharp distinction between risk and uncertainty has not been empirically drawn. In this study therefore, the term risk and uncertainties are used interchangeably throughout.

2.2 Sources of Risks and Uncertainty

Sources of risks and uncertainty in agriculture are classified into various ways. Ellis (1998) identified four types of risks; natural hazards (weather, pests and diseases), market fluctuations (of output prices), social uncertainty (due to differences over control of resources) and state actions and wars. Huirne *et al.,* (2000) and Hardaker *et al.*, (2004) distinguished between two types of agricultural risk. Firstly, business risk includes production risks, market risks, institutional risk and personal risk and secondly, financial risk.

Musser and Patrick (2001) made five distinctions of agricultural risks i.e. production risk, market risk, financial risk, legal and environmental risk and lastly human resource risk. Moschini and Hennessey (2001) dwelt on uncertainty and identified four sources of uncertainty namely; production uncertainty, price uncertainty, technological uncertainty and

policy uncertainty. The World Bank (2005) development report, classified agricultural risk into the following categories;

2.2.1 Production Risks

Agriculture is often characterized by high variability of production outcomes or, production risk. Unlike most other entrepreneurs, agricultural producers are not able to predict with certainty the amount of output the production process will yield due to external factors such as weather, pest and disease (Hardaker *et al.,* 2004). Agricultural producers can also be hindered by adverse events during harvesting or collecting that may result in production losses. For crops, risk to production yield and quality are predominantly weather related; the main risk factors are drought, cold weather, floods, disease, pest and unfavorable conditions for planting and harvesting (LeBel, 2003; Musser and Patrick, 2002). Late planting can reduce yield because of the shortened growing season, while delayed harvesting risks quality through damaging frost or disease.

2.2.2 Market Risk

Input and output price volatility are important sources of market risk in agriculture (OECD, 2009). Prices of agricultural commodities are extremely volatile and cannot be predicted with certainty. Output price variability originates from both endogenous and exogenous market shocks. Segmented agricultural markets will be influenced mainly by local supply and demand conditions, while more globally integrated markets will be significantly affected by international production dynamics (OECD, 2009).

Another form of market risk arises in the process of delivering produce to the market place (Hardaker *et al.,* 1997). The inability to deliver perishable products to the market at the right time can impair the efforts of producers. Inadequate infrastructure and markets have made price risk a significant source of agricultural risk in many developing countries.

2.2.3 Financial Risks

The ways businesses finance their activities is a major concern for many economic enterprises. However, in this respect, agriculture also has its own peculiarities. Many agricultural production cycles stretch over long periods of time, and farmers must anticipate expenses that they will only be able to recuperate once the product is marketed (Drollete, 2009). This leads to potential cash flow problems exacerbated by lack of access to credit and the high cost of borrowing. Farmers with insufficient working capital must market their crops at harvest in order to make payments on their loans and input costs (Hardeker, 2004). The same is true for farmers without adequate storage options. Greater freedom in choosing when to market their produce would allow farmers to respond to price variation by withholding their product during unfavorable periods (World Bank, 2005).

2.2.4 Institutional and or Policy Risks

Institutional risk is another important source of uncertainty for agricultural producers. It is generated by unexpected changes in regulations that influence producer's activities (Hardaker *et al*., 2004). Change in regulations can significantly alter the profitability of farming activities. This is particularly true for import/export regimes and for dedicated support schemes, but it is also important in the case of sanitary and phytosanitary regulations that can restrict the activity of producers and impose costs on households. Government policies are only imperfectly controllable or predictable by farmers, and can strongly influence the costs or returns from a farm operation (OECD, 2009).

2.2.5 Human or Personal and Asset Risks

Farmers are also subject to the human or personal risks that are common to all business operators. Disruptive changes may result from such events as death, divorce, injury, or poor health. In addition, the changing objectives of individuals involved in the farming enterprise may have significant effects on the long run performance of the farm business (Musser and

Patrick, 2002). Asset risk is also common to all businesses and involves theft, fire, or other loss or damage to equipment, buildings, and livestock.

2.3 Climate Change and Agricultural Risks

There is a growing concern about the effects of climate change on agriculture. A report by the Intergovernmental Panel on Climate Change (IPCC) stated that countries in Sub-Saharan Africa are likely to be severely affected by climate change and climate variability. Evidence is emerging that climate change is increasing rainfall variability and the frequency of extreme events such as drought, floods, and hurricanes (IPCC 2007). Early empirical studies using crop simulation models suggested that agriculture in developing countries was highly vulnerable to global warming (Reilly *et al.*, 1996). Subsequent economic research using Ricardian Models (Mendelsohn *et al.*, 1994) also suggests that, in developing countries, crops are vulnerable (Seo and Mendelssohn, 2008). The impact of climate change include; Increasing temperature, changes in local precipitation, increasing atmospheric carbon dioxide, changing pattern of pests and diseases and changes in soil fertility, salinity and soil erosion rates.

2.4 Agricultural Risk Management Strategies

Beal (1996) stated that it is to be expected that risk management strategies adopted by farm managers reflect their personal perceptions of risk, and managing such risks is critical for the long-term success of individuals and economic systems alike. According to Harwood *et al*. (1999), risk management can be defined as choosing among alternatives to reduce the effects of uncertainty. This requires an evaluation of tradeoff between changes in risk, expected returns and entrepreneurial freedom among others. For an individual farmer, risk management involves finding the preferred combination of uncertain outcomes and varying levels of expected returns (Boehlje and Lins, 1998).

Farmers manage risks through a continuous adaptive process, whereby decisions are made based on perceptions of the external environment, resources and the farmers own attitude and preferences (IFAD, 2004). Managing risk in agriculture does not necessarily involve avoiding risk, but instead, involves finding the best available combination of risk and return given a person's capacity to withstand a wide range of outcomes (Hardaker, 2004). Effective risk management involves anticipating outcomes and planning a strategy in advance given the likelihood and consequences of events, not just reacting to those events after they occur. That is, the four main aspects of risk management involve ; identifying potentially risky events, anticipating the likelihood of possible outcomes and their consequences, taking actions to obtain a preferred combination of risk and expected return, and lastly, restoring (if necessary) the firm's capacity to implement future risk-planning strategies when distress conditions have passed (OECD, 2009).

Mechanisms and strategies employed by producers to deal with risks are classified as formal and informal mechanisms and *ex-ante* and *ex-post* strategies (World Bank Development Report, 2001), informal strategies are identified as "arrangements that involve individuals or households or such groups as communities or villages," while formal arrangements are "market-based activities and publicly provided mechanisms."

2.4.1 Informal Risk Management Mechanisms

Ex-ante informal strategies are characterized by diversification of income and plot (traditional crop diversification and intercropping) and choice of agricultural production strategy to reduce risk of crop failure due to adverse weather events, crop and pest infestation (Murdoch, 1995). Farmers most often have employed risk avoidance as a strategy ex-ante. Risk avoidance has been associated with extreme to high incidence of poverty that makes farmers in developing countries risk averse. Murdoch (1995), showed evidence that households whose consumption levels are close to subsistence and which are highly

vulnerable to income shocks devote a large share of land to safer traditional production methods. Producers facing these circumstances often avoid activities that entail significant risk, even though the income gains might be larger than for less risky choices.

Buffer stocks accumulation of crops and liquid asset for smoothing consumption among household in developing countries have been identified as ex-post strategy to manage risk in informal mechanism. Townsend (1998), showed that building up currency and crop inventories function as buffers or precautionary savings. Typical ex-post informal income smoothing mechanisms include the sale of assets, such as land or livestock or the reallocation of labor resources to off-farm labor activities.

2.4.2 Formal Risk Management Mechanisms

Formal risk management mechanisms can be classified as publicly provided or market based (World Bank, 2005). Government action plays an important role in agricultural formal risk management, both *ex ante* and *ex post*.

Ex ante agricultural extension education and services provided by agricultural extension help familiarize producers with the consequences of risk and help them adopt strategies to deal with it. Governments also reduce the impacts of risk by developing relevant infrastructure and by adopting social schemes and cash transfers for relief to cushion the aftershocks. Various market based risk management solutions have been developed to address these sources of risk (World Bank, 2005). One way producers have traditionally managed price variability is by entering into pre harvest agreements that set a specific price for future delivery. These arrangements, known as forward contracts, allow producers to lock in a certain price, thus reducing risk but also foregoing the possible benefits of positive price deviations.

Farmers in developing countries are increasingly adopting crop insurance as a strategy to manage production risk *ex-ante* (World Bank, 2005). Insurance is a technique in which losses

suffered by few are met from funds accumulated through small contributions made by many who are exposed to similar risks. Crop insurance is a means of protecting the farmers against financial loss on account of anticipated crop loss arising from practically all natural calamities such as natural fire, drought, floods, pests, diseases, etc. (Manoj *et al.*, 2003).

2.5 Theoretical Framework

The study is grounded on the theory of consumer behavior. According to this theory, the consumer is assumed to behave as if they have a utility function and makes a choice that maximizes satisfaction while firms seek to maximize profits. Utility in this case is a function of wealth or income and can mathematically be expressed as equation (2.1a and 2.1b) below, (Hardaker *et al.*, 1997).

$$u = u(w) \quad \text{.....2.1a}$$

$$U'(w) \geq 0 \quad \text{.....2.1b}$$

If the first derivative for wealth is positive, then it represents the situation of more being preferred to less (convex utility function). Similarly, risk aversion is indicated by a utility function that shows decreasing marginal utility as the level of pay off is increased (concave utility function), while indifference to risk is presented by a linear utility function (Hardaker *et al.*, 1997).

In this study, the behavior of decision makers (farmers) under risk will be studied using the following two approaches; expected Utility Theory (EUT) and the Safety First Models (SFM).

2.5.1 Expected Utility Theory

The Expected Utility Theory (EUT) was defined by von-Neumann and Morgenstern (1944) to explain the reasons behind individual choices involving risk. The EUT theory states that

the Decision Maker (DM) chooses between risky or uncertain prospects by comparing their expected utility values.

It is argued that individuals are reluctant to accept a bargain with uncertain payoff rather than another bargain with more certain, but possibly lower expected payoff (Gill, 2007; Levy, 2006). According to the von-Neumann and Morgenstern (VNM) theory, the consumer is assumed to have a utility function and the consumer is expected to maximize the VNM utility function subject to income constraint equation (2.2) below;

$U = u(y, c)$ ……..….2.2

Where y is the net farm income and c is consumption. The EUT essentially defines risk aversion in terms of the concavity or convexity of the decision makers utility functions at any particular point (Cox and Sadiraj, 2006; Eisenhauer, 2006). Friedman and Savage (1948) showed that the concavity or convexity of Von-Neumann Morgenstern expected utility function *U(X)*, indicates a risk preference of a decision maker.

The seminal works of Arrow (1965) and Pratt (1964) paid attention to one of the key elements of decision theory (the measure of risk aversion of the economic agents). Arrow (1965) and Pratt (1964) proposed two indicators that overcame the limitations in the use of a cardinal utility function in order to compare differences in risk attitudes. As such, the Arrow Pratt measure of risk aversion for von Neumann-Morgenstern expected utility function have been used extensively to analyze problems in the microeconomics of uncertainty (Ross 1981). There are two well received versions of the theory, i.e., Subjective Expected Utility Theory (SEUT) in the case of uncertainty, and Von Neumann Morgenstern Theory in case of risk.

2.5.2 Risk Aversion

Risk aversion is the central behavioral concept in the expected utility theory (Quiggin, 1993,

2002). Risk aversion measures a decision maker's unwillingness to accept a bargain with an uncertain payoff rather than another bargain with more certainty but with the probability of a lower expected payoff. This implies that the shape of a decision maker's utility function reflects his or her risk preferences (Hardaker, Huirne, *et al.*, 2004). The decision maker's utility function has a positive slope over a whole range of payoffs, which implies that greater payoff is always preferred to less. This can be illustrated in mathematical terms as $U'(w) > 0$, where $U'(w)$ is the first derivative of the utility function with respect to wealth (Hardaker, Huirne, *et al.*, 2004).

Risk aversion can be measured by the second derivative of the utility function for wealth ($U''(w)$). In other words, risk aversion is the change in the marginal utility as the level of wealth increases. This became a way to classify a decision maker's attitude toward risk as risk loving, neutral or averse in terms of the second derivative (Hardaker, Huirne, *et al.*, 2004; Schumann, 2005):

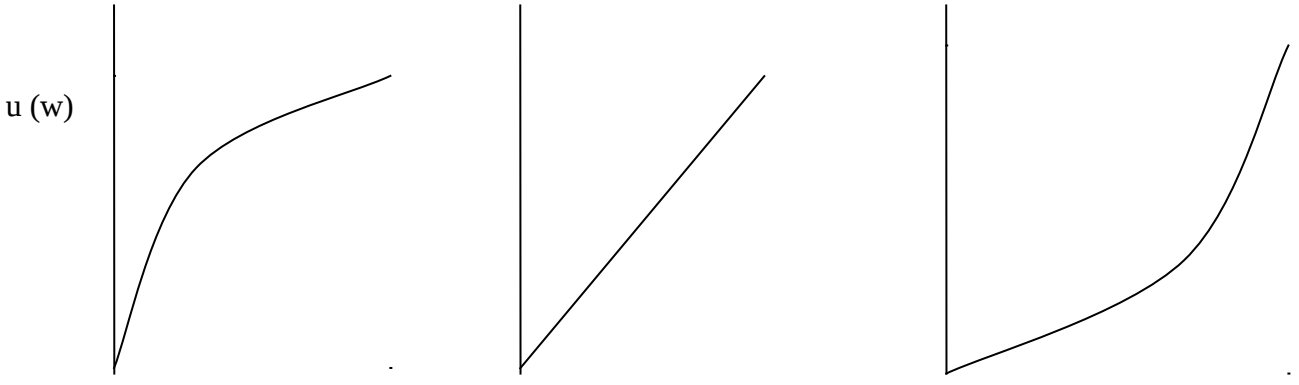
i. $U''(w) > 0$ means risk averse;

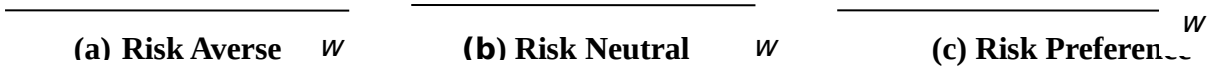
ii. $U''(w) = 0$ means risk neutral; and

iii. $U''(w) < 0$ means risk loving.

The risk attitude classification are shown in Figure 2.1 below;

Figure 2.1 The Shape of Utility Functions Exhibiting Risk Attitude Behavior





Source: Hardaker *et al.*, (2004)

2.5.3 Utility 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 reported in the literature to represent farmer's attitudes and their utilities toward risk. They include (Gómez-Limón, Arriaza, and Riesgo, 2003):

2.5.3.1 Direct Elicitation of the Utility Functions (DEU)

In this method, the farmers risk preferences are assessed by interview. The farmer is asked to state their indifference point with a series of the hypothetical risky prospects and the sure outcomes. An individual utility function is then calculated using regression approaches. 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).

2.5.3.2 Experimental Methods (EM)

Real money payoffs are employed to measure farmer's preferences rather than using hypothetical alternatives. However, this approach is not widely used and is quite complicated to implement in practice (Gómez-Limón *et al.*, 2003). Binswanger (1980) employed the EM technique to measure the attitude toward risk of rural farm households in India. The results of the study showed that all respondents were moderately risk-averse. Also, the author argued that the EM is a reliable technique compared with DEU because the interviewer's bias can influence the DEU results.

2.5.3.3 Observed Economic Behavior (OEB)

In this method, the risk response behavior 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-Limón *et al.*, 2003; Rovere, 1997; Young, 1979). Studies that used the OEB method to estimate farmer's attitudes toward risk include Chavas and Holt (1990), Chavas and Holt (1996), Pope and Just (1991) and Lence (2000).

2.6 Empirical Studies on Agricultural Risk and Risk Management

This section reviews literature on risk attitude, sources of agricultural risks and risk management strategies both locally and internationally. The socio economic attributes affecting risk preferences among farming household is also reviewed. Priority in this section is given to recent literature from the African continent.

Jirgi (2013), investigated technical efficiency and risk preferences of cropping systems in Kebbi state, Nigeria using the Experimental Gambling Approach, Factor Analysis and Logit regression, found out that risk attitudes of the farmers reveal that there are more intercroppers among the risk-averse class (92%) than monocroppers (74%). Further tests by using Chi Square showed that there are statistically significant differences between the risk averse and the neutral to preferring risk classes of the mono and intercrop respondents. The results of the determination of the sources of risk for both monocroppers and intercroppers indicate that diseases, erratic rainfall, changes in government and agricultural policy, and price fluctuations are the five most important sources of risk. The variables rainfall, difficulties in

finding labour, theft, market failure, price fluctuation and family relationships were statistically significantly different between monocrop and intercrop farmers. Concerning the risk management strategies ,the results showed that overly, monocroppers and intercroppers scored spreading sales (3.20), family members working off-farm (3.15) and borrowing (cash or grains) (2.96) to be the most important risk management strategies. Other management strategies perceived to be important by both monocroppers and intercroppers were spraying for diseases and pests (2.94), intercropping (2.90) and storage programmes (2.73).

Kwesi *et al.,* (2012) investigated the attitude towards risk using Equally Likely Certainty Equivalent with a Purely Hypothetical prospect (ELCE-PH) and analyzing copping strategies used by food crop farmers in Ghana. The study found out that 67.5% of the food crop farmers were risk averse while 22.5% and 10% represented risk neutral and risk takers/loving respectively. The study further revealed that income and household size positively related with risk averse attitude whereas access to micro credit, levels of education and age inversely related with risk aversion. The most dominant coping strategies among the food crop farmers were enterprise diversification, geographical diversification and labour supply for non-farm wage to manage risk of loss in yield.

In studying the source of risk management strategy among agricultural households and the role of off-farm investment in Uasin Gishu County, Korir (2011), used Equally Likely Certainty Equivalent (ELCE) method and exponential utility functions fitted by the method of non-linear least squares to estimate the coefficient of absolute risk aversion. He further used the logit model to identify determinants of off-farm investment. The study found that the major risks of concern to farmers were drought, market/price, pests and diseases and institutional risks. The study also revealed that all sampled farmers were risk averse and that

the years of experience in farming, employment income, and gender and farm income significantly determined off-farm investment decisions.

Salimonu and Falusi (2009), in examining the sources of risk in a period of three years in the Osun state, Nigeria identified five sources of risk constituting the major sources of risk in each of the three years under consideration. These were classified as market failure, price fluctuation, drought, pest and diseases attack and erratic rainfall. Others included crop diseases, bush fire outbreak and flood disaster. These had effects on the reduction in farmers' productivity, reduction in farmers' income and food shortage.

Attitudes towards risk among maize farmers in the dry savannah zone of Nigeria were analysed by Olarinde *et al*., (2007). The researchers applied econometric analysis to quantitatively determine the individual risk attitudes of the sampled maize farmers. The extent of the risk attitudes was then made the basis for categorizing the farmers into three groups of low, intermediate and high risk averse maize farmers. This categorization formed a necessary condition for improving the typology of the farmers, which was hypothesized to be influenced by socio-economic, demographic and other extrinsic “risk factor”. The typology was essentially made possible by discriminant analyses, which re-categorized the farmers into their appropriate risk groups. The findings revealed that about 8%, 42% and 50% of the farmers were low, intermediately and highly averse to maize risk, respectively. About 72% of the hypothesized variables were found to be responsible for the risk aversion among the sampled farmers. These variables were the basis of a policy recommendation to address issues generated by the four types of risks identified in maize production, namely natural, social, economic and technical risks. These are important for harnessing crop technology and to alleviate hunger and poverty in Africa.

Akcaoz and Ozkan (2005), divided farmers into three categories: risk-averse, risk neutral and risk-taker. The risk averse farmers' viewed the most important source of risk to be change of government's agricultural policies and the least important source of risk was farmhand's hygienic problems. In their opinion the financial and security factor was the most important factor in risk management. Among risk-neutral farmers, the most important source of risk was considered to be change in the input and output's cost, while among the risk-taker, price change of the inputs and the products were the most important source of risk and the relationships between families were the least important source of risk. The study concluded that the financial and security factor, out of farm investment and working outside the farm were the most important factors influencing risk management strategies by risk-neutral farmers.

Kisaka *et al.*, (2005), measured farmer's attitudes towards risk for 200 households in the Umbumbulu District and Kwanzulu Natal Province of South Africa. The Arrow Pratt Absolute Risk Aversion (APARA) coefficient was used to measure farmer's degree of risk aversion and the experimental gambling approach to establish the risk classification. She found that at higher pay-offs, most farmers are intermediate to moderately risk averse with little variation according to socio-economic characteristic and that non- certified farmers tend to be more risk averse than fully and partially-certified farmers. Education and gender were statistically significant among fully-certified organic farmers while household size was significant for non-certified farmers. The study also found that female farmers were more willing to take risk than their male counterparts in the fully-certified and partially- certified groups.

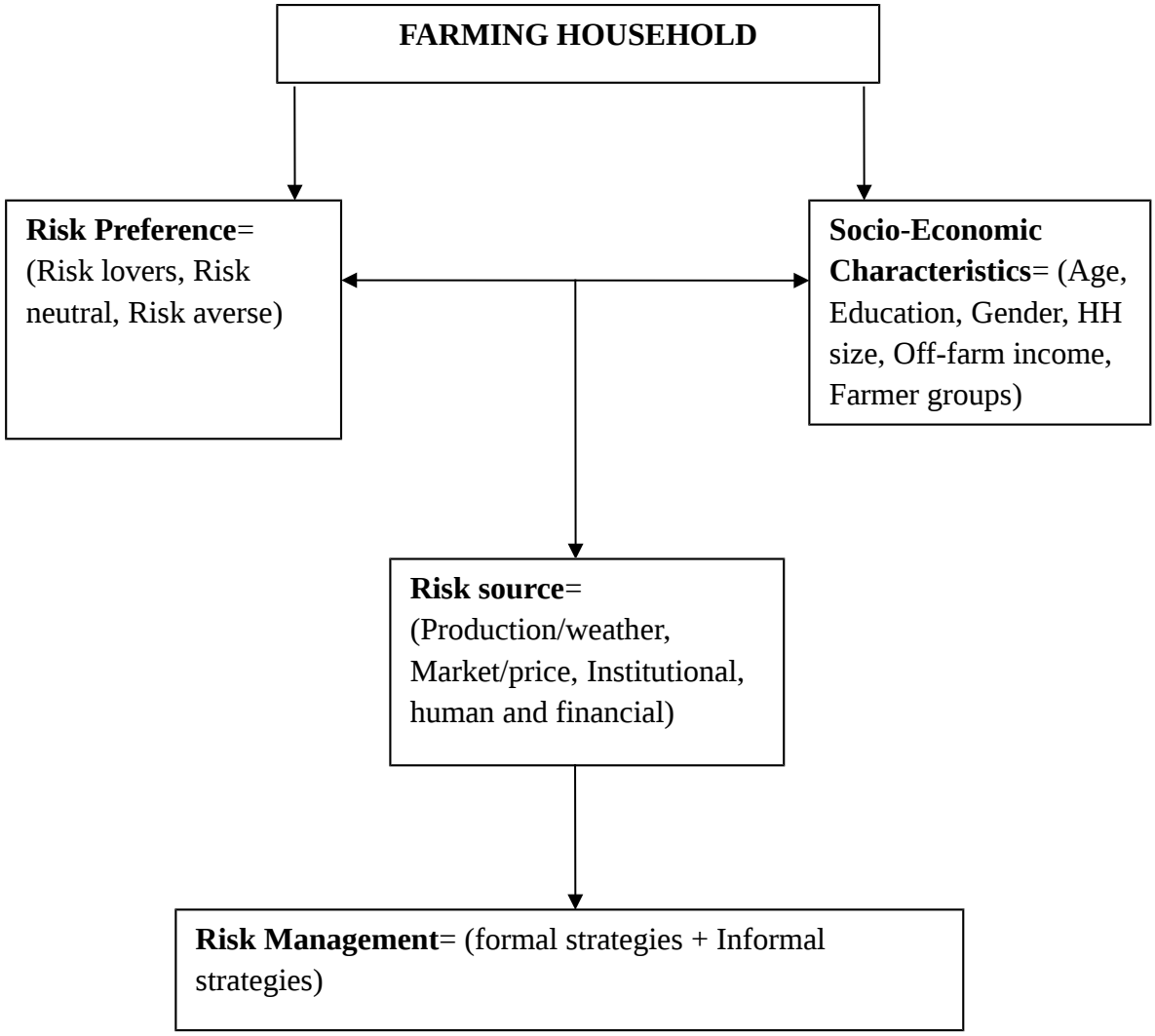
Torkamani (2005), evaluated the risk aversion attitudes of farmers in Fars province, Iran. A total of 60 respondents were interviewed using an applied ELCE questionnaire to elicit the farmer's utility values and the absolute risk aversion coefficients were assessed. The results showed that all sampled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

Binswanger (1980), examined the attitude toward risk in rural India. The researcher used two methods i.e. interview method and experimental gambling approach with real payoffs. Two hundred and forty subjects were involved in the risk attitude experiment. The result interpreted from the utility framework showed that all but one of 118 individuals had non-linear, risk-averse utility functions, which exhibit increasing partial risk aversion. At high payoff levels, almost all the subjects are moderately risk-averse with slight variation based on personal characteristics. Risk aversion reduces slightly as wealth level increases but its effect is not statistically significant. The interview method results were completely different with the experimental measures of risk aversion owing to interviewer bias.

2.7. Conceptual Framework

The conceptualization of the research is illustrated in the figure (2.2) below. Farmers risk attitude is modeled as a function of risk aversion, risk indifference and risk preference. The socio economic factors are assumed to be a function of household age, education level, household size, access to credit, availability of extension services, off-farm income and membership to farmer associations. Sources of agricultural risk are categorized into market/price risk, production risk, financial risk, human or personal risk and institutional and policy risk. The risk management strategies are modeled as a function of both the market based and self-insurance. Socio economic characteristics interact with risk attitude to determine risk management strategy.

Figure 2.2. Conceptual Framework



Source: Own Conceptualization.

CHAPTER THREE

METHODOLOGY

3.1 Area of Study

The study was conducted in Trans Nzoia County in North Rift region of Kenya. The county is located between the Nzoia River and Mount Elgon. Precisely, the county is located at latitude 0°52´-1°18´S, and longitude 34°38´-35°23´E , with the highest point elevated at 6300 feet (1900m) above the sea level. The county borders the Republic of Uganda to the North West, West Pokot County to the North; Elgeyo Marakwet County to the East; Uasin Gishu and

Kakamega Counties to the South, and Bungoma County to the West and South West (CRA, 2012).

Trans Nzoia County covers a total area of 954 square miles (2,495.5Km^2) and divided into three districts i.e. Trans Nzoia East, Trans Nzoia West and Kwanza Districts. Kitale town is the administrative headquarter. The human population is relatively high approximately 818,757 and a density of 328 people per Km^2 (KNBS, 2010).

The county is endowed with an ideal climate with temperatures ranging from an annual minimum of 10°C to a maximum of 37°C, and a bimodal rainfall pattern with a rainfall ranging from 1800 to 1900mm. The ideal climatic condition has facilitated bee hive of agricultural activities in the area such as; Commercial maize, beans, wheat, tea, coffee, seed maize, seed beans and horticultural crops .Agriculture is indeed the bark borne of Trans Nzoia County.

3.2 Data Types and Sources

The study used primary data collected through a household survey using a structured questionnaire. Interviews and observation were also used and formed the basis for primary data collection.

3.3 Research Design

This section presents the structure within which the research was conducted. It constitutes the blue print for data collection, measurement and analysis of data.

3.3.1 Sampling Frame

The population for the farmer survey involved different categories of farmers in Trans Nzoia County. These included medium and lager scale farmers. The study also covered contracted seed maize farmers in the region. The survey population was drawn from Trans-Nzoia East district, Trans-Nzoia West district and Kwanza districts.

3.3.2 Sampling Procedure

Multi-stage sampling technique was used to identify household survey units where locations, sub-locations and farming households were selected. Farmers were further stratified into small-scale, medium scale and large scale depending on the farm acreage under cultivation. The sampling unit was the household and 196 respondents were randomly selected using simple random sampling. Reconnaissance visit was done prior to enumerator recruitment and pre testing of the questionnaire. Enumerators were then trained during which questionnaire pre-testing was done. The field work took six days to complete. Data cleaning for corrections of errors and coding were done. Data was entered in Excel and SPSS version 20 computer programme ready for data analysis.

3.3.3 Sample Size

The study adopted Cochran (1963) formula to determine the sample size, since the population of farming households in Trans Nzoia County is not known with certainty and presumed to be very large. The equation is presented in equation (3.1) below;

$$n_0 = \frac{z^2 pq}{e^2} \qquad \text{……..…..... (3.1)}$$

Where; n_0 is the sample size, Z^2 is the abscissa of the normal curve that cuts off an area at the tails, e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q is $1-p$. Using equation (3.1) above and a desirable confidence interval of 93%, the sample size used in the study is given by;

$$n_0 = \frac{(1.96)^2(0.5)(0.5)}{(0.07)^2} = \text{196 respondents}$$

3.4 Model Specification and Data Analysis

This section presents the description of the procedures used to achieve the objectives of the study.

3.4.1 Equally Likely Certainty Equivalent with a Purely Hypothetical Risky Prospect (ELCE-PH)

The study adopted the ELCE-PH as modeled by Hardaker *et al.,* (1977), which is designed to avoid bias caused by probability preferences through the use of ethically neutral probabilities (i.e., P= (1-P) = 0.5). The subject is confronted with two-state risky prospects having an equal probability of 0.5 for each state. This method overcomes the criticism of bias owing to probability preference. However, it still has the difficulty that the subject is forced to select between a certainty and a lottery. Nevertheless, this problem may be minimized by presenting the questions as practical decision making problems (Anderson, Dillon, and Hardaker, 1977). In this study, each farmer was asked to indicate the certain income that he or she would need to be indifferent between receiving this certain amount and a lottery with the highest possible win of Ksh 10,000/= and the lowest of Ksh 5,000/= , each with a probability of 0.5. The expected value of the above lottery is Ksh 7500/=. So depending on whether the certain amount is greater than, equal to, or less than the expected value of the risky prospect, each farmer in the sample can be classified as risk preferring, risk neutral or risk averse.

Risk-preferring: Kshs 7,500.00 < certain amount – Risk-neutral: Kshs 7,500.00 = certain amount - Risk-averse: Kshs 7,500.00 > certain amount.

3.4.3 Regression analysis

In measuring the impact of socioeconomic characteristics on respondent risk attitude a logit model was adopted for the study. The independent variables were respondent socioeconomic characteristics while the dependent variable was the risk the farmer’s attitude. The logit

model is based on the logistic cumulative probability function represented by Wright (1995), as follows;

LOGIT: log [Pi/ (1- Pi)] = Zβ + E.....……3.2

The dependent variable is the risk attitude dummy (1 = if farmer is risk averse, 0 = otherwise).

Where:

Z – Represents the matrix of observations of the explanatory variables

β – Represents the column vector of the coefficients; and

E – Represents a vector of disturbances.

Pi – The dependent variable describes the probability that a particular condition occurs. Hence the test of the estimated beta (β) coefficients in the model equations were used to draw conclusions on how the socio-economic variables influence farmer-risk behavior. This equation is further fitted in equation 3.3 below:

Z = f (Ag, Se, Hhs, Edn, Crdit, Ext, Offarm Y, GrpMrb, U)……..3.3

$Z = \beta o+\beta_1 Ag+ \beta_2 Se+ \beta_3 Hhs+ \beta_4 Edn + \beta_5 Crdt + \beta_6 Ext + \beta_7 Offarm+\beta_8 GrpMrb+\varepsilon$ …...……3.4

Where: Z = Log [PZA/ (1- PZA)] = risk attitude parameter, PZA = probability that a farmer is risk-averse and U/e = random term that is assumed to be $\varepsilon \sim N(0, \delta^2)$.

The definition of the dependent variables are presented in table 3.1 below

Table 3.1: Definition and Measurement of the Independent Variables

Variable	Description	Units	Expected sign
Age	Age of the household head	Years	+
Sex	Gender of the household head	1 Male; 0 Female	+/-
Household size	Size of the household	Number	+
Education	Education level of the household head	Years	-

Credit	Access to credit	1 Yes; 0 Otherwise	-
Extension	Access to extension service	1 Yes; 0 Otherwise	-
Off-farm Income	Amount of the other incomes	Ksh	+
Farmer Groups	Membership to farmer groups	1 Yes; 0 Otherwise	-

Source: Own Conceptualization

3.4.3 Factor Analysis

The dimensions of the perceived risk sources and risk management strategies in the fourth objective were determined using factor analysis. Factor analysis describes the variance in the observed variables in terms of the underlying latent factor (Habing, 2003). In the questionnaire, surveyed farmers were presented with a likert-type scale ranging from one (strongly disagree) to five (strongly agree). Farmers were asked to rank the risk sources and management strategies that were important to them. The average scores and rankings of means were used to determine the most important risk source and management strategies.

Checking for Multicollinearity

Multicollinearity refers to a statistical phenomenon where there exists a perfect or exact relationship between the predictor variables. When multicollinearity exists, it becomes difficult to come up with reliable estimates of individual coefficients. To determine whether multicolinearity existed between variables in the risk source and management models, the study carried out an examination of the correlation matrix. Large correlation coefficients in correlation matrix of predictor variables indicate multicollinearity. If there exists a perfect relationship between any two predictor variables, the correlation coefficient between these two variables will be near to unity. The rule of thumb is that multicollinearity becomes a problem if the correlation coefficient in factor analysis exceeds 0.7 for any two of the independent variables (Anderson *et al.*, 2008).

Data was further analyzed by use of both descriptive statistics (frequencies, percentages, means and standard deviations) and quantitative methods, by use of Excel spreadsheet SPSS version 20.0 software.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Overview

This chapter presents the results and discussion of the socio economic and demographic characteristics of the respondents, risk attitude, sources of risk and risk management strategies as well as the results of factor analysis obtained on risk sources and management strategies. Out of the 196 respondents targeted 167 responded giving a high response rate of

86 percent that was largely attributed to systematic planning of the study and cooperative nature of the respondents.

4.2 Risk Attitude of the Respondents

In determining the nature of risk attitude, analysis of the responses of the sample farmers were done and presented in Table 4.1 below. The results showed that on average, 74.25%, 16.77% and 8.98% of the respondents revealed their preference for prospects representing risk-averse, risk neutral and risk loving respectively. The interpretation of the results indicates that most of the farming household would not take a chance investing in profitable ventures i.e. High Yield Varieties (HYV) and Innovation with uncertain outcomes rather prefer a lower profitability position with safer outcomes.

Table 4.1: Risk Attitude Classification of Farmers

Risk attitude group	Risk averse	Risk neutral	Risk loving	Total
Frequency	124	28	15	167
Percent farmers	74.25	16.77	8.98	100

Source: Field Survey Data, July 2013

The study also revealed that risk-averse farmers are more apprehensive about taking risk. The risk-averse farming households tend to safeguard against crop failure by diversifying their farming activities i.e. by intercropping predominantly maize and beans. The study results are in line with the findings of Olarinde *et al*., (2007) who reported that maize farmers in the dry savannah zone of Nigeria are lowly (8%), intermediately (42%), and highly risk averse (50%). Binici *et al.*, (2003) found that not all, but the majority of the farmers were risk-averse. Korir, (2011) found all sampled farmers in Uasin Gishu County were risk-averse.

4.2 Socio-Demographic Variables

Study results presented in table 4.2 below show that 62% of the respondents were male while 38% represented the female headed households. Among the women interviewed, 36% were

risk averse while 33% were risk lovers. On the other hand, 64% of the male headed households were risk averse and 67% were risk preferring. The results showed no significant difference in the number of male and female among risk averse and risk preferring farmers. In both groups, men dominated the number of people interviewed and few women. The overall difference in the numbers of women and men involved in maize production may be attributed to the common cultural norms which deny women ownership of resources such land.

In general, there were 72% married, 10% single, 7% Widowed and 11% divorced farming household in the study area as presented in table 4.2 below. The findings further showed that among the married 75% represented the risk averse while 64% were risk preferring households respectively. However, only 3% and 27% represented risk averse and risk preferring farming household. Both groups of risk averse and risk lovers had a big number of married, few single and widowed farmers. However, the chi-square test showed no significant difference between the marital statuses of the risk averse and risk preferring farming households.

Table 4.2 Demographic Variables, Access to Credit, Extension Service and Group Membership

Variable	Description	Aggregate(n= 167)	Risk Averse(n=122)		Risk Loving (n=45)		Chi-Square	Sig
			No	%	No	%		
Sex of Farmer	Male	62 %	78	64	30	67		
	Female	38 %	44	36	15	33	6.17	0.647
Marital Status	Married	72 %	92	75	29	64		
	Single	10 %	4	3	12	27		
	Widowed	7 %	16	13	2	4	8.16	0.401
	Divorced	11 %	10	8	2	4		
Access to Credit	Yes	22 %	7	6	38	84	32.16	
	No	78 %	115	94	7	16		0.000
Extension Service	Yes	24 %	25	20	40	89	14.16	
	No	76 %	97	80	5	11		0.000

Group Membership	Yes	28 %	10	8	35	78	54.12	0.000
	No	72 %	112	92	10	22		

Source: Field Survey Data, July 2013

Accessibility to credit and agricultural extension service are very important factors in agricultural production. The study findings however showed that only 22% and 24% of the sampled farmers had access to credit and agricultural extension service respectively. The source of credit included bank loans, credit input and Sacco loans while extension services were mainly offered by ministry of agriculture staff, NGOs and Seed Company's. Interestingly, the results further shows that only 6% of the risk averse and 84% risk preferring had access to credit. Study further showed that the risk preferring farming household had more access to extension service (89%) compared to risk averse (20%). Chi-square tests also revealed that there was a significant difference at 1% level, with respect to the proportion of farmers who had access to credit and extension service among the two farmer categories.

Only 28% of the maize farmers in the study area were members of a farmer groups as shown in the table above. Almost all the risk preferring households (78%) were group members compared to 8% among the risk averse. In fact, the chi-square test was strongly significant at 1% level, indicating that there were significantly more group members among the risk preferring farmers than those who were risk averse.

Table 4.3 below shows that the mean age of all the sampled farmers was 46 years with the average age for risk averse farmers being 50 years while the risk preferring farmers was 39 years. These study findings shows that risk averse farmers had a higher prime age compared to the risk preferring farmers. This could mean that younger farmers are less risk averse compared to their counterparts. Similarly, t test was significant at 5% level of significance

which indicated that the risk averse farmers had significantly higher mean age compared to risk preferring farmers**.**

Table 4.3: Socio Economic Characteristics by Risk Attitude Classification

Variable	Description	Aggregate	Risk Averse	Risk Loving	t value	Sig
Age	Mean	46	50	39		0.040
	Std. deviation	(12.47)	(12.45)	(12.33)	2.024	
Education	Mean	9	6	11		0.001
	Std. deviation	(3.47)	(3.47)	(3.43)	2.009	
Household Size	Mean	5	7	3	-1.001	0.025
	Std. deviation	(2)	(3)	(1)		
Off-farm income	Mean	96,500	98,000	95,000	-1.70	0.213
	Std. deviation	(86,000)	(82,550)	(80,100)		

Source: Field Survey Data, July 2013

The results in table 4.3 above showed that the majority of the sampled farmers acquired an average of 9 years of formal education. This translate to the fact that the majority of the farming household had at least acquired primary school education. The results also shows the average years spent in education to be 6 and 11 years for risk averse and risk loving respectively. This could be an indication that the more years spent in education the less risk averse the farmer is expected to be. The statistical test was also significant at 1% level implying indeed the risk preferring farmers were more educated than the risk averse farmers.

Results in table 4.3 above shows that the average size of the household in the study are was 5 members per household. The risk averse farming household comprised of an average of 7 family members while the risk preferring farming household had an average of 3 family members. Larger households was indication of source of labor, high food consumption needs and therefore tend to be more risk averse. The statistical test was significant at 5% level showing that indeed the risk averse farmers had a higher family size compared to the risk preferring farmers.

Table 4.3 above further shows the average income received from off-farm activities in the study area was Ksh 96,500/=. The results shows that the risk averse farmers had a higher off-farm income of Ksh 98,000/= compared to Ksh 95,000/= obtained by the risk preferring farmers. The risk-averse farmers were highly involved in off-farm activities mainly due to the uncorrelated nature of off-farm income with farm income thus spreading the risk associated with agricultural activities. However, the statistical test showed no significant difference on the amount of off-farm income received between the risk averse and risk preferring farmers at all level of significance. For this study, off-farm income comprised of average annual income from employment, business, as well as transfer earnings from relatives, borrowings, gifts, rent from land or buildings and motorcycles.

4.4 Regression Analysis of Risk Attitude on Socio-Economic Characteristics

In order to determine the relationship between risk attitude and socio economic characteristic in the third objective, a binary logit regression analysis was carried out and results tabulated in table 4.4. The theoretical expectations of the model were broadly confirmed. The results suggest that the statistical parameters that indicate the goodness of fit of the model specified for the study are highly significant at alpha level of 5%. R square in our case is 0.54 indicating that at least 54% of the variation in the dependent variable is explained by the logistic model. The F-test statistic tested is statistically significant, suggesting that the explanatory variables have significant effect in explaining whether a farmer in the study area has risk aversion attitude in production or otherwise.

Table 4.4. Logistic Regression Analysis of Risk Attitude on Socio Economic Characteristic of the Farming Household

VARIABLES	B	SE	T Value	Sig
Age of HH	0.512*	0.078	6.564	0.001
Sex	0.314**	0.062	5.064	0.021
Household Size	0.003	0.021	0.143	0.568

Education	-0.005*	0.099	-0.051	0.000
Access to Credit	-0.420	0.399	-1.053	0.456
Access to Extension	-0.496	0.403	-1.231	0.645
Off Farm Employment	0.104*	0.504	-0.216	0.000
Group Membership	-0.160*	0.251	-0.637	0.000
Constant	0.025**	0.011	2.273	0.034
R^2	54.4			
F	25.124**			

Source: Field Survey Data, July 2013. * and ** significance at 1% and 5% alpha level

The coefficient for age was positive and statistically significant at 1% level of significance suggesting that age had significant effect in explaining farmer's attitude towards risk. This implies that the younger the farmer, the less risk averse he will be. The results showed that younger farmers were more willing to adopt new and high yielding farming technology. Younger farmer were also more active in farmer groups and associations compared to their older counter parts. However, this study contradicts the findings of earlier studies (Binswager, 1980 and Aye *et al.,* 2007). Binswanger asserted that older people having dealt much more in risky economic games at high stakes might be more willing to take risks at high levels than young people. According to Aye and Oji, age may also be indexing for the wealth status of the household and accumulation of social capital. It is believed that older farmers are more likely to have accumulated more wealth than younger farmers; and hence older farmers are more likely to have greater social capital and networks, which serve as some form of traditional insurance or fall back strategies in the process of decision making.

The result shows that sex is positively related to risk aversion attitude (i.e. $\beta = 0.314$) and significant at 5% level of significance. This observation underscores the fact that the gender of the respondents played very significant role in their response to risk; and suggests that male farmers in the study area are likely to be less risk averse compared to their female counterparts. Male headed household were found to be more willing to invest in farming activities compared to female headed households. These findings are similar to Binswanger,

(1980) whose results showed a negative between gender and risk attitude among Indian farmers. The study also noted that one's sex assigns the person to a particular cultural role in the communities in the study area, and this to a large extent may determine one's access to available productive resources in the community.

On the other hand, the coefficient for household size in the study area had a positive and statistically insignificant significant relationship with risk attitude (i.e. $\beta = 0.003$). This suggest that farmers with larger families are likely to be more risk averse compared to households with fewer member. These findings are interpreted that the larger the household size, the greater will be the total consumption needs of the farm family and hence, the more risk-averse behavior. However, the results are inconsistent with the findings of Kwesi et al., (2012) who found an inverse relationship between household size and risk attitude of respondents while studying attitudes towards risk and coping response in Ghana.

The results given in table 4.4 above shows that education had a significant and inverse relationship with risk preference at 1% level of significance. This result conforms to the a priori expectation that the more educated respondents would be more willing to take risk than the less educated ones. The results further indicate that farmers with higher levels of literacy were more willing to invest in uncertain outcome for maximum gains. Educated farmers are also more willing to adopt better farming technologies such as improved animal breeds, irrigation and high yielding varieties (HYV). The result is consistent with (Binswanger, 1980 and Ndzebah, 2012) who reported that schooling had a positive impact on risk taking.

The coefficient for access to credit and agricultural extension services had an inverse and insignificant relationship with risk attitude at both 1% and 5% level of significance. These implied that the more credit support and access to agricultural extension services is given to

farmers, the less risk averse the farmers will become. Farming enterprises is capital intensive and therefore requires huge capital outlay at affordable interest rates. The study noted that farmers were constrained in using institutional financing schemes since they were tied to insurance and long administrative bureaucratic procedures. This implies that availability of credit and presence of extension service to farmers improves farmer's adoption of productive technologies translating to higher productive efficiency and lesser risk averse. However in the study area there was very little evidence of farmers who had access to credit.

The coefficient for off-farm income is positive and statistically significant at 1% level of probability. This could be interpreted to mean that the higher the level of off-farm income the lesser risk-averse the household is expected to be. The study also indicated that off-farm investment is considered a risk management strategy. This was in tandem to the fact that off-farm investment has imperfect correlation with farm income. These study result are also found by Korir (2012), who found out that employment and salary had negative effect on off farm investment.

The coefficient for membership to farmers groups and associations had an inverse relationship with risk preference and significant at 1% level of significance. The results shows that membership to a farmers group had a negative relationship with risk attitude coefficient implying that members exhibit less risk averse behavior than non-members. This supports the interpretation that membership to farmers association increases flow of information through farmer's interaction and accessibility to change agents. The study findings revealed existence of several farmer groups/association in the study area such as Kimitu farmers SHG, Decese (Development Education System of Community Empowerment), Ngombe safi SHG, Gaa seiyot women SHG and Kiungani dairy farmers

group. Kenya Maize Development Programme (KMDP) encourages and supports the formation of farmers association as a means of improving the efficiency and participation of small holder maize producers. For instance KMDP had conducted seminars and workshops themed “Farming as a Business” (FaaB).

The regression results obtained using the risk preference classifications shows that there are more than just the observed explanatory variables that are reported here that explain the risk attitude of farming households in the study area. Risk preference could be better explained by individual psychological factors that were not readily observable for the sample farmers. However the results above point up the socio-economic variables that impact of the farmer‘s risk preference.

4.5 Sources of Agricultural Risk and Risk Management Strategies

This section presents the study findings using factor analysis on different sources of agricultural risk and risk management strategies adopted by the farming households in the study area. The questionnaire used for data collection and analysis was based on farmer’s responses on the perceived importance of risk source and management strategies. The responses were collected on a 1(Strongly disagree) to 5 (Strongly agree) lickert scale.

To determine whether it was necessary to perform factor analysis, the data was subjected to correlation analysis. The result for the correlation analysis shows that the variables were correlated for both risk sources and risk management strategies. The highest correlation value is 1.000 (Appendix 2a and 2b).

Bartlett’s Test of Sphericity was used to test the null hypothesis that the variables in the study are uncorrelated in the population: in other words, the population correlation matrix is an identity matrix. The study results reported that $p < 0.001$ thus rejecting the null hypothesis

that the variables in the study are uncorrelated, thus the factor analysis is appropriate for the study (Table 4.5).

Table 4.5. Kaiser Meyer Olkin and Bartlett's Test

KMO and Bartletts Test		**Risk Source**	**Risk Mgnt**
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.50	0.50
Bartlett's Test of Sphericity	Approx. Chi-Square	417.282	201.432
	Df	120	55
	Sig.	.000	.000

Source: Field Survey Data, July 2013.

The Kaiser-Meyer-Olkin test (KMO) gives a measure of sampling adequacy and determines suitability of individual variables for use in factor analysis. The measure of sampling adequacy must lie between 0 and 1. The acceptable KMO should not exceed 0.50 (Kaiser and Rice, as cited by Berghaus *et al*., 2005). The study found that the KMO value for both risk management and risk source strategy to be 0.5 for both risk source and management strategy respectively (Table 4.5). Therefore the KMO measure of sampling adequacy suggested that the sample was factorable and factor analysis was appropriate.

The study results further indicated collinearity to be too low since the correlation coefficient was less than 0.7 for both risk source and management strategies (Appendix 2a and 2b). The tests described above indicated that multicolinearity was not a serious problem in the model. Therefore, regressions were done without adjusting the model.

4.5.1 Sources of Agricultural Risk

In investigating the types of risk faced by farmers in Trans Nzoia County, data was gathered under a measure of strength of 16 variables. A lickert scale on a continuum ranging from 1 (strongly disagree) to 5 (Strongly agree) was adopted for data collection. From the results obtained, the risk source variable with the highest mean value indicated the most important risk source to the farmer while the least mean value showed the least important risk variable.

As presented in Table 4.6 the most effective risk among farming household in the study area were; fluctuating out prices (4.80), Input price volatility (4.66), unpredictable weather (4.28), Lack of labour (4.23),Soil deficiency (4.23), soil deficiency (4.23) Storm/hail (4.22), Road network (4.22), Inadequate extension services (4.06), crop and animal diseases (3.74) and pests (3.62). The study further revealed the following risk source had little significance on farming activities in the study area. These include vandalism and theft of assets and produce; death and divorce of the household head; changes in the agricultural and environmental policy; availability of credit; availability of land for cultivation and interest rate on credit.

Koutsoyiannis (1987) suggested retaining principal components that meet Kaiser's criterion i.e. have Eigen values of one or above and an estimated component greater or equal to 0.3 can be meaningfully interpreted. Table 4.6 shows the factor loadings of the sources of risk on the 7 factors identified using SPSS 20. The results show that out of the sixteen individual risk source variables, seven factors with Eigen values greater than 1 explained 65.53% of the total variation in the explanatory variables. Interpreting the loadings, the factors 1 to 7 can most accurately be explained as 'weather risks', 'Market/price risks', 'Biological risks', 'Labour bottlenecks', 'Finance risk', 'Land bottlenecks and 'Human/personal risk'.

Table 4.6: Varimax Rotated Factor Loadings of Risk Sources

VARIABLES	Mean	SD	Component						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Labour	4.23	.646	.256	-.284	.075	**.486**	.014	.121	-.007
Unpred.Weather	4.28	.548	**.733**	-.223	.101	-.129	-.222	-.050	-.007
Soil deficiency	4.23	.646	**.871**	-.040	.008	.011	.041	.033	-.160
Storm and hail	4.22	.723	**.686**	.114	-.182	.255	.233	.023	.143
Output Price	4.66	.617	-.274	**.604**	.079	-.116	**.343**	.007	-.028
Input Price	4.80	.446	**-.412**	**.476**	.059	**-.388**	.109	-.128	.049
Nature of roads	4.22	.807	.024	**.817**	.003	-.025	.019	-.002	-.093
Extension	4.06	.883	.019	**.737**	-.134	.089	-.297	-.017	.071
Credit	1.06	.238	.018	-.018	.071	-.127	**.800**	.041	.053
Intrest on Credit	1.04	.298	-.104	.053	-.166	-.159	-.114	.148	**-.760**

Agric policy	1.11	.337	-.090	.100	.042	**.772**	-.143	-.076	.047
Land	1.05	.214	-.036	.137	.118	**-.300**	**-.324**	**.643**	.280
Death/ HH	1.15	.358	-.251	-.006	-.273	-.152	-.079	.161	**.619**
Vandalism /theft	1.23	.421	-.052	.135	.061	-.173	-.228	**-.807**	.181
Pests	3.62	1.113	-.078	-.018	**.803**	-.057	.159	-.009	.004
Diseases	3.74	1.064	.041	-.023	**.831**	.123	-.077	.020	-.008
Eigen Values			2.17	2.00	1.54	1.30	1.19	1.16	1.14
% Var. Expl			13.58	12.48	9.62	8.06	7.45	7.22	7.13
Cumm. Var Ex			13.58	26.06	35.68	43.74	51.19	58.41	65.53

Source: Field Survey Data, July 2013

Notes: Loadings ≥ 0.30 are in bold showing the correlation among variables

The results in table 4.6 above indicate the first principal component; “Weather risks” explained 13.58 % in the explanatory variable. The results showed that farmers who expressed concern with the unpredictable weather as a risk element also faced the risk of storm/hail and soil deficiency. However this group of farmers did not consider the volatility of input price as a risk factor. It should also be noted that weather is absolutely beyond the control of farmers and has a direct impact on yield. The consequent effect of erratic rainfall is delay in planting dates and crop failure when dry spell prolongs. This is in tandem with Korir, (2011) who found out that 59% of the farmers revealed weather risk to be the most perceived.

The second principal component, ‘Market/price risks’ accounts for 12.48% of the total variance explained (Table 4.6). The results revealed that the main source of price/market risk was the volatility in the input and out prices. Availability of extension service and the inadequate infrastructural networks had positive relationship with the market prices for input-output. Farmers in the study area expressed concerns on the pricing mechanism of both green and dry maize. It was revealed that middlemen have taken the advantage of the weak market mechanism and lack of cooperatives to exploit the farming community. Farmers are however

optimistic the county government administration will highlight their plight given that farming is their major economic activity.

Agricultural extension services provides farmers with important information such as patterns in crop prices, high yielding varieties (HYV), crop and animal husbandry and marketing. Exposure to such activities is intended to increase farmer's ability to optimize their use of their resources. The Index shows that farmers who perceived inadequate road network to be a risk factor also showed concern on the nature of storage facilities such as cold storage/refrigeration. It was evident that transportation of perishable produce such as tomatoes and milk from rural parts of the county was a huge risk. This study finding was in tandem with those of Korir (2011) who found out that 34 % of the study population identified price/market risk.

Principal component 3, i.e. Biological risk explained 9.62% of the total variance explained. The risk source variables crop/livestock diseases, and pests have positive factor loadings. Pests and diseases were also found to be prevalent in most parts of the county. Diseases found to be common in the area of study included; Grey leaf spot (GLS), Maize streak virus (MSV) and Maize Lethal Necrosis (MLN). It was also observed that pests such as weevil, aphids, thrips, leafhoppers and stem borer have contributed to huge loses of yield. 0Most of these pests have acted as a vector in transmission of deadly viral diseases such as MLN.

The fourth component refers to labour bottlenecks and accounted for 8.06% of the variation in the explanatory variables. The results indicated that farmers perceived availability of labour both skilled and unskilled to be an important risk factor. Inadequate labor could be due to labor out migration especially to urban areas and the unwillingness of youth to take up

farming as a profession. However, farmers in this category did not perceive input price volatility and availability of land to an important risk factor.

‘Credit Bottlenecks’ is the fifth component explaining 7.45% of the total variation in the explanatory variables. Farmers who expressed concern on availability of credit facility to finance the purchase and acquisition of farm inputs and machinery also indicated concern on the high interest rate on the available credit. Lack of liquidity may remain a risk in the short and medium term as the rural farmers do not have collateral required by the financial institution for access to credit. It was also noted the purchase of crop insurance cover was mandatory in order to qualify for the available credit offered by commercial financial institutions. The results further revealed that farmers also perceived output price volatility to be a dominant risk source in the study area. However, farmers in the fourth component did factor land availability as an important risk factor.

‘Land bottleneck’ accounted for 7.22% of the variation. This factor comprises the availability of agricultural land (0.648) and vandalism /theft of farm produce and assets (-0.807). It was evident that farmers especially seed maize grower’s perceived availability of land to be an important risk factor. This is partly attributable to the isolation requirement in seed maize production. Farmers however did not consider vandalism/theft as an important risk partly because of the stability in the area of study.

Lastly, factor 7 comprised of ‘personal/human risk’ accounting 7.13% of the variations. Most farmers who indicated concern theft of farm produce as a risk factor also mentioned death of the household head and divorce to be the most dominant. Illness and eventual death and or divorce of the household head and members may lead to inadequacy in managerial capability.

Illness of a household member affects farmers' budgets since most farmers in the rural areas do not plan for medical bills and a health insurance policy has yet to be established for farmers in the rural areas. Interestingly, farmers in this category did not consider interest on credit to a dominant risk factor since most of the farmers could even not access credit.

4.5.2. Risk Management Strategies among Farmers in Trans Nzoia County

Weather, financial, market/price, biological and institutional risks, along with a farmer's attitude towards risk, has a major impact on the choice of risk management strategies and tools to be used (Shapiro *et al*., 1993). Risk cause adversity in yield, prices and production units (Anderson *et al*., 1985). The study result indicates the existence of several strategies that farm households in Trans Nzoia County have opted in mitigating and coping with farm risks.

Table 4.7 shows twelve risk management strategies adopted by the farming household in the study area. The most dominant risk management strategy in order of importance were; crop diversification (4.82), off-farm investment (4.78), other sources of income (4.1),cost minimization(3.69), and adoption of high yielding varieties(3.29).Other management strategies with least importance were; debt management (1.92),buffer stock accumulation (1.88),forming cooperatives (1.11), irrigation (0.94),crop insurance (0.75),security safe guarding (0.65) and contract marketing (0.33).

Table 4.7: Varimax Rotated Factor Loadings of Risk Management Strategies

			Component				
VARIABLES	Mean	SDV	1	2	3	4	5
Off-farm investment	4.78	.634	.203	-.003	**.388**	.106	**-.480**
Crop insurance	0.75	.608	-.054	**.553**	**-.563**	.013	-.261
Market Contracts	0.33	.520	-.024	.042	**.770**	-.153	-.091
Crop Diversification	4.82	.518	**.672**	-.204	-.275	-.076	-.088
Farmer Groups	1.11	.892	-.200	**.693**	-.038	.019	.210
Buffer Stock	1.88	1.293	-.105	.068	-.094	**.871**	.117
Irrigation	0.94	.841	**.756**	.055	.056	-.265	.121
Cost Management	3.69	1.348	.047	.122	.067	.133	**.849**
Debt Management	1.92	1.148	**-.752**	.135	**-.303**	-.170	.137

Security	0.65	.884	-.065	**.620**	-.046	**.425**	-.075
Salaries	3.29	1.314	.081	**.597**	**.350**	**-.394**	.186
Eigen Value			1.697	1.612	1.371	1.252	1.166
Total Var. Explained			15.431	14.655	12.46	11.386	10.597
Cumm. Var.Explained			15.431	30.086	42.546	53.932	64.529

Source: Calculated from Field Survey Data, July 2013

Notes: Factors 1 to 5 are 'enterprise diversification', 'risk sharing and cooperatives', 'off-farm investment', 'buffer stock index', 'financial management', loadings of ≥ 0.3 are in bold.

Notes: Loadings ≥ 0.30 are in bold showing the positive correlation among variables

The factor loadings obtained after conducting a factor analysis on the risk management variables are presented in table 4.7 above. The results showed that five factors with Eigen values greater than 1 explained 64.529% of the cumulative variance. According to the factor loadings results, the factors in order of importance can be described as; 'Enterprise diversification', 'Risk sharing and cooperatives' 'Off-farm investment', 'Buffer stock index' , 'financial management' .

'Enterprise diversification' had the positive and significant loadings on diversification (0.672), use of irrigation (0.756) and debt management (-0.752) with Eigen value of 1.697 explaining 15.431% of the total variation in the explanatory variables .The motivation for diversifying is based on the idea that returns from various enterprises do not move up and down in lockstep, so that when one activity has low returns, other activities would likely have higher returns (Kisaka, 2011).

The study revealed several forms of diversification. These included diversifying the number of hybrid seed varieties planted in a particular farm. For instance, farmers planted H614 and H6213 in alternate plots of land. This is a strategy *ex ante* believed to be effective in cases of seed borne diseases. In such scenario, one variety acts as a security cover against the other variety in the event of disease outbreak. Intercropping was also a dominant strategy *ex-ante* within the study area. The main crops intercropped in the county were maize and beans. It

was also revealed that intercropping maize with legume increases maize productivity. This is due to the fact that legumes are nitrogen fixer which is a very important component in cereal production thus reducing large doses of manufactured nitrogen. This is consistent with a study carried out by KARI (2005), which indicated greater maize harvest in an intercropped maize field. . Irrigation had the least average of 0.94 indicating the fact that agriculture in the study area is rainfed. Only a few farming household engaged in horticulture farming are involved in small scale irrigation. Farmers in this category did not consider debt management as an important risk factor.

'Risk sharing and Cooperatives' forms the second principal component explaining 14.655% of the variation in the explanatory variables. The results indicated crop insurance (0.553), farmer groups and associations (0.693), security guards (0.620) and engagement in salaried employment (0.597). Crop insurance was evident among the farmers contracted by seed companies such as Kenya Seed Company and Western Seed Company. Lastly, the coefficient for membership to farmers groups and associations had an inverse relationship with risk preference. The results showed that farmer associations reduced the degree of risk aversion. The results revealed existence of several farmer groups/association in the study area such as Kimitu farmers SHG, Decese (Development Education System of Community Empowerment), Ngombe safi SHG, Gaa seiyot women SHG and Kiungani dairy farmers group. This supports the interpretation that membership to farmers association increases flow of information through farmer's interaction and accessibility to change agents. The study indicated that an average of 4.1 of the sampled households had at least a member involved in salaried activities. This has greatly contributed to the out migration of labour especially to urban area.

Thirdly, ‘Off-farm investment’ accounted for 12.460% of the variation in the explanatory variables. ‘Off-farm investment’ index scored Eigen value of 1.371 included returns from off-farm investment (0.388), crop insurance (-0.568), contractual marketing (0.770), debt management (-0.303) and engagement in salaried employment (0.350). The study findings support the interpretation that off-farm investment reduces farm risk because of the imperfect correlation between off-farm income and farm income. These finding supports the results of Korir (2011), indicating that 67 percent of farm households in Uasin Gishu County were engaged in off-farm investment. These result supported by the fact that agriculture in the study area is seasonal and mainly rain-fed thus leaving the farm households with surplus labor during the slack period. Households, therefore, find an incentive to send off some of their members for alternative sources of income. Contact marketing was not perceived to be an important management strategy. Only seed maize farmers within the study area had been contracted by Kenya Seed Company, AgriSeed Co. Ltd and Western Seed Company. Farmers however did not consider insurance and debt management as a strategy.

Buffer stock index explained 11.386% of the explanatory variable with an Eigen value of 1.252. This component had positive loadings of buffer stock (0.871), security guarding (0.425) and engagement in salaried employment (-0.394). Buffer stock accumulation was in form of input reserve and food stock. This acted as a coping strategy in cases of input and food shortages respectively.

Financial management’ is the fifth principal component explaining 10.597% of the variation on the farmer’s scores on the perceived risk management strategies. The study noted that cost management (0.849) had the highest positive factor loadings .Cost management among the

sampled farmers mainly involved cost reduction on the purchased inputs. This had negative consequence of farm productivity and profitability.

In conclusion, the study revealed that households mainly engage in the sale of assets such as livestock, farm machinery and harvest in order to cope with extraordinary situations such as food shortage.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Summary

The objective of this study was to determine the risk attitude of farmers, the socio economic characteristics influencing risk attitude and the dimension of the sources of risk and management strategies.

The data used for the study was mainly collected from primary sources through a survey questionnaire of 167 farming households. Data was collected on socio economic and demographic characteristics of the farming households, risk attitude of the respondents, sources of risk and risk management strategies, among others. Secondary data from government reports and other published materials were also collected and used to augment the primary data. The data was analyzed using various methodologies in accordance with the objectives of the study.

Attitude towards risk of farmers were assessed by use of ELCE-PH, the results showed that on average, 74.25%, 16.77% and 8.98% of the respondents revealed their preference for prospects representing risk-averse, risk neutral and risk seekers respectively. The study noted risk-averse farming households are more apprehensive about taking risk. Such households have diversified their cropping patterns and source of income in order to mitigate against unforeseen circumstances.

An analysis of socio-economic characteristic of the farming household revealed the average age of risk-averse farmer to be 50 years while the risk seeker was 39 years. The study results showed that over 70% of the farm households were married, 10% single, 7% widowed and 11% divorced. The size of the households in the study area averaged at five persons with risk-averse household having an average of seven family members and risk seeker had three members. Over 62% of the farming households in the study area were male headed. Also, the average years spent in education was 9 years an indication of post primary education level an interpretation of low levels of illiteracy within the study area. The mean off-farm income was Ksh 95, 500/= with over 84% of the households involved in off-farm investments and income. This was translated as a risk management strategy due to the uncorrelated nature of off farm income and farm activities. The accessibility of credit and agricultural extension in the study area was very minimal.

The regression analysis of risk attitude on socio economic characteristics of the farm households showed that household age, education level, off-farm income and membership to farmer groups to be significant at 1%. On the other hand, gender was statistically significant

at 5%. However, the coefficient for household size, access to credit and extension service were statistically insignificant at all levels.

From the sampled respondents, an average of 9.46 indicated volatility in both output and input price to be the dominant source of agricultural risks. This was mainly associated with weak input and output agricultural markets that lacked proper regulations. However, majority of the respondents were optimistic with the introduction of county administration since agriculture is the main economic activity of Trans Nzoia County. Other sources of risk prevalent in the study area were; unpredictable weather (4.28), Lack of labour (4.23), Soil deficiency (4.23), Storm/hail (4.22), Road network (4.22), inadequate extension services (4.06), crop and animal diseases (3.74) and pests (3.62). Vandalism and theft of assets and produce; death and divorce of the household head; changes in the agricultural and environmental policy; availability of credit; availability of land for cultivation and interest rate on credit little impact on the farming community.

The main crop diseases in the study area were grey leaf spot, maize streak virus and maize lethal necrosis. It was also observed that pests such as weevil, alpids, thrips, leafhoppers and stem borer have contributed to huge loses of yield. Most of these pests have acted as a vector in transmission of deadly viral diseases such as MLN.

Farmers manage risks through a continuous adaptive process, whereby decisions are made based on perceptions of the external environment, resources and the farmers own attitudes and preferences (IFAD, 2004). The study revealed the most dominant risk management strategy in order of importance to be crop diversification (4.82), off-farm investment (4.78), other sources of income (4.1), cost minimization (3.69), and adoption of high yielding varieties (3.29).Other management strategies with least importance were; debt management

(1.92),buffer stock accumulation (1.88), forming cooperatives (1.11), irrigation (0.94),crop insurance (0.75),security safe guarding (0.65) and contract marketing (0.33). The study showed a very small proportion of the farming household had signed production contracts with Kenya Seed Company and Western Seed Company. This category of farmers had insured their crops i.e. seed maize with UAP/*Kilimo Salama* and had access to agricultural finance mainly from National Bank of Kenya and Kenya Seed Company advance input programme.

Factor analysis examined the dimensions of the perceived risk sources and management strategies. The main observation from the factor analysis for sources of risk indicated that out of the sixteen individual risk source variables, seven factors with Eigen values greater than 1 explained 65.53% of the total variance. Interpreting the loadings, the factors were most accurately be explained as ‘weather risks’, ‘Market/price risks’, ‘biological risks’, ‘labour bottlenecks’, ‘Finance risk’, ‘Land bottlenecks and ‘Human/personal risk’.

The weather variable involved the unpredictable rainfall pattern within the study area. This was perceived to be the most prevalent since weather is beyond the control of man. Elements of weather included excessive rainfall and storm which results in huge losses in soil nutrients through leaching and run off. Instance of dry spell were also noticed in parts of the county especially during sowing and at flowering/tilering stage. Market/price risks was mainly attributable to the volatility in input and out prices. Other risk factors such as biological risks’, ‘labour bottlenecks’, ‘Finance risk’, ‘Land bottlenecks and ‘Human/personal risk’ had lower loadings.

The factor loadings obtained after conducting a factor analysis on the risk management variables indicated five factors with Eigen values greater than 1 and explained 64.529% of

the cumulative variance. According to the factor loadings results, the factors in order of importance were best described as; ‘enterprise diversification’, ‘risk sharing and cooperatives’, ‘off-farm investment’, ‘buffer stock index’, ‘financial management’. Enterprise diversification was the most significant within the study area with diversification taking several forms such as intercropping, planting different varieties of hybrid seeds and diversifying into different forms of agricultural activities. Off-farm investment was dominant due to its uncorrelated nature with farm income. Risk sharing and cooperatives was the least and involved crop insurance and contract marketing.

5.2 Conclusion

Conclusively, risk and uncertainty within the study area is real and causes adversity in yield, prices and production. Majority of the farming households were risk-averse. This has had major effect on decision making, investment on farm and adoption of improved agricultural practices. The study revealed that there exist new improved technologies (crop/animal) at the Kenya Agricultural Research Institute (KARI) Kitale whose adoption by farmers is very low. Weather risks remains the most perceived source of agricultural uncertainty. To manage agricultural risks, farmers have adopted self-insuring mechanism such as enterprise diversification, off-farm and on-farm investment. To a small extent the farm households have embraced market based strategies such as crop insurance and contract marketing in order to cope with production and market risks. However, such arrangements have been succefull with youth full and educated farmers. It was evident that a small proportion of farmers who had been contracted by Kenya Seed Company (KSC) to grow seed maize, had access to credit mainly from National Bank and KSC inputs advance programme. For this category of farmers it was mandatory for them to insure their crops. Other companies contracting farmers in the study area included Western Seed Company.

5.3 Policy Recommendations

This study provides useful insights for policy makers and developers in a variety of situations. To begin with, the study results can yield substantial payouts in terms of the development of quality farm risk management and education programs as well as the design of more effective government policies in so far as agricultural risk management is concerned. New agricultural technologies and rural development programs need to be tailored to the farmers risk attitudes if they are going to be effective. Due to the risk aversion nature of the farmers, policy makers need to develop strategies that enable them better manage and reduce risk while mitigating against the identified sources of risk.

5.4 Recommendation for Further Research

This study investigated the decision behavior of farm household in an uncertain environment, risk sources and risk management approaches. While conducting this study, it was apparent that weather based index crop insurance (UAP/*Kilimo Salama*) had been adopted by contracted seed maize growers as strategy to manage agricultural risk. This study therefore, recommends further research to determine the extent of adoption of weather index crop insurance in Trans Nzoia County. Research in this area could also include small holder farmers' willingness to take up formal insurance and their insurance purchase decision as well as the cost effectiveness of weather based index insurance.

REFERENCES

Anderson, J.R. and Dillon, J.L. (1992). Risk Analysis in Dry Land Farming Systems. *Farm Systems Management. Series No. 2*. Rome, Italy: FAO.

Akcaoz, H., & Ozkan, B. (2005). Determining Risk Sources and Strategies among Farmers of Contrasting Risk Awareness: A Case Study for Cukurova Region of Turkey. *Journal of Arid Environments*, *Vol*. 62, No. 4, PP. 661-675.

Arrow, K.J. 1965. *Aspects of the Theory of Risk Bearing*. Helsinki, Finland: Academic Bookstores.

Aye, G.C. and Oji, K. O. (2007). Effect of Poverty on Risk Attitudes of Farmers in Benue State, Nigeria

Beal, D.J. (1996). Emerging Issues in Risk Management in Farm Firms. *Review of Marketing and Agriculture Economics*, 64: 336–347.

Binswanger, H.P. (1980). Attitudes towards Risk: Experimental Measurement in Rural India. *American Journal of Agricultural Economics,* 62, 395-407.

Binswanger, H.P. (1982). Empirical Estimation and use of Risk Preferences: *American Journal of Agricultural Economics*, 64: 391-393.

Binici, T., Koc, A.A., Zulauf, C.R. & Bayaner, A. 2003. "Risk Attitudes of Farmers in Terms of Risk Aversion: A Case Study of Lower Seyhan Plain Farmers in Adana Province, Turkey".*Turk J of Agric For* 27. pp. 305-312.

Boehlje, M.D. and Lins, D.A. (1998). Risks and risk management in an industrialised agriculture. *Agricultural Finance Review*, 58: 1–16.

Capitanio, F. (2008). "Risk Management through Insurance and Environmental Externalities from Agricultural Input Use": An Italian Case Study, Paper Prepared for the 109th EAAE Seminar. Virtebo, Italy, November 20-21st.

Capps, O., and Kramer, R. 1986. Analysis of Food Stamp Participation Using Qualitative

Choice Model. *Amer. J. Agric. Econ* ., **68**: 519 - 527.

Cox, J. C. and Sadiraj, V. (2006), Small and Large Stakes Risk Aversion: Implications of Concavity Calibration for Decision Theory. *Games and Economic Behavior,* 56: 45-60.

Drollete, S.A. (2009). Understanding Agricultural Risk. AG/Econ/2009-01 RM, January, 2009. Utah State University Extension. pp. 1-3.

Ellis, F. (1998). "Household Strategies and Rural Livelihood Diversification". *Journal of Development Studies*, 35(1), 1-38.

Eisenhauer. J.G. (2006). Risk Aversion and Prudence in the Large. *Research in Economics*, 60: 179–187.

"Fact Sheet" Syngenta Foundation for Sustainable Agriculture. Kilimo Salama Agricultural Initiative in Kenya retrieved on November 20, 2011.

Fafchamps, M. (1993). "Sequential Labor Decisions under Uncertainty: An Estimable Household Model of West African Farmers." Econometrica 61(September): 1173-1197.

Food, Agriculture and Fisheries Working Papers, No. 40, OECD Publishing. (2011).

Gill, T (2007), No fear: Growing up in a Risk Averse society http://www.gulbenkian.org.uk/media/item/1266/223/No-fear-.12.07.pdf#page=28.

Gujarati, (2004), Basic Econometrics, Fourth Edition, McGraw−Hill.

Government of Kenya (2010), Commission for revenue Allocation http://www.crakenya.org/wp-content/uploads/2013/02/CRA-strategic -plan

Government of Kenya (2010), Kenya National Bureau of Standards http://www.knbs.or.ke/index.pnp.option=com_content&view=article&id=152:p.population&catid=112&itemid=638

Gómez-Limón, J.A., Arriaza, M and Riesgo, L. (2003). An MCDM analysis of agricultural risk aversion. *European Journal of Operational Research*, 151: 569-585.

Habing, B. (2003). Exploratory Factor Analysis. University of South Carolina.

Hardaker, J.B., Huirne, R.B.M. and Anderson, J.R. (1997) Coping with Risk in Agriculture. CAB International, Wallingford, UK.

Hardaker, J.B., Huirne, R.B.M., Anderson, J.R. and Lien, G. (2004). Coping with Risk in Agriculture. 2nd edition. Oxfordshire, UK.

Harwood, J.R. Heifner, K. Coble, T. Perry, and A. Somwaru (1999). Managing Risk in Farming: Concepts, Research and Analysis. Economic Research Service USDA.

Hennessy, D. A., B. A. Babcock, and D. J.Hayes. (1997). "Budgetary and Producer Welfare Effects of Revenue Insurance." *American Journal of Agricultural Economics. Econ.*

Huirne, R.B.M., M. Meuwissen, J.B. Hardacker and J.R. Anderson; "Risk and Risk Management in Agriculture: An Overview and Empirical Results", *International Journal of Risk Assessment and Management*, (2000).

Intergovernmental Panel on Climate Change (2007) "Climate Change Impacts, Adaptation and Vulnerability".

IFAD. (2004). Community Based Agriculture and Rural Development Programme, Appraisal Report. Vol. 1: Main Report, Vol 1, Main Report pp. 1-21. The Federal Republic of Nigeria.

Jirgi, A.J. (2013). Technical Efficiency and Risk Preferences of Cropping systems in Kebbi state, Nigeria. Unpublished Phd. Thesis, Agricultural Economics .Department of Agricultural Economics. University of the Free State Bloemfontein, South Africa.

Kimura, S., J. Antón and C. LeThi, (2010). "Farm Level Analysis of Risk and Risk Management Strategies and Policies: Cross Country Analysis", *OECD Food, Agriculture and Fisheries Working Papers*, No. 26.

Kisaka M.L (2012). Risk Preferences and Consumption Decisions in Organic Production: The Case of Kwazulu Natal and Eastern Cape Provinces of South Africa. Unpublished PhD. Thesis Department of Agricultural Economics and Extension Faculty of Science and Agriculture University of Fort Hare, Alice South Africa

Kisaka M. L, Darroch M.A.G and Ferrer S.R.D., (2005). "Analysis of Risk Attitudes of Smallholder Crop Farmers in Umbumbulu District Kwanzulu- Natal, South Africa." *African Crop Science Conference Proceedings vol*.7.

Korir .L. K, (2011). "Risk Management among Agricultural Households and the Role of Off-farm Investment in Uasin Gishu County, Kenya." Unpublished Msc. Thesis, Egerton University

Koutsoyiannis, A. (1987). Theory of Econometrics: An Introductory Exposition of Economic Methods. 2nd edition. Palgrave Macmillan.

Kwesi S.N.D and De-Graft H.A (2012).Attitudes Towards Risk and Coping Responses: The Case of Food Crop Farmers at Agona Duakwa in Agona East District of Ghana. *International Journal of Agriculture and Forestry 2012, 2(2): 29-37*.

Lim, Y., and Townsend. (1998). "General Equilibrium Models of Financial Systems: Theory and Measurement in Village Economies." *Review of Economic Dynamics 1: 59-118.*

LeBel, P. (2003). "Risk in Globalization": A Comparative Analysis of African and Asian Countries". *7th International Conference on Global Business and Economic Development*. Bangkok, Thailand.

Levy, H. (2006). *Stochastic Dominance: Investment Decision Making under Uncertainty*, Springer.

Manoj, K., Sreekumar, B. and Ajith, K. (2003) "A Case Study of Banana Farmers in Wayanand District." *Agricultural Economics Research Review,* 54: 1-56, (2003).

Mendelsohn, Robert & Nordhaus, William D and Shaw, Daigee. (1994). "The Impact of Global Warming on Agriculture: A Ricardian Analysis," *American Economic Review*, vol. 84(4), pages 753-71.

Meuwissen, M., Huirne, R., & Hardaker, J. B. (2001). "Risk and Risk Management: An Empirical Analysis of Dutch Livestock Farmers". Livestock Production Science, No. 69, pp. 43-53.

Menezes, C.F. and Hanson, D.L. (1970). On the Theory of Risk Aversion. *International Economic Review,* 11: 181-187.

Murdoch, J. (1995). "Income Smoothing and Consumption Smoothing." *Journal of Economic Perspectives* 3: 103-114.

Moscardi, E. and de Janvry, E. (1977). Attitudes toward Risk among Peasants: An Econometric Approach. *American Journal of Agricultural Economics, 59, 710-16*

Mohammed MA (2004). Perceptions and Management of Risk by Commercial Farmers in Eritrea. Unpublished MSc Agric dissertation, School of Agricultural Sciences and Agribusiness, University of KwaZulu-Natal, Pietermaritzburg, South Africa

Moschini, G. and D.A. Hennessy (2001), Uncertainty, Risk Aversion, and Risk Management for Agricultural Producers", Chapter 2 in Gardner and Rausser.

Musser, W.N. and G.F. Patrick (2002), "How Much Does Risk Really Matter to Farmers?.

Miyata, S. (2003). Households risk attitudes in Indonesian villages. *Applied Economics,* 35: 573-583.

Nyikal .R.A and Kosura .W.O. (2005). “Risk Preference and Optimal Enterprise Combinations in Kahuro Division Muranga District”, Kenya. *Agricultural Economics*, 32(2), 131-140.

Olarinder O. L, Manyong.V and Akintola.O.J (2010). “Factors Influencing Risk Aversion among Maize Farmers in the Northern Guinea Savanna of Nigeria; Implication for Sustainable Crop Development Programmes. *Journal of Food, Agriculture and Environment Vol (8); 128-134.*

Olarinde, L.O., Manyong, V.M. & Okoruwa, V.O. (2007). "Analyzing Optimum and Alternative Farm Plans for Risk Averse Grain Crop Farmers in Kaduna State, Northern Nigeria". *World Journal of Agricultural Sciences* 4(1). pp. 28-35.

Otieno D. J, Willis, Kosura O.W,Thuo J. K, Drucker A, Rege.E,(2006). “Risk Management in Smallholder Cattle Farming”. A Hypothetical Insurance Approach in Western Kenya.

OECD (2008e), “Economic Aspects of Adaptation to Climate Change”, OECD, Paris.

OECD (2009), “An Overview of Policy Measures for Risk Management” .

Patrick, G. R., Wilson, P. N., Barry, P. J., Boggess, W. G., & Young, D. L. (1985). Risk Perceptions and Management Responses: Producer Generated Hypotheses for Risk Modeling. *Southern Journal of Agricultural Economics, 17*(2), 231-238.

Pratt, J.W (1964), ‘ Risk aversion in the small and large ; *Econometrica 32. (1-2* 122-36*)*

Quiggin, J. (1993), *Generalised expected utility theory: The rank dependent model*. Kluwer Academic Publisher,Boston.

Reilly, J.M., and Schimmelpfennig, D. (1999). “Agricultural Impact Assessment, Vulnerability, and the Scope for Adaptation,” *Climatic Change* 43: pp. 745-88.

Roy, A. (1952). Safety First and the Holding of Assets. *Econometrica*, 20: 431–49.

Rostami, F., Shabanali Fami, H., Movahhed Mohammadi, H., & Irvani, H.(2005)“Risk Management of Wheat Production in Domestic Beneficiary System” The Case of Harsin region in Kermanshah province. *Journal of Iranian agricultural science*, Vol. 37-2, No. 1, pp. 93-106.

Ross, S.A. (1981). Some Stronger Measures of Risk Aversion in the Small and in the Large with Applications, Econometrica, 49:621-39.

Salimonu K.K., and Falusi, A.O. (2009). Sources of Risk and Management Strategies among Food Crop farmers in Osun State, Nigeria. *AJFAND ONLINE*, 9(7), 1591-1605.

Skees, J. R. (2003). “Risk Management Challenges in Rural Financial Markets: Blending Risk Management Innovations with Rural Finance.” The Thematic Papers Presented at the USAID.

Sookhtanlo M. and Sarani V. (2011). “Analysis of Factors Affecting on Risk Management of Wheat Production among Wheat Farmers.

Shahabuddin, Q., Mestelman, S. and Feeny, D. (1986). "Peasant Behavior towards Risk and Socio-economic and Structural Characteristics of Farm Households in Bangledesh"

Stockholm Environment Institute (SEI), “Economics of Climate Change, Kenya”, Project report (2009)

Shapiro, B.I., Sanders, J.H., Reddy, K.C.and Baker, T.G. (1993). Evaluating and adapting new technologies in a high-risk agricultural system in Niger. *Agricultural Systems*, 42: 153-171.

Torkamani, J. and Rahimi, M. (2001). "Evaluation of Farmer’ Risk Attitudes using Alternative Utility Functional Forms". *J. Agric. Sci. Technol.* 3. pp. 243-248.

Townsend, R.M .1994. Risk and Insurance in Village India”. *Econometrica*, 62(3): 539-591.

Tyraei Y. N. (2002). Personality Factors Influencing Risk Insurance Plans Accepted Postulates in Agricultural Products by Beneficiaries of Khuzestan Province (Iran). Unpublished Msc. Thesis in Agricultural Extension and Education Field. Department of Agricultural Extension and Education, Tarbiat Modarres University

Von Neumann, J. and Morgenstern, O. (1944), Theory of Games and Economic Behaviour. Princeton, NJ, Princeton University Press

World Bank (2005), *Managing Agricultural Production Risk*. World Bank: Washington, D.C.

World Bank (2001), World Development Report. Attacking Poverty. Oxford University Press, New York.

Wright, R.E. (1995). Logistic regression. In Grimm, L.G. and Yarnold, P.R (eds.): *Reading and understanding multivariate statistics***.** Washington, DC: American Psychological Association

APPENDICES

APPENDIX 1: Questionnaire

Moi University, School of Business and Economics

INSTRUCTIONS

This study will be conducted under the supervision of Moi University. The study seeks to carry out an analysis of Risk attitude, risk source and risk management among farming household in Trans Nzoia County.

Please note that the information you provide will be treated with utmost confidentiality. You are, therefore, not required to disclose your name in the questionnaire.

All necessary precautions to ensure the information you give is used only for the intended purpose have been taken .Your participation in this survey is anonymous.

Please read and answer all the questions. Circle the answer.

QUESTIONS		**Please tick/write responses where applicable**	
A	**Background Information**		
1	Gender of the Household Head)	Male Female	**01** **02**
2	Age of the HH (YEARS)		
3	How many years did you spend in education		

4	What is your marital status	Married Single Divorced Widowed(Souse died)	**01** **02** **03** **04**
5	How many children do you have		
B	**Farm Resource Information**		
6	The total size of your farm in acres	0-5acres 5-10 acres 10-15 acres 15 Acres and above	**01** **02** **03** **04**
7	What proportion of the total land area farmed is owned (acres or percentage)...	……	
8	Nature of land tenure system	Own Rented	**01** **02**
9	Do you receive any extension service	Yes. How frequent?..... No**(If no skip to Qn. 10)**	**01** **02**
10	Do you receive any credit facilities	Yes. Source …….. No **(please answer question Qn.11)**	**01** **02**
11	Why?	Not available Interest Rate high Don't Know Other Reasons (Specify)…….	**01** **02** **03** **04**
12	Did the household acquire any inputs on credit	Yes No	**01** **02**
13	Are the farm operations mechanized	Yes No	**01** **02**
14	What are your farming objectives	Income Food Others (Specify)…….	**01** **02** **03**
15	Are you a member to farmers group?	Yes No If Yes (Specify name of the group) ……..	**01** **02**

16. Income status of family members. (Please indicate by filling the table below)

Gender	**Number of family members involved**	**Total income received in KSH**
On-farm income		
Off-farm income		
Total		

17. Farming pattern (Kindly indicate by ticking on the alternatives indicated below).

Activity	Please	Activity	Please	Activity	Please
Maize		Wheat		Sunflower	
Horticulture		Forestry		Diary	
Beef		Sorghum		Fish	
Beans		Poultry			

18. Determination of farmers risk attitude class.

Hypothetical Question	**Farmers response**		**Tick Appropriate**
The farmer is presented with practical lottery as to whether He/ She will accept an offer of Ksh 10,000/= per acre of maize field to forego production	[1] Yes	Risk Averse	
	[2] No	Risk Loving	
	[3] Not ready to accept or reject	Risk Neutral	

19. Could you please indicate to what extent the following risk factors affect your farm income. ? Kindly indicate by circling the appropriate responses.

Variable	**Strongly Agree**	**Disagree**	**Indifferent**	**Agree**	**Strongly Agree**
Labour	1	2	3	4	5
Unpred.Weather	1	2	3	4	5
Soil deficiency	1	2	3	4	5
Storm and hail	1	2	3	4	5
Output Price	1	2	3	4	5
Input Price	1	2	3	4	5
Nature of roads	1	2	3	4	5
Extension	1	2	3	4	5
Credit	1	2	3	4	5
Interest on Credit	1	2	3	4	5
Agric policy	1	2	3	4	5
Land	1	2	3	4	5
Death/ HH	1	2	3	4	5
Vandalism /theft	1	2	3	4	5
Pests	1	2	3	4	5
Diseases	1	2	3	4	5

20. Could you please indicate to which extent you apply risk management strategies? Kindly indicate by circling the appropriate responses

Variable	**Strongly Agree**	**Disagree**	**Indifferent**	**Agree**	**Strongly Agree**
Off-farm investment	1	2	3	4	5
Crop insurance	1	2	3	4	5

Market Contracts	1	2	3	4	5
Crop Diversification	1	2	3	4	5
Farmer Groups	1	2	3	4	5
Buffer Stock	1	2	3	4	5
Irrigation	1	2	3	4	5
Cost Management	1	2	3	4	5
Debt Management	1	2	3	4	5
Security	1	2	3	4	5
Salaries	1	2	3	4	5

Thanks you for your time and cooperation. God bless you.

END

Appendix 2a. Correlation Matrix for Risk Source.

VARIABLES	Labour	Ex. rainfall	Soil deficiency	Storm and hail	Output price	Input price	Nature of roads	Extension	Credit	Interst Rates	Agric Policy	Land	Death of HH	Theft ft	Pests	Diseases
Labour	**1.000**	.175	.178	.239	-.200	-.319	-.233	-.108	-.050	-.050	.074	-.079	-.122	-.103	.021	.094
Ex.rainfall	.175	**1.000**	.533	.298	-.307	-.306	-.179	-.110	-.038	.038	.021	-.013	-.063	.008	.000	.104
Soil Defi.	.178	.533	**1.000**	.484	-.215	-.340	-.037	-.077	-.011	-.050	-.037	-.079	-.330	-.147	-.079	.033
Storm /hail	.239	.298	.484	**1.000**	-.048	-.233	.000	-.002	.027	-.043	.094	-.108	-.013	-.068	-.096	-.066
Output Price	-.200	-.307	-.215	-.048	**1.000**	.472	.339	.192	.097	.077	-.047	.031	.065	.064	.092	.005
Input Price	-.319	-.306	-.340	-.233	.472	**1.000**	.223	.245	.059	.065	-.125	.103	.117	.184	.085	-.048
Road	-.233	-.179	-.037	.000	.339	.223	**1.000**	.480	.058	.087	.020	.079	-.029	.121	.019	-.054
Extension	-.108	-.110	-.077	-.002	.192	.245	.480	**1.000**	-.161	-.010	.038	.048	.067	.093	-.148	-.067
Credit	-.050	-.038	-.011	.027	.097	.059	.058	-.161	**1.000**	-.036	-.085	-.057	-.035	-.077	.087	.037
Interest rates	-.050	.038	-.050	-.043	.077	.065	.087	-.010	-.036	**1.000**	-.048	-.032	-.059	-.077	-.079	-.061
Agrc. policy	.074	.021	-.037	.094	-.047	-.125	.020	.038	-.085	-.048	**1.000**	-.076	-.042	.029	-.044	.099
Land	-.079	-.013	-.079	-.108	.031	.103	.079	.048	-.057	-.032	-.076	**1.000**	.142	-.122	-.024	.028
Death HH	-.122	-.063	-.330	-.013	.065	.117	-.029	.067	-.035	-.059	-.042	.142	**1.000**	.012	-.097	-.135
Vandalism	-.103	.008	-.147	-.068	.064	.184	.121	.093	-.077	-.077	.029	-.122	.012	**1.000**	-.006	.024
Pests	.021	.000	-.079	-.096	.092	.085	.019	-.148	.087	-.079	-.044	-.024	-.097	-.006	**1.000**	.435
Diseases	.094	.104	.033	-.066	.005	-.048	-.054	-.067	.037	-.061	.099	.028	-.135	.024	.435	**1.000**

Source: Field Survey Data, July 2013.

Appendix 2b: Correlation Matrix for Risk Management Strategies

VARIABLE	Off-farm invest	Crop insurance	Mkt Contracts	Crop Diversification	Farmer Grps	Buffer Stock	Use of irrigation	Cost Mgnt	Debt Mgnt	Security	Salaries
Off-farm	**1.000**	-.052	.113	.025	-.075	-.077	.122	-.094	-.191	-.116	-.037
Crop insurance	-.052	**1.000**	-.213	-.030	.250	.122	-.065	-.035	.237	.240	.018
Mkt Contracts	.113	-.213	**1.000**	-.047	-.064	-.174	.045	-.019	-.145	-.038	.210
Crop Diver.	.025	-.030	-.047	**1.000**	-.205	-.113	.252	-.088	-.349	-.150	-.099
Farmer Grps	-.075	.250	-.064	-.205	**1.000**	.090	-.168	.203	.197	.254	.276
Buffer Stock	-.077	.122	-.174	-.113	.090	**1.000**	-.256	.117	.030	.243	-.171
Use of irrigation	.122	-.065	.045	.252	-.168	-.256	**1.000**	.079	-.386	-.101	.136
Cost Mgnt	-.094	-.035	-.019	-.088	.203	.117	.079	**1.000**	.120	.032	.102
Debt Mgnt	-.191	.237	-.145	-.349	.197	.030	-.386	.120	**1.000**	.125	-.012
Security	-.116	.240	-.038	-.150	.254	.243	-.101	.032	.125	**1.000**	.104
Salaries	-.037	.018	.210	-.099	.276	-.171	.136	.102	-.012	.104	**1.000**

Source: Field Survey Data, July 2013.

Appendix 3a: Total Variance Explained for Risk Management Strategy

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.260	20.543	20.543	2.260	20.543	20.543	1.697	15.431	15.431
2	1.491	13.551	34.095	1.491	13.551	34.095	1.612	14.655	30.086
3	1.232	11.204	45.299	1.232	11.204	45.299	1.371	12.460	42.546
4	1.075	9.770	55.070	1.075	9.770	55.070	1.252	11.386	53.932
5	1.041	9.460	64.529	1.041	9.460	64.529	1.166	10.597	64.529
6	.931	8.463	72.993						
7	.732	6.659	79.652						
8	.688	6.252	85.904						
9	.607	5.516	91.420						
10	.544	4.949	96.369						
11	.399	3.631	100.000						

Source: Field Survey Data, July 2013. Extraction Method: Principal Component Analysis.

Appendix 3b. Total Variance Explained for Risk Source

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.827	17.669	17.669	2.827	17.669	17.669	2.172	13.577	13.577
2	1.650	10.316	27.984	1.650	10.316	27.984	1.997	12.483	26.060
3	1.499	9.371	37.355	1.499	9.371	37.355	1.539	9.621	35.681
4	1.251	7.819	45.174	1.251	7.819	45.174	1.289	8.058	43.739
5	1.145	7.156	52.330	1.145	7.156	52.330	1.192	7.451	51.190
6	1.074	6.714	59.044	1.074	6.714	59.044	1.155	7.216	58.407
7	1.038	6.490	65.534	1.038	6.490	65.534	1.140	7.127	65.534
8	.914	5.713	71.247						
9	.871	5.443	76.690						
10	.753	4.703	81.393						
11	.735	4.596	85.990						
12	.603	3.768	89.758						
13	.529	3.305	93.063						
14	.481	3.007	96.070						
15	.354	2.213	98.283						
16	.275	1.717	100.000						

Source: Field Survey Data, July 2013. Extraction Method: Principal Component Analysis.