AN ANALYSIS OF RISK ATTITUDES AND RISK MANAGEMENT STRATEGIES AMONG DAIRY FARMERS IN MURANG'A COUNTY, KENYA

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DECLARATION AND APPROVAL

Declaration:

This thesis is my original work and has not been presented for the award of a degree in any academic institution.

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DEDICATION

I dedicate this thesis to my parents Mr. and Mrs. Leonard Waweru. Their constant support and encouragement have truly made this journey a success.

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ABSTRACT

Kenya's dairy sector has been reported as a success story, with over 70 percent of the gross marketed output produced in smallholdings. Despite the celebrated success which has seen a number of processing plants established, and the export market opportunities coming up, the sector is not without problems. At the primary level, one of the biggest challenges among many is variations in milk supply attributable to over-reliance on foliage produced under uncertain rainfall conditions, exacerbated by climate change. These challenges and uncertainties bring about the element of risk in Kenya's dairy farming. Farmers' mitigation strategies, however, are not clear. This study therefore set out to determine the risk attitude of farmers, the risk management strategies that they use and the socio-economic factors affecting their choice of Risk Management Strategies (RMS). This is in a bid to understand how best to reduce the effects of the risks and in turn reduce the adverse agricultural output and income instabilities.

The study was carried out in Murang'a County where 212 households were interviewed. The Certainty Equivalent approach was used to determine the farmers' risk attitudes while descriptive analysis and factor analysis were used to assess the major RMS. Factor analysis was also used to assess farmers' perception of the most important RMS and Probit regressions were applied to evaluate socioeconomic factors that determine choice of RMS.

Results indicate that 73 percent of the farmers were risk averse, 22 percent were risk loving while 5 percent were risk neutral. The major RMS used by dairy farmers were found to be income diversification, training and financial interventions. The 5 strategies the dairy farmers perceived as most important are financial strategies, training strategies, income diversification strategies, labour strategies and insurance strategies. The results further indicated that choice of income diversification RMS was determined by gender of the household head, distance to the

tarmac road, perception on financial strategies and perception on the importance of income diversification strategies. The choice of training RMS was found to be determined by membership to a farmer group, access to extension services, credit access, agro-ecological zone, household size, wealth index, distance to the tarmac road and perception on the importance of training strategies. The choice of using financial RMS was found to be significantly influenced by membership to a dairy cooperative, gender of the household head, credit access, risk attitude, total land size, perception on the importance of financial strategies and perception on the importance of labour strategies.

The study recommends that extension officers together with financial service providers should develop women training programs aimed at disseminating information on good financial risk management strategies within the dairy industry. This will increase farmers' knowledge on risk management which will consequently increase farmers' uptake of the RMS. In addition, extension officers in collaboration with dairy cooperatives could help in establishing farmer groups through which the extension officers can use to disseminate agricultural information that is related to risk management. This will enable farmers have better access to information and will help influence the uptake of training RMS and financial RMS. Finally, the results indicate that majority of the farmers are risk averse therefore they would be potential clients for insurance packages whose uptake would help in stabilizing incomes. These recommendations would help the dairy farmers in managing risk which in the long run would lead to higher and more stable incomes as well as improved agricultural output that would serve to improve the food security status in the County.

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LIST OF ACRONYMS

ASDS	Agricultural Sector Development Strategy
AUROCC	Area under the Receiver Operating Characteristic Curve
CAADP	Comprehensive Africa Agriculture Development Programme
CE	Certainty Equivalent
CIC	Co-operative Insurance Company
EADD	East Africa Dairy Development
EFA	Exploratory Factor Analysis
ELCE	Equally Likely Certainty Equivalent
EMV	Expected Monetary Value
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GoK	Government of Kenya
KCC	Kenya Cooperative Creameries
KDB	Kenya Dairy Board
KMO	Kaiser-Meyer-Olkin
MSA	Measure of Sampling Adequacy
PCA	Principal Component Analysis
RMS	Risk Management Strategies
SEU	Subjective Expected Utility
SSA	Sub-Saharan Africa
UAP	Union des Assurances De Paris
USAID	United States Agency for International Development
VIF	Variance Inflation Factor

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Risk is defined as the possibility of loss and according to Hardaker et al., (2004) taking a risk is exposing oneself to a considerable chance of loss. Hardaker et al., (2004) also defined uncertainty as a situation when all the probable outcomes and their probabilities of occurrence are unknown. The authors differentiated the two concepts by stating that in risky scenarios, the possible outcomes are known but their probabilities of occurrence are unknown, while in uncertain scenarios both the possible outcomes and their probabilities are unknown. In both cases there is lack of knowledge about the future yet decisions have to be made therefore the two words are sometimes used interchangeably. Farmers and especially livestock producers have to encounter risky and uncertain phenomena, mainly due to their dependence on the natural environment, which is neither quite stable nor exactly predictable.

Livestock is a key sector in African agricultural production because it plays a significant role in providing food security and nutrition. This is through providing milk, meat, manure and draught power. Around 10 percent of Sub Saharan Africa (SSA) population is largely dependent on livestock products of which milk constitutes around 27 percent of the value of edible livestock products. Various strategies have therefore been put in place to help develop the dairy sector in Africa. Such strategies include the Comprehensive Africa Agriculture Development Programme (CAADP) framework that identified livestock development as one of the sectors that could be used to meet the third pillar of improving responses to emergency crises, reducing hunger and increasing food supply (AU-IBAR, 2010).

Livestock keeping plays a key socio-cultural and economic role among many rural communities in Kenya (GoK, 2010a). In 2014, livestock contributed 4.9 percent to Kenya's Gross Domestic Product (GDP) and 18 percent to the agricultural GDP (GoK, 2015). The key livestock subsectors are dairy and beef cattle, camels, pigs, goats, sheep and poultry of which dairy production is the second largest livestock enterprise after meat production. Dairy farming is also a valuable Kenyan enterprise and was valued at KES 18.8 billion in 2014 with production increasing to 541.3 million litres in 2014 up from 515.7 million litres in 2012 (GoK, 2015). Muriuki (2011) indicated that smallholder dairy farmers[1] are more than one million and contribute more than 70 percent of milk sold on formal market channels further illustrating the importance of the dairy sector to the Kenyan economy. In 2014, the dairy sub-sector registered 36 new societies and also had an increase in formal employment in manufacturing of dairy products thus signifying increased investment opportunities in the sub-sector (GoK, 2015).

Smallholder dairy production in Kenya is a multi-purpose cattle system, serving as a capital asset and producing both manure and milk. Commercial dairy farming started in the early 20th century but indigenous Kenyans were only allowed to participate in commercial dairy after the Swynnerton Plan of 1954 (Conelly, 1998). Soon after independence in 1963, there was a transfer of dairy cattle to smallholder farmers from the settler farms which resulted to a decrease of the cattle population on large-scale farms and since then the dairy industry in Kenya is smallholder dominated.

[1] A farmer is an individual who owns or manages a farm. The study looks at farmers as decision makers who have to make present farming decisions that will affect their future outcomes where the future is characterized by risk and uncertainty.

According to Omiti (2001) the government implemented reforms in the dairy sub-sector to encourage dairy production by smallholder farmers which included decontrol of animal feed prices and later decontrol of milk prices in 1992. However the first comprehensive dairy policy was published in 1993 after the 1992 decontrol of milk prices which emphasized the elimination of government interventions (MoALD, 1993).

Since 2003, the government focused on improving the dairy sector and according to GoK, (2010a and 2015), Kenya is now self-sufficient in milk production. Despite this, the world demand for milk is increasing. It is projected that between 2014 and 2024 the world consumption of dairy products will keep increasing at a rate of 1.9 percent per annum. In addition, the total consumption of fresh dairy products in developing countries is projected to rise by 3 percent per annum over the projected period, exceeding the growth of milk production by 2.7 percent per annum (OECD/FAO, 2015). The projected increase in demand for dairy products presents opportunities in dairy development, which would double up as poverty reduction strategies for the farmers. According to FAO (2013) dairy farming creates more income and jobs per unit of land than crops do and approximates one off-farm job for every 30 litres of milk collected, processed and marketed. Consequently the government emphasizes on the implementation of Vision 2030 which identifies the need to transform key institutions in livestock, to increase livestock productivity as well as value addition to livestock products in order to promote agricultural growth (GoK, 2007a).

The Ministry of Agriculture, Livestock and Fisheries works together with the Kenya Dairy Board (KDB) to ensure continuous growth in the dairy sector. The KDB is a state corporation established through an Act of Parliament, Cap 336 of the Laws of Kenya and is mandated to develop, regulate and promote the dairy sector. Other stakeholders that have also contributed to

the prosperity of the dairy sector in Kenya include United States Agency for International Development (USAID) and the East Africa Dairy Development (EADD) project.

Despite the Kenyan dairy sector being an African success in terms of dairy self-sufficiency, it still faces a lot of challenges. Muriuki (2011) identified fluctuations in milk supply as one of the main challenges facing the sector. This is due to reliance on fluctuating forage availability which heavily depends on rainfall that is uncertain due to climate change.

The agricultural sector as a whole is faced with many risks and uncertainties mainly caused by changing political, economic/social and natural environments. Agriculture in developing countries is characterized by over reliance on rainfall which causes output variation. The livestock sector is also characterized by pest and diseases that cause loss of animals and decrease in productivity thus causing variation in output. These characteristics trigger food shortages thus food insecurity problems as well as deteriorating farmer welfare due to high volatility in incomes. Due to the high uncertainties caused by changing weather patterns some insurance companies have attempted to introduce agricultural insurance in Kenya to curb output risk but it has not been well adopted. For instance in Murang'a, the Co-operative Insurance company (CIC) developed a weather index insurance product for banana farmers which was sold in 2010, but the uptake was very low with only 4 farmers buying the insurance product (Kerer, 2013).

In 2012 an insurance product that covers dairy farming in Kenya was introduced by Union des Assurances De Paris (UAP) Insurance in the Eldoret region. They insure dairy cattle from production risk caused by pests and diseases, and they also require their farmers to purchase an animal care package. This therefore is an indicator that the dairy industry in Kenya is faced by various risks among them being the production risk.

Central Kenya and Rift valley are the main producers of milk within the country. The main milk producers within the Rift valley regions are Uasin Gishu, Nandi and Kericho counties (GoK, 2015). Within highlands of central Kenya, dairy is an important enterprise in Kiambu, Murang'a, Nyeri and Meru regions (Muriuki, 2011). In 2014, Uasin Gishu, Kiambu, Murang'a, Nyeri, Nyandarua and Nakuru counties were among the leaders in milk production (GoK, 2015). The introduction of insurance to dairy farmers in Eldoret which is in the Rift valley region is an indicator that already the farmers within Rift Valley region are handling dairy farming risks.

Within the central Kenya highlands, Muranga County is unique, especially with respect to dairy development prospects. The County has already identified dairy development as one of their main development projects according to Ministry of Devolution and Planning (2013). Unlike Kiambu County, dairy farmers in Muranga County face higher income risks. Dairy income volatility is lower in Kiambu, given that the county is a peri-urban region closer to Nairobi city which has a high demand for milk. The other regions within the central highlands have not yet exhibited any prospects for institutional support for the dairy sector. Murang'a County, however, has placed dairy development agenda in its growth strategies which is essential for the success of the sector. In addition, according to GoK (2015), Murang'a County had approximately 239,196 dairy cows in 2014 with 84 percent of the households in Murang'a County owning dairy cattle therefore smallholder dairy farming is an important livelihood option for many households within the County (GoK, 2010b; GoK 2010c; GoK, 2015). Milk production is also the most valuable livestock enterprise within the county with production estimated at KES 2.42 billion in 2012 while the second most valuable livestock enterprise was estimated at 750 million shillings (Ministry of Devolution and Planning, 2013). According to GoK (2015), Murang'a County produced 5 percent of the total national milk produced in 2014.

1.2 Statement of the Problem

The Kenya dairy sector is a success story in SSA with Central highlands and Rift valley being the major milk producers in Kenya. Kenya is self-sufficient in milk production and production was estimated at 541.3 million litres in 2014 and valued at 18.8 billion shillings (GoK, 2015). Kenya's dairy cattle population is approximated to be 3.5 million with Central highlands owning 24 percent of these (Muriuki, 2011). Despite the national dairy success the sector experiences variation in output due to climatic changes that affect the feed availability, pests and diseases as well as loss of animals. As a result this causes a variation in their incomes. The sector is also faced with public health risks of main concern being diseases such as brucellosis and tuberculosis (Muriuki, 2003).

Murang'a County, having prospects for growth and development of the dairy sector, is not without challenges. Low returns from coffee, milk and tea as well as high prices of farm inputs, contribute to the high levels of poverty (36 percent) within the County. According to the Ministry of Devolution and Planning (2013) the major problems affecting livestock development within the county are low livestock productivity and poor marketing systems for livestock products. The county government acknowledges that these problems are caused by pests and diseases infestation, climatic change which affects feed availability, high cost of livestock feeds, high cost of Artificial Insemination services and underdeveloped cooperative societies that deal with livestock products. The county has been regularly affected by livestock and crop disease outbreaks. Foot and mouth disease and anthrax diseases have affected livestock within the county causing many livestock and human deaths. The county has recognized the growth potential of the dairy sector and among its development projects is purchase of milk cooling plants and package equipment in order to develop the livestock sector through value addition

(Ministry of Devolution and Planning, 2013). In 2015, milk cooling plants were established in every ward within Murang'a County.

Agricultural insurance which reduces the risk effect has recently been introduced in the country. Livestock insurance in Kenya has been introduced in the arid areas for pastoralists and UAP insurance introduced one that covers dairy farmers within Eldoret, a high potential area. Within Murang'a County CIC introduced crop insurance for bananas in 2010 but only four farmers bought the product. Livestock insurance that covers dairy farmers however has not yet been introduced in the county. The farmers may be using traditional risk handling methods, which are themselves not documented adequately to give insight into interventions during this path of county-government led growth of the sector. According to the Ministry of Devolution and Planning (2013) farmers still get low returns from the dairy sector.

Various studies have focused on health and safety in the dairy sector in Murang'a County (Gitau et al., 1997; Gitau et al., 1999; Gitau et al., 2000; Muriuki, 2003; Gicheru et al., 2015) and other studies focused on economic analysis of dairy farming within the county (Mwangi, 1997; Schaik, 1996) but little is known about any innovative risk management strategies in an industry that seems to have a good growth potential. The studies do not put particular emphasis on risk management and its linkage to farmer risk attitudes and there is also a notable gap in knowledge that links choice of risk management strategies and socioeconomic characteristics of dairy farmers. It is therefore necessary to analyze risk attitudes and risk management strategies in order to help improve farmer incomes and in the long run farmer welfare.

1.3 Objectives of the Study

The purpose of the study is to assess the risk attitudes and risk management strategies among smallholder dairy farmers in Murang'a County.

Specific Objectives:

i) To examine the risk attitudes of smallholder dairy farmers in Murang'a County

ii) To assess the major risk management strategies used by smallholder dairy farmers in Murang'a County

iii) To assess farmers perception of the most important risk management strategies in Murang'a County

iv) To evaluate socioeconomic factors that determine choice of risk management strategies among smallholder dairy farmers in Murang'a County, Kenya

1.4 Research Questions

i) What are the risk attitudes of dairy farmers in Murang'a County?

ii) What are the major risk management strategies employed by dairy farmers in Murang'a County?

iii) What do farmers perceive to be the most important risk management strategies in Murang'a County?

iv) What socioeconomic factors determine choice of risk management strategies of Murang'a dairy farmers?

1.5 Justification of the Study

Failure to recognize and manage risks leads to uncertain and often adverse agricultural output as well as volatile farm incomes. Risk attitudes affect the type of investments a farmer makes and influence level of technology adoption. Risk management strategies employed are affected by risk attitudes and serve to reduce the effect of risk thus reducing the adverse agricultural output and income instabilities. Hardaker et al., (2004) reiterated that a farmer's welfare and the survival of any farming business may depend on how well agricultural risks are managed. Therefore effective management of risk would have a positive effect on farmer welfare as well as increase dairy output aimed at meeting the increasing demand for dairy products. This in turn would improve the food security situation of the county.

This study will help the government to develop informed risk management policies in the dairy sector to ensure high and stable incomes and regular supply of dairy products at affordable prices. It further acts as an impetus to the achievement of Sustainable Development Goal (SDG) number 2 of achieving zero hunger. The government can also use this study to help farmers cope with risks. The study shall also be informative to the Murang'a County government that is already working at improving the county's dairy sector. In addition, it will provide agribusiness firms with information that will help them develop and market appropriate products having considered the risks in dairy farming. Lastly the financial organizations shall also gain information that would help them develop appropriate products for dairy products such as insurance or loans.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

It is difficult to predict the future with certainty but farmers have to make present economic decisions that will have future consequences. This therefore shows the need to consider risks while making decisions in any farming activity.

Farmers especially in the developing world are exposed to risks such as price instabilities, natural disasters, pests and diseases, political and ethnic conflicts, climate change, and uncertainty about access to both output and input markets. Due to the narrow asset base of the smallholder farmers, they often lack adequate means to manage those risks thus requiring external safety nets such as aid agencies and government interventions (AU-IBAR, 2010). This in return normally affects the level of output and the income of smallholder farmers thus adversely affecting food security of the communities.

2.2 Empirical Review

Risk plays an important role in farmer decision making therefore, it affects agricultural productivity. Various studies have looked at farmers' decision making under risk such as the effect of risk on investment decisions (Roessali et al., 2011), the effect of risk on optimal farm plans (Nyikal and Kosura 2005; Kuyiah et al., 2006) and the role of risk in new technology adoption (Feder, Just and Zilberman, 1985; Isik and Khanna, 2003; Abadi Ghadim et al., 2005; IFPRI, 2014). Other studies have looked at yet another aspect of risk such as sources of risk (Boggess et al., 1985; Akcaoz, 2009), risk attitudes (Korir, 2011; Demiryürek et al., 2012; Wissink, 2013) and risk management strategies (Kaguongo, 1996; Gebreegziabher and Tadesse, 2014) which are of importance to this study.

2.2.1 Risks in Agriculture

Many researchers have found that risks cause farmers to be less willing to undertake investments and activities that have higher expected outcomes; however they carry with them risks of failure (Alderman, 2008). Unless risk is well managed, it can slow development and hinder poverty reduction. Therefore it is important to look at farmers' risk attitudes and their responses to risk in order to understand their risk behavior.

Risk can be upside risk or downside risk where upside risk is when the outcome (return) is higher than expected while downside risk is when the outcome is worse than expected. Downside risk is of more concern to economists thus this paper deals with downside risk. According to Hardaker et al., (2004) uncertainty is a situation when all the possible outcomes and their probabilities of occurrence are unknown but in risk the possible outcomes are known thus differentiating the two concepts. However several economists downplay this difference and use these words interchangeably as used in this study, because in either case, decisions have to be made with less than perfect information.

Hardaker et al., (2004) identified two major types of risks: business risk and finance risk. Business risk constitutes institutional risk, production risk, price/market risk and human/personal risk while finance risk results from the financing method of the firm. Ellis (1998) also identified four different types of risks: natural risks, market fluctuations, social uncertainties and wars. Risk can also be classified into systematic and unsystematic risk. Systematic risk is caused by changes in the market as a whole and affects many producers at the same time and cannot be diversified away such as natural risks, wars, economic and political risk. However unsystematic risk is caused by factors unique to the farmer and thus can be diversified away e.g. production risk and personal risk. This study examines risk as classified by Hardaker et al., (2004).

Various studies have been undertaken to examine the sources of risk in the agricultural sector and others have been specific to the dairy sector. In North Florida and South Alabama, Boggess et al., (1985) found that the most important sources of risk for livestock farmers were weather variability, diseases and pests, livestock and product prices, as well as costs of operating inputs. The production dynamics in that part of the world may not necessarily be the same as those in Kenya, or specifically those in Murang'a. The results of a study conducted in Kiambu District, Kenya, indicated that the major source of risk among dairy farmers was production risk due to disease (Kaguongo, 1996). East coast fever, *mastitis* and *anaplasmosis* were the major risks identified by Kaguongo, (1996), with *anaplasmosis* being the third major source of risk. Other sources of risk identified were fluctuating milk prices, unavailability of inputs, poor marketing infrastructure and unpredictable weather patterns. In Netherlands, Meuwissen et al., (2001) found that production and price risks were the most important sources of risk for livestock farmers. Akcaoz and Ozkan (2005) intensified the research on sources of risk by investigating the sources of risk for the different risk attitude groups. They found that the risk averse group perceived government policy and agricultural policy as the major sources of risk while the risk loving group perceived input costs and crops prices as their major risk sources and the risk neutral group perceived input costs as the major source of risk. Price volatility and institutional risk of outputs and inputs were perceived as the main sources of risk in France (Belhenniche, et al., 2009). A recent study conducted in Ethiopia, Africa, identified financial, institutional, price, technological and production risk as the major sources of risk in smallholder dairy farmers (Gebreegziabher and Tadesse, 2014). All the documented sources of risk in the many parts of the world could be investigated for the Murang'a case.

From the discussed evidence, several studies have been undertaken regarding risk in the developed countries (Boggess et al., 1985; Patrick et al., 1985; Pellegrino, 1999; Meuwissen et al., 2001; Hall et al., 2003; Flaten et al., 2005) but few have been done in the developing countries (Kaguongo 1996; Nicol et al., 2007; Ahsan, 2011; Kisaka-Lwayo and Obi, 2012) and even fewer in the dairy industry in Africa (Kaguongo 1996; Gebreegziabher and Tadesse, 2014). Therefore there is need for more investigation into the situation of agricultural risk in African countries. In any case, risk per se is inert, but its management, and therefore the decision maker's attitude makes it an important issue in production decisions.

2.2.2 Risk Attitudes

Hoag (2010) described risk attitude as, "a fear/greed of trade-off between making money and avoiding potential unfavorable consequences as a result of taking risks". These risk attitudes are implied by the shape of the utility function as illustrated in Figure 1 (Hardaker et al., 2004).

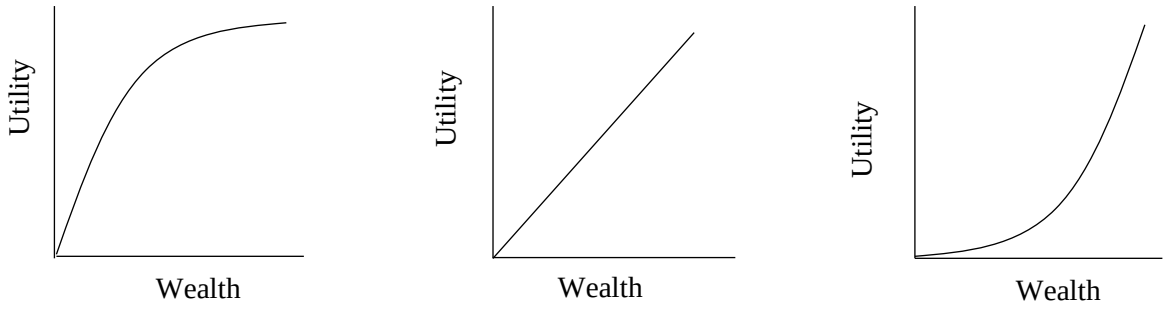

Figure 1: Utility Functions

Source: Hardaker et al., (2004)

There are three main risk attitudes: risk averse, risk neutral and risk loving. The risk averse farmer is afraid of taking risks and chooses an investment with a lower return but sure expected

income. The risk neutral farmer only cares about the expected returns and not the risks involved, they do not actively take risks and do not pay to avoid them. Lastly the risk loving farmer actively engages in risky investments and will choose a risky investment with a higher return than the sure expected income (Hoag, 2010).

Ellis (2000) defined a risk loving farmer as, "one who is willing to take the risk of doing better than expected while being aware of the possibility of doing worse off than expected". The risk neutral farmer was described as, "one who is indifferent between certain and uncertain outcomes with the same expected value of income". Lastly the author described the risk averse farmer as, "one who prefers a situation in which a given income is certain to a situation yielding the same expected value for income but which involves uncertainty/risk".

Globally several studies have been carried out on risk attitudes of farmers. The most recent studies on risk attitudes in the livestock sector include one on milk producers in France, and was based on the expected utility framework. The results indicated that dairy farmers exhibit a risk-averse attitude but that there is no link between socioeconomic characteristics and risk attitude (Belhenniche et al., 2009). A comparative study of risk attitudes among conventional and organic hazelnut producers in Turkey found that organic hazelnut producers were less risk averse than conventional hazelnut producers (Demiryürek et al., 2012). Wissink (2013), established that farmers are most willing to take risk concerning production and financial issues and their willingness to take risks on marketing issues was lower. Yu et al., (2014) linked risk attitudes and willingness to pay for DNA genotyping service for mastitis susceptibility. They found that risk attitudes had a significant impact on the producers' willingness to pay for the technology. Generally, there is widespread literature on farmers' risk attitudes in the developed countries.

Risk in agriculture in the developing countries is phenomenal, yet interventions are not yet deemed adequate. In Uganda, a developing country, Nanyeenya et al., (2008) examined risk attitudes of dairy farmers. The results indicated that extensive dairy management systems unknowingly extravagantly utilized farm resources beyond optimal levels, thus risk loving. The farmers in the intensive dairy management system were found to be risk averse.

In Kenya not as many studies have been done concerning risk attitudes of farmers in general. Nyikal and Kosura (2005) established that the optimal farm enterprise is sensitive to variations in risk preference in Murang'a. Korir (2011) determined farmers' risk attitude in Uasin Gishu and the results showed that all the farmers were risk averse. Shikuku et al., (2013) obtained responses on smallholder peri-urban commercial kale farmers' attitudes in Wangige. The results indicated that a significant negative relationship exists between individual farmers' attitudes and yield variability. Kale is generally a more stable enterprise than dairy, with a shorter gestation period, and probably easier to integrate with other enterprises. It would be desirable to establish risk attitudes of dairy farmers which would probably lead to choosing the respective risk management strategy.

2.2.3 Risk Management Strategies

Risk management is choosing among alternatives to reduce the effects of risk and involves evaluation of tradeoffs between changes in risk and changes in expected income (Harwood et al., 1999). Hardaker et al., (2004) defines risk management as, "the systematic application of management policies, procedures and practices to the tasks of identifying, analyzing, assessing, treating and monitoring risk".

Bauer and Bushe (2003) categorized risk management strategies into four: accept, control, transfer or avoid. If the severity of loss is small and the frequency of occurrence is low then the

farmer chooses to accept the risk, whereas if the severity of loss is large and the frequency of occurrence is high then the farmer avoids the risk. If the potential for loss is small and the frequency of occurrence is high, the farmer chooses to control the risk, and chooses to transfer the risk if the potential for loss is high with a low frequency of occurrence. Hardaker (2004) did a different categorization and classified them as: on-farm risk management strategies and strategies for sharing risk with others. On the other hand Korir (2011) classified them into: ex-ante risk management strategies and ex-post risk management strategies. Ex-ante risk management strategies are employed by farmers in advance of the risk occurring thus reducing the potential loss. Ex-post risk management strategies are employed by farmers after the risk has occurred to help cope with the losses. In Kenya most of the risk management strategies are ex-post as illustrated by Kerer (2013). Risk management strategies can also be classified into three: mitigation, transfer and coping. The above risk management strategies have different effects on the farm, but none of the responses can provide protection from all types of risk (Patrick, 1998). Several studies have been done on agricultural risk management in both developing and developed countries and relatively few studies have been done specific to the dairy sector.

2.2.3.1 Agricultural risk management in developed countries

Several risk management strategies in developed countries have been reported. A study conducted in Florida and Alabama, United States, identified diversification and maintaining feed reserves as the most important risk management strategies related to production risk employed by both crop and livestock farmers (Boggess et al., 1985). The study also identified spreading sales and market information as the most important risk management strategies for managing price risks. Yet another study in the United States reported that enterprise diversification, obtaining market information and placing of investments were the most important risk

management strategies used by crop and livestock farmers (Patrick et al., 1985). In Netherlands Meuwissen et al., (2001) found that insurance and producing at lowest possible cost were regarded as important risk strategies among livestock farmers. Still in the United States, a study among beef farmers in Texas and Nebraska revealed that storing hay and understocking pasture were perceived as the most effective risk management strategies (Hall et al., 2003).

2.2.3.2 Agricultural risk management in developing countries

Studies in agricultural risk management in developing countries are also gaining importance for the phenomenon they serve. Catfish farmers perceived disease prevention, farm management and selecting good quality inputs (fingerlings, feed and water source) as the most relevant risk management strategies in Vietnam (Tru and Cheong, 2009). In Bangladesh, Ahsan (2011) found that farm management training, elimination of middlemen from the supply chain, prevention of disease and timely supply of shrimp seeds are considered among the best risk management methods in shrimp-farming. Off-farm investments were considered as effective risk management strategies among agricultural households in Uasin Gishu, Kenya (Korir, 2011). In Thailand, financial and production strategies were considered as the most important responses to risk (Aditto et al., 2014) while in Brazil, reduction or prevention of crop diseases and obtaining credit reserves were the most important risk management strategies (Borges and Machado, 2012). In South Africa, the most important traditional risk management strategies were identified as precautionary savings, crop diversification, and participating in social networks (Kisaka-Lwayo and Obi, 2012). Majority of the studies done on agricultural risk management have not put a particular emphasis on the dairy sector and the few studies done within the dairy sector are concentrated in the developed countries.

2.2.3.3 Dairy sector risk management in both developing and developed countries

Although there have been a number of studies that have examined agricultural risk management strategies in both developing and developed countries, there have been relatively few in the dairy industry.

Dairy farmers in New Zealand identified routine spraying, drenching and maintaining feed reserves as the best strategies to manage risk (Martin, 1996). According to Kaguongo (1996), the major risk management strategies that affected dairy farmers in Kiambu district in Kenya were matching, input parsimony and diversification. Matching which is producing most of the food consumed at home to reduce exposure to market risk reduced the resources available for dairying. Input parsimony was restricting the use of inputs to reduce fluctuations in net income while diversification ensured that income sources do not vary in the same direction. Planting maize was also used as a risk management strategy and it was used both as fodder and food for the household. Two decades later, there have been several changes in the dairy sector, and probably the risks and respective mitigating strategies, necessitating another look. Some of the changes experienced are: increase in total milk production at an average of 5.3 percent per year; increase in consumption mainly due to expanding urban milk market and a rise in middle class; declining farm holdings and climate change (MoALF, 2010; Rademaker et.al., 2016).

Flaten et al., (2005) reckoned that disease prevention, cost of production, increasing farm liquidity and buying farm insurance were perceived as the most important risk management strategies among conventional and organic dairy farmers in Norway. In Turkey almost similar results were found among the smallholder dairy farmers. The most important risk management strategies identified were keeping good liquidity, implementation of strict hygiene rules and reducing livestock disease (Akcaoz, 2009). In China, reducing livestock disease and reducing

production costs were also identified as the most important risk management strategies among dairy farmers (Zhou et al., 2012). Neyhard et al., (2013) found that the strategy selected by a farmer depends on risk preference and the unique characteristics of the dairy farm. The major risk management strategies practiced by Ethiopian dairy farmers include financial management, expanding market networks, income diversification and reducing cattle disease, (Gebreegziabher and Tadesse, 2014). This illustrates that risk management studies especially in dairy farming have mainly been done in developed countries and there have been relatively few studies done in developing countries. There is therefore need for more investigation on dairy risk management in developing countries.

In conclusion, the fact that social and economic environments in developed countries are different from developing countries specifically African countries, it makes it difficult to generalize the results obtained from the developed countries and apply them in African countries. Two studies have been done in Africa (Kenya and Ethiopia) that deal with risk management among dairy farmers (Kaguongo 1996 and Gebreegziabher and Tadesse 2014). For Kenya, the two decades since the last relevant study have seen a lot of reforms and changes in the sector, hence the need for this study.

CHAPTER THREE

METHODOLOGY

This chapter illustrates the theoretical and conceptual frameworks and the empirical models used to analyze the data. It also explains the methods and procedures used in data collection.

3.1 Study Area

The study was conducted in Murang'a County which is one of the five counties in the Central Kenya highlands. It lies between latitudes 00^0 34' and 10^0 7' South and longitudes 360^0 and 370^0 27' East and occupies 2558.8 square kilometres with the average farm size for most of the households being 1.4 acres. It is bordered by Nyeri to the North, Embu, Machakos and Kirinyaga, counties to the East, Nyandarua to the West and Kiambu to the South.

The county is divided into six agro-ecological zones. The agro-ecological zone one consists of the highest potential zones where the most important economic activities are forestry, tea, dairying and tourism. Agro-ecological zones two and three are the lowlands east of the Aberdare ranges (mountains) and are generally suitable for both dairy and coffee farming. Agro-ecological zones four, five and six are characterized by semi-arid conditions where coffee and pineapple thrive through irrigation (Ministry of Devolution and Planning, 2013). Murang'a County is hence a good representation of the country's physiographic conditions.

The agricultural sector accounts for 57 percent of labour force in the county while the rate of unemployment within the county is approximately 18.17 percent (Ministry of Devolution and Planning, 2013). The county has a high poverty rate, 36 percent of the population living below the poverty line. Low returns from coffee, milk and tea, and high prices of farm inputs contribute to the high levels of poverty (Ministry of Devolution and Planning, 2013).

The county experiences a low of 400 mm rainfall and a high of 1600 mm (Ministry of Devolution and Planning, 2013). The adverse effects of climate change include variation in weather patterns with low rainfall and failed seasons. The county is food insecure in terms of staple food especially in the lower parts of the county. The food insecurity is attributed to inadequate and unreliable rainfall, high prices of farm inputs and concentration on growing cash crops. The county aims to improve animal health and production as well as enlighten the community on wealth creation opportunities in order to curb the food insecurity problem.

Agriculture is the major economic activity of the county, where both cash crops and food crops are produced; horticultural crops are produced both for the market and for subsistence. The populace also engages in livestock and fish production. The main livestock bred in the county are cattle, pigs, goat, sheep, rabbits and chicken. According to the Ministry of Devolution and Planning (2013), dairy is the leading livestock enterprise with milk production valued at 2.4 billion shillings in 2012. The county produced an average of 106.2 million litres of milk in 2012 valued at KES 2.42 billion and aims to increase this production by 2017 to 167.5 million litres. The county also has several agro based industries with three of them being milk based. The county also has 120 active cooperative societies which are mainly engaged in agricultural marketing of cash crops and dairy.

Murang'a County was chosen as the study area because it is one of the main producers of milk within the country (Lekasi et al., 1998; Muriuki, 2011) and milk production is its most valuable livestock enterprise valued at KES 2.42 billion in 2012 (Ministry of Devolution and Planning, 2013). Due to the growth potential of the dairy sector, the county has prioritized developing the dairy sector and already has projects aimed at improving the sector through value addition. In addition, smallholder dairying makes an important contribution to household income in

Murang'a County (Lekasi et al., 1998), therefore improving the dairy enterprise will result to increased income hence poverty reduction to majority of the population.

Figure 2 shows the Murang'a County and the neighboring counties. The 8 sub counties are highlighted with different colors and the main towns within the sub counties are also shown.

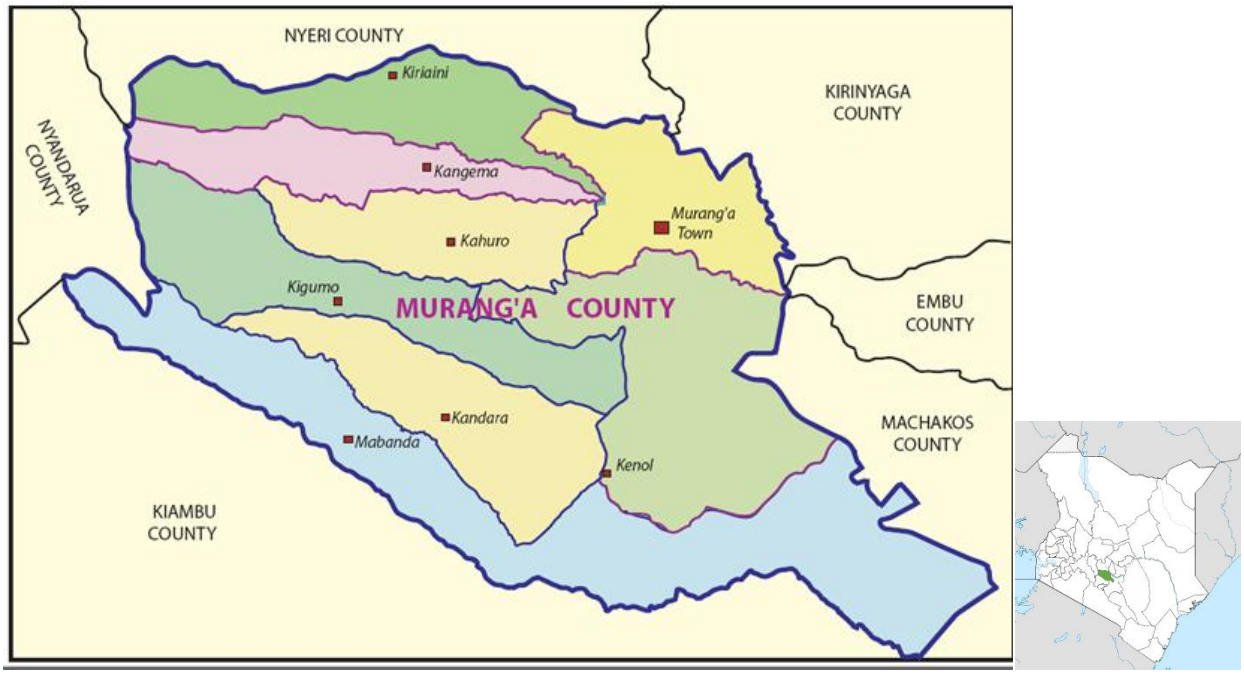

Figure 2: Map of Murang'a County

Source: Ministry of Devolution and Planning (2013)

3.2 Theoretical framework

The dairy farmers seek to maximize their expected utility while minimizing risk thus the study is based on the Expected Utility Theory. Expected utility theory is also vastly used in economics to explain choice under uncertainty. Expected utility is both for the milk consumers and the dairy farmers because as the consumers seek to maximize their utility they shape the demand which

affects the dairy farmers supply. The consumers' utility may be expressed as minimizing costs while the producers' utility may be expressed as maximizing gains.

According to Cather (2010), the expected utility theory is a vital component of risk and risk attitudes. Risk attitudes are based on a set of axioms initially proposed by Von Neumann and Morgenstern. These axioms are desirable properties that a farmer's preferences should satisfy and they include: transitivity, completeness and independence. Transitivity assumes if a farmer prefers payoff x to x' (x>x') and prefers x' to x" (x'>x"), then transitivity assumes that the farmer prefers x to x". Completeness states that farmers have preferences for all payoffs and can be able to rank those payoffs. Independence axiom states that if a farmer is indifferent between two possible payoffs, then they will be indifferent between two lotteries that offer the same payoffs with equal probabilities. Bernoulli further created the expected utility theory in 1738 by using mathematics to assess benefits associated with alternative solutions (Cacho et al., 1999). The farmer chooses the alternative that offers the highest utility (Samuelson and Eckhauer, 1988). Therefore the dairy farmer will choose whether to manage risk or ignore it depending on which alternative gives the most gains. If the farmer chooses to manage risk, the choice of the management strategy becomes an issue.

Farmers' utility is derived from actions precisely when they make choices. The choices that farmers make are expected to maximize their gains thus a farmer chooses a strategy that offers them higher expected gains. In this case a farmer's expected gains is based on income. As illustrated by Korir (2011), the expected utility of random income can take two values with 50-50 probability is as follows:

$$Y = \begin{Bmatrix} \bar{y} + \delta \; with \; 50\% \; probability \\ \bar{y} - \delta \; with \; 50\% \; probability \end{Bmatrix}$$

Thus the expected utility is:

$E\,u(y) = 0.5\{U(\bar{y} + \delta) + U(\bar{y} - \delta)\}$…… (eq. 1)

The difference between the expected utility $E\,u(y)$ and the utility of the sure income $u(\bar{y})$ is the cost of risk i.e. a loss in the expected utility. The sure sum (milk selling price in this case) that makes a farmer indifferent to choosing between the risky prospect or the sure sum is known as the Certainty Equivalent (CE) and this varies between people because of different risk attitudes. If the CE is greater than the Expected Monetary Value (EMV) then the farmer is risk loving while if CE is less than EMV, the farmer is risk averse and if they are equal the farmer is risk neutral (Hardaker et al., 2004). As illustrated in figure 3 on conceptual framework below, these risk attitudes influence a farmer's economic behavior.

3.3 Conceptual framework

Figure 3 presents the study's conceptual framework.

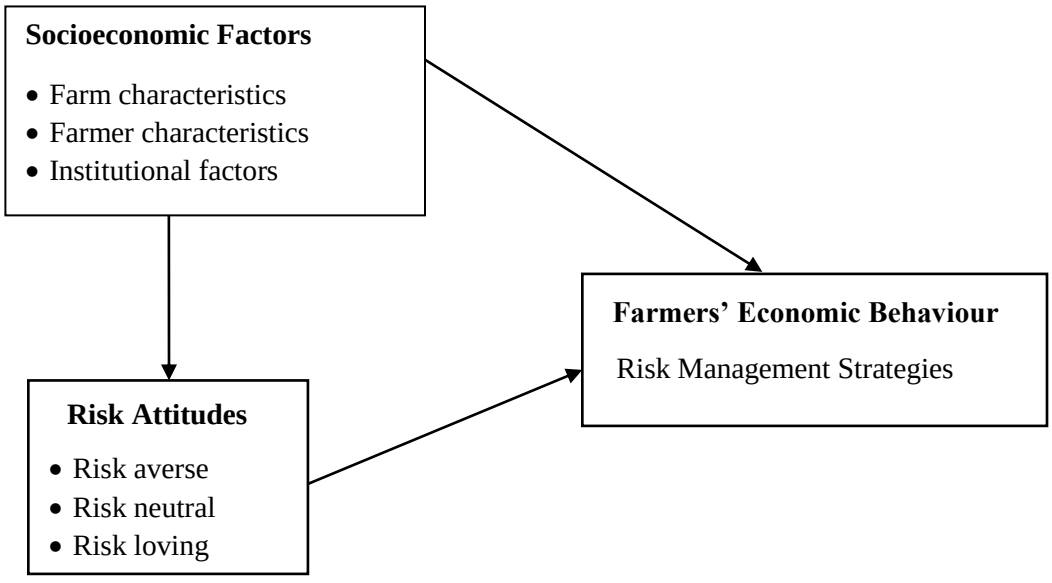

Figure 3 : Conceptual Framework

Source: Modified version of van-Raaij's (1981) model

Dairy farmers' utility is derived from actions specifically when they make choices. Expected utility from these actions determines the choice of risk management strategies. Risk attitudes are also derived based on the farmers' utility function. Kaguongo (1996) noted that to assess how risk influences farmers' decision making requires knowledge of their risk attitudes. In addition, Bauer and Bushe (2003) also stated that the farmers risk attitudes determines their risk management strategies. A farmer's choice of risk management strategies depends on the expected utility of the particular strategies. A farmer hence chooses the risk management strategy that offers the highest expected utility. Therefore the conceptual framework for this study is based on the expected utility theory.

The Van Raaij (1981) descriptive model of the decision making environment for the farm was used as a basis for developing this study's conceptual framework. According to Raaij (1981) both the farm and farmer characteristics as well as risk perception jointly influence the farmers' economic behavior. Several risk management studies have used this framework (Flaten et al., 2005; Bihan et al., 2013; Borges and Machado, 2012; Wissink 2013). This study modifies the Van Raaij model by including institutional factors such as membership to a farmer group, access to extension services and membership to a dairy cooperative.

In addition to risk attitudes influencing choice of risk management strategies, socioeconomic factors also influence the choice of risk management strategies. Akcaoz (2009) stated that the selection of good risk management strategies depends on the farmers' financial situation, the farm operator and the risk attitudes of the farmer. Aditto (2014) also stated that some socioeconomic factors have significant influence on risk management strategies as established in Thailand. Therefore the framework for this study assumes that both the socioeconomic factors

and the risk attitudes jointly influence farmers' economic behavior (in this case risk management strategies).

The study therefore sought to examine risk attitudes using certainty equivalent approach as shown in Section 3.4.1. The study also sought to assess the major risk management strategies used by the dairy farmers through the use of descriptive statistics (see Section 3.4.2). Perception of the most important risk management strategies were also assessed using a likert scale of 1 to 5 and then summarized using factor analysis (see Section 3.4.3). Other socioeconomic factors were also obtained in order to find out their influence on choice of risk management strategies. Based on the conceptual framework, these perceptions and other socioeconomic factors as well as risk attitudes were later used as independent variables to evaluate factors that determine choice of risk management strategies using probit models (see Section 3.4.4).

3.4 Empirical models

3.4.1 Objective 1:

To examine the risk attitudes of smallholder dairy farmers in Murang'a County

Risk attitude measurement

Moscardi and de Janvry (1977) broadly classified the techniques for measuring risk attitudes into direct and indirect approaches. In addition, Torkamani and Abdolahi (2001) also classified risk attitude measurement into direct and indirect approaches as shown in Figure 4:

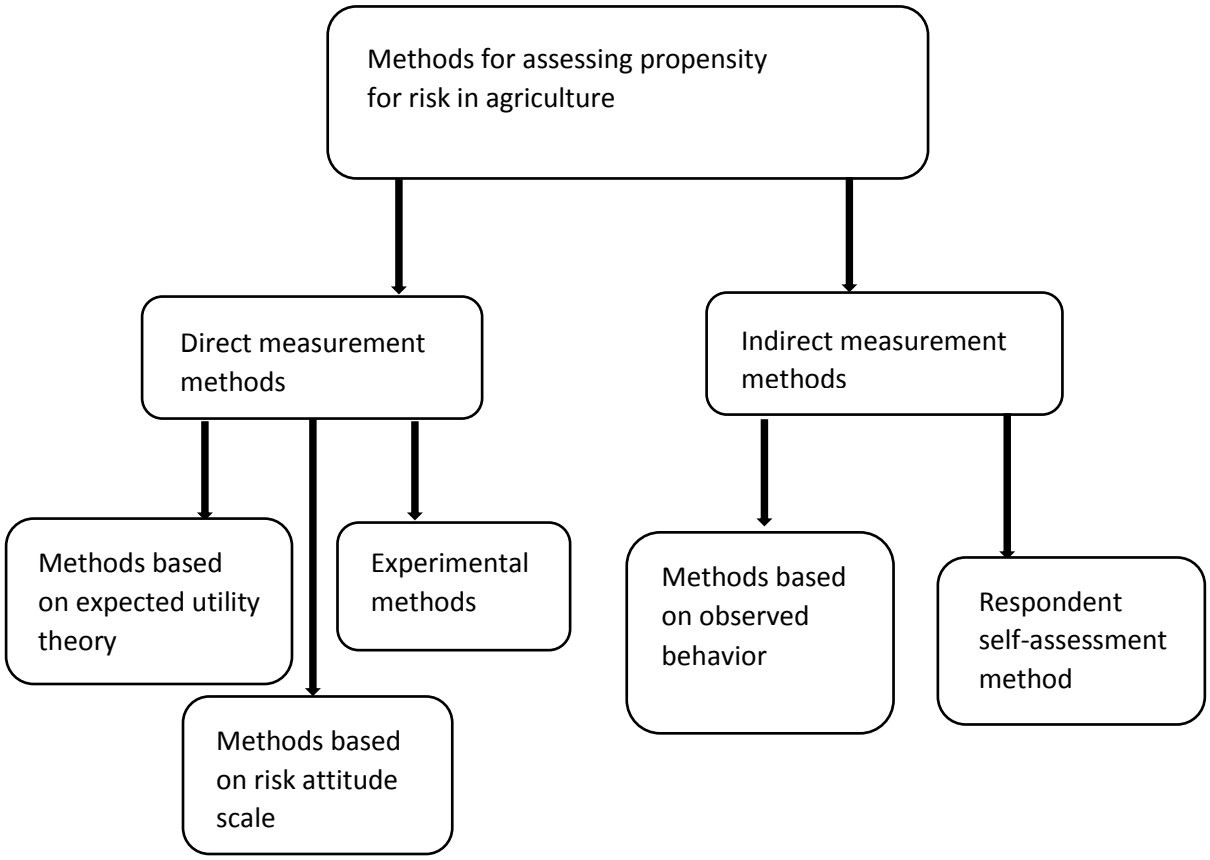

Figure 4 : Classification of Risk Attitude Measurement Methods

Source: Adapted from Torkamani and M. Abdolahi (2001)

The indirect methods are based on observed behavior or on self-assessment of the respondents. The direct methods are either based on the expected utility theory, risk attitude scale or on experimental methods. The indirect methods are considered as inaccurate (Georgieva, 2011) thus this study chooses from the direct methods. The direct methods based on the risk attitude scale are undesirable because use of the scale may be biased or dependent on the level of awareness of the farmers on the risk management strategies. The experimental methods are also criticized to be very expensive (Georgieva, 2011). Therefore this study chooses from the expected utility methods, anchored on the theoretical framework of this study. According to Georgieva (2011), there exists no best method among the expected utility methods for assessing the attitude of

farmers towards risk. Therefore this study used the Certainty Equivalent approach which is based on the expected utility theory to characterize farmers risk attitudes. This is a simple and practical approach as stated by Dillon and Hardaker (1980).

Certainty Equivalent Approach

Certainty equivalent is the sum of money that would make a farmer just indifferent between facing a risky prospect and accepting a sure sum of money which varies between different farmers (Hardaker et al., 2004). Garvey (2009) defined certainty equivalent as the amount that makes a decision maker indifferent between receiving a sure sum and engaging in a lottery. Dillon and Hardaker (1980) also had a similar definition of certainty equivalent. They defined it as the amount of money that would make a decision maker indifferent between receiving a sure (non-risky) consequence and taking the act with risky consequences. Therefore the utility of the risky act and the utility of the sure consequence are equal. Certainty equivalents (CE) are varied among different farmers which indicate different risk preferences. By comparing farmers' CE for the same risky prospect we can tell whether a farmer is more, or less, risk averse than another. In addition, comparing a farmer's CE with the Expected Monetary Value (EMV) helps characterize a farmer as risk averse, risk preferring or risk neutral (Dillon and Hardaker 1980). According to Wilkinson (2005), EMV is given by $\sum p_i x_i$ where p_i is the probability of occurrence and x_i is the expected outcome. The following illustrates the mathematical relationship between CE and EMV:

CE<EMV implies risk aversion

CE=EMV implies risk neutrality

CE>EMV implies risk preferring

A farmer whose CE is less than the EMV is considered as risk averse while a farmer whose CE is greater than the EMV is considered as risk preferring. A farmer whose risk attitude is neutral has equal CE and EMV (Machina and Viscusi, 2014; Pinto and Garvey, 2012; Garvey 2009; Damodaran, 2008; Hardaker et al., 2004; Dillon and Hardaker, 1980). For instance if the CE of a farmer is KES 1000 and the EMV is KES 1200 then the farmer is risk averse and is willing to forego up to KES 200 in order to avoid taking the risky act (Dillon and Hardaker, 1980).

According to Torkamani and Abdolahi (2001), it is difficult for respondents to answer hypothetical questions. However, Binswanger (1981) found that individual preferences in hypothetical games were consistent with their actual game behavior. Therefore this study chose to use hypothetical but realistic scenario as it is cheaper than actual game behavior.

Dairy farmers risk environment

Dairy farmers are faced with the choice of whether to sell milk on contractual basis or to sell to brokers. Contractual milk buyers include hotels, schools and hospitals which enter into a contract with the farmer and agree on the quantity and price of milk that the farmer will be supplying to them. Other contractual buyers are processing companies and dairy cooperatives that normally buy milk at a pre-agreed price per litre with the farmers but they do not enter into a contract on the quantity of milk the farmer should supply. These companies and cooperatives within Murang'a County are Brookside Dairy Limited, New Kenya Cooperative Creameries (New KCC) and Aspendos Dairy commonly known as Njire (producers of mountain fresh milk brand). Farmers that choose this market channel are normally assured of milk income at the end of the month thus a sure income.

The alternative choice of selling to brokers and selling direct to consumers is characterized with risk but with a chance of getting higher prices than the prices offered on contract. There is also a chance of payment default or lack of buyers leading to even greater losses when a farmer chooses to sell to brokers and consumers. Therefore selling to brokers and consumers involves more uncertainties as opposed to selling to hotels, schools, dairy companies and cooperatives that offer a sure income.

Milk price variation is greatly influenced by rain seasons. During drought seasons, milk is in short supply thus higher prices and during rainy seasons milk is in high supply thus lower prices. It is uncertain whether it will rain or not and the event of raining or not raining have an equal chance of occurrence. Therefore the alternative actions (risky decision) for the dairy farmer are to either to sell on contract or not with the uncertain state of nature being raining (low milk prices), or not raining (high milk prices). Choosing to sell milk on contract results to a sure income and choosing not to sell on contract results to a more risky income but with a chance of getting higher income or incur greater loss.

Hypothetical but realistic risky scenario

Farmers were presented with the following hypothetical situation:

Would you prefer selling milk on contract at KES 30[2] per litre or selling at KES 35 per litre to a broker (uncertain)? If the farmer chooses the contract price of 30 it is decremented by KES 1 until the moment in which the farmer shows indifference between selling on contract or selling to brokers. If the farmer chooses to take the risk of selling to a broker then the contract price is incremented by KES 1 until the moment the farmer shows indifference between selling in the

[2] KES 30 was decided upon during pre-survey as it was the average milk selling price for the Murang'a farmers.

two market channels. The price given at the point of indifference is the certainty equivalent of the farmer. The EMV is the average of the minimum and maximum milk price. As earlier discussed if the CE was less than the EMV then the farmer is risk averse while if the CE was higher than the EMV then the farmer is risk preferring. If the CE and EMV are equal then the farmer was classified as risk neutral. This exercise answers the first research question.

Previous studies that have used CE and EMV to determine the risk attitudes of farmers include Dadzie and Acquah (2012); Georgieva (2011); Torkamani and Abdolahi (2001).

3.4.2 Objective 2:

To assess the major risk management strategies used by smallholder dairy farmers in Murang'a County

This was assessed using descriptive statistics and the farmers were asked to answer Yes/No questions to find out the main strategies that they use. There are several strategies that could be used in managing risk among dairy farmers hence a variable reduction technique is appropriate to attain the second objective. Therefore these strategies were reduced using factor analysis which is a variable reduction technique.

3.4.3 Objective 3:

To assess farmers perception of the most important risk management strategies

Previous studies obtained farmers' perception of the most important risk management strategies using a likert scale of 1 to 5 and further summarized using descriptive statistical analysis (Boggess et al., 1985; Flaten et al., 2005; Hall et al., 2003; Tru and Cheong, 2009; Ahsan 2011; Borges and Machado, 2012; Gebreegziabher and Tadesse, 2014). Some studies went ahead and employed factor analysis to summarize the information in a reduced number of factors (Flaten et al., 2005; Akcaoz, 2009; Ahsan, 2011; Aditto et al, 2014; Borges and Machado, 2012; Zhou et

al., 2012; Gebreegziabher and Tadesse, 2014). A few of the studies also analyzed the relationship between socioeconomic characteristics and the risk management perceptions using multiple linear regressions (Flaten et al., 2005; Ahsan, 2011; Aditto et al, 2014; Borges and Machado, 2012; Kisaka-Lwayo and Obi, 2012). This study summarized the information using factor analysis.

Objective three of the study was analyzed using factor analysis. "The general purpose of factor analytic techniques is to find a way of condensing the information contained in a number of original variables into a smaller set of new composite dimensions (factors) with a minimum loss of information" (Hair et al., 1987). The study chose between Principal Component Analysis (PCA) and Exploratory Factor Analysis (EFA) which are both variable reduction techniques and are also used for qualitative data analysis. The study used the EFA approach which is a data reduction procedure which explores the observed variation in responses.

A likert scale of 1 to 5 was used. Farmers were asked to rank the importance of the strategies with 1 being not important and 5 being most important.

Data was first subjected to Bartlett test of sphericity and KMO to test for appropriateness of factor analysis. The Bartlett test of sphericity tests the null hypothesis that the variables in the matrix are uncorrelated (Hair et. al., 1995; Bartlett, 1954). According to Tabachnick and Fidell, (2007) and Hair et al., (1995), the Bartlett's test of sphericity should be significant for factor analysis to be applicable. KMO is a measure of sampling adequacy that predicts if data is likely to factor well based on correlations. For the dataset to be considered appropriate for factor analysis, the KMO measure must exceed 0.5 (Hansson and Lagerkvist, 2012; Tabachnick and Fidell, 2007; Hair et al., 1995; Kaiser, 1974; Kaiser, 1970).

STATA 11 was used for data analysis to get factors with eigenvalues of more than one. The variables with more than 0.5 within these factors (eigenvalue>1) were the ones that were used. The factors were given a name according to the variables constituted within those selected factors. For instance, the factor would be named "financial management" if three factors are identified with eigenvalues greater than 1, with factor 1 having 3 observable variables with more than 0.5 namely, producing at lowest possible cost, managing debt with the help of experts and good liquidity. If the factors are really mixed up and do not seem to explain one factor, it is an indicator that factor analysis was not done correctly or there is a problem with data collected.

3.4.4 Objective 4:

To evaluate socioeconomic factors which determine choice of risk management strategies among smallholder dairy farmers in Murang'a County, Kenya

The major risk management strategies as identified and reduced using factor analysis in objective two were the ones used as the dependent variables in this objective. The dependent variables were binary choice variables, therefore probit or logit models would be suitable for analysis. Logit function assumes a standard logistic random variable while probit assumes a standard normal cumulative distribution function. Many economists tend to favor the normality assumption for *e (error term),* which is why the probit model is more popular than logit in econometrics (Wooldridge, 2004). In addition, Wooldridge (2004), states that several specifications are most easily analyzed using probit because of properties of the normal distribution. This study therefore chose to use the probit model and the fact that sampling was random makes the assumption of normality valid. The study has three dependent variables and multivariate probit model was considered for analysis but it was not suitable for analysis because

there were no correlations between the dependent variables therefore individual probit models were estimated.

Probit Model specification

A farmer *i* makes decisions to implement a risk management strategy if the utility associated with the implementation choice of strategy (u_{1i}) is higher than the utility associated with the decision to not implement a risk management strategy(u_{0i}). According to Koop (2003), the utilities of the two alternative choices is given as:

$I_i^* = u_{1i} - u_{0i}$ ..... (eq. 2)

Where I_i^* is an unobserved latent variable

The decision to implement a risk management strategy depends on an unobservable latent variable (I_i^*) which is determined by more than one explanatory variable as shown in Equation 3:

$I_i^* = X_i\beta + e_i$ ..... (eq. 3)

Where: X_i are the set of explanatory variables influencing the decision of the i^{th} farmer.

β parameter estimates

e_i is the error term assumed to have a normal distribution

The relationship between the unobservable latent variable (I_i^*) and the observed variable (y_i) is as specified in Equation 4:

$Y_i = 1$ if $I_i^* \geq 0$..... (eq. 4)

$Y_i = 0$ if $I_i^* \leq 0$

Where Y_i is the use of a risk management strategy; 1 if yes and 0 otherwise

The i^{th} household will use a risk management strategy if $u_{1i} > u_{0i}$ therefore the probability of use of a risk management strategy is as shown in Equation 5:

P (1) = P ($u_{1i} > u_{0i}$)..... (eq. 5)

According to Gujarati (2004) the probability of a farmer making the decision of whether to use a particular risk management strategy or not is as expressed in Equation 6:

$P_i = P(Y = 1|X) = P(I_i^* \leq I_i) = P(Z_i \leq \alpha_0 + \beta_2 X_i) = F(\alpha_0 + \beta_2 X_i)$..... (eq. 6)

Where: $P(Y = 1|X)$ is the probability that a farmer will use a risk management strategy given the values of the explanatory variables (X).

Z_i is the standard normal variable $Z \sim N(0, \delta^2)$

F is the standard normal cumulative distribution function

α_0 is the constant term

β_2 is the coefficient to be estimated

The basic form of binomial probit model with X as a vector of determinants of the farmer's decision is as specified in Equation 7:

$Y_i = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_j X_j + \varepsilon_j$ ..... (eq. 7)

The use of a risk management strategy decision model is therefore specified as follows:

$RISKUSE_i = \alpha_0 + \sum \beta \ X_i + \varepsilon_i$ ..... (eq. 8)

Where;

$RISKUSE_i$ the decision made by a farmer whether to use a risk management strategy or not

α_0 the constant term

β the coefficients to be estimated

X_i the vector of socioeconomic characteristics and risk attitudes of farmer *i*

ε_i the error term

Table 1 shows the list of explanatory variables used in the Probit models and their expected signs.

Table 1: Explanatory variables and their expected signs

Variable	Expected signs
Household size	+
Gender of household head	+/-
Education level of the household head	+
Membership to a dairy cooperative	+
Farmer group membership	+
Distance to the nearest tarmac road	-
Dairy farming experience	+
Total land size owned	+
Agro-ecological zone 1	+
Extension access	+
Access to credit	+
Wealth index	+
Risk management perceptions	+/-
Risk Attitude	+/-

Source: author's conceptualization

Description of the explanatory variables

Household size is the number of persons in a household and was expected to have a positive influence on choice of risk management strategies. Larger households are likely to have small

land sizes coupled with a high demand for food therefore they are more likely to manage risk in order to improve their milk production and income.

Gender of the household head is a dummy variable with 1 being male and 0 being female. The gender coefficient can either be positive or negative.

Education level of the household head is the highest level of education completed by the household head (1=none, 2=Adult education, 3=Primary (KCPE), 4=Secondary (KCSE), 5=College (certificate), 6=College (diploma), 7=University (degree), 8=University (masters)). This is expected to have a positive coefficient because the more the education, the more knowledge the farmer is expected to have, thus they are likely to be aware of the available risk management strategies and their importance.

Membership to a dairy cooperative is a dummy variable (1=belong to a cooperative and 0=does not belong to a cooperative). Farmer group membership is also a dummy variable with 1 being belonging to a farmer group and 0 otherwise. These membership to both the cooperative and farmer group was based on three years (2012, 2013 and 2014). They were both expected to have a positive influence on choice of risk management strategies as they increase farmers' access to information.

Distance to the nearest tarmac road was expected to have a negative coefficient. The farther away the farmer is from the tarmac road, the less likely they are to take up risk management strategies. This is because they do not have easy access to markets and are likely to have higher transaction costs thus may not have an incentive to improve their dairy farming through risk management.

Dairy farming experience is the number of years a farmer has been involved in dairy farming and was expected to have a positive influence on choice of risk management strategy. The longer the experience the more likely a farmer will have a vast knowledge concerning risk thus the higher the likelihood of uptake.

Total land size owned is the total land owned by the household during 2014. This was expected to positively influence the choice of risk management strategies. It is expected that the households with larger areas also have higher incomes thus they may have the capacity to take up some risk management strategies such as insurance.

Agro-ecological zone 1 is a dummy variable that indicates the location of the household farm. Belonging to agro-ecological zone 1 (tea and dairy farming zone) was denoted by 1 and zero otherwise. This was expected to positively influence choice of risk management strategies because the region has dairy farming as one of the major economic activities thus the farmers are likely to choose to manage risk in order to improve their incomes.

Access to extension services is a dummy variable (1=access to extension 0=no access to extension) and was expected to positively influence choice of risk management strategies. This was based on the years 2012, 2013 and 2014. Access to extension services improves access to information thus increases the likelihood of farmers taking up risk management strategies.

Access to credit is a dummy variable for accessing credit within the years 2012 to 2014 (1=access to credit and 0=no access to credit). Credit access improves investment ability thus farmers are more likely to invest in risk management strategies such as use of silage. The effect of credit access variable is therefore expected to be positive on choice of risk management strategies.

Wealth index is a continuous variable that was calculated using Principal Component Analysis (PCA) that was recommended by Filmer and Pritchett (2001). It aggregates several binary wealth ownership variables into a single dimension the wealth index. This wealth index was expected to have a positive influence on choice of risk management strategies.

Risk management perceptions are the ones obtained in objective three summarized using factor analysis (see section 3.4.3). They were expected to have a positive or negative influence on choice of risk management strategies because farmer perceptions influence economic behavior.

Risk Attitudes are categorized into three: risk loving, risk neutral and risk averse. The more risk averse a farmer is the more likely they are to employ risk management practices.

3.5 Methods and Procedures

3.5.1 Sampling design

Multistage sampling was used and Murang'a County was purposively chosen from the Central highlands. Kahuro and Kangema sub-counties were also purposively chosen as they have a large herd structure within Murang'a County and they lie in agro-ecological zone one, two and three whose major economic activities are coffee, tea and dairy farming (Ministry of Devolution and Planning, 2013).Six locations were purposively chosen from both sub counties in order to capture important diverse segments of the population. From Kangema sub-county the locations selected were Kanyenyaini, Muguru and Rwathia, while in Kahuro sub-county Mugoiri, Murarandia and Wangu were selected. Systematic random sampling technique was then used to select households to be interviewed in the sampled 17 villages where every fifth farmer was interviewed along the prescribed route with a random start in each of the villages.

3.5.2 Sample size

A sample size of 207 was taken from the Cochran formula (Cochran, 1963).

$$n_o = \frac{Z^2\, pq}{e^2} \quad \text{.....} \quad \text{(eq. 9)}$$

Where;

n_0 = the sample size to be determined,

z^2 =.the abscissa of the normal curve that cuts off an area at the tails,

p = the estimated proportion of an attribute that is present in the population

q = $(1 - p)$.

e = the desired level of precision,

Livestock ownership is widespread amongst households in Kenya's high potential agricultural areas with 77-85 percent of households keeping dairy cattle (Lekasi et al., 1998). According to GoK (2010b) and GoK (2010c), 84 percent of the households in Murang'a County own dairy cattle and therefore the study uses p as 0.84.

Therefore the targeted sample size was 207 farmers calculated as follows using a 95 percent confidence level:

$$n_o = \frac{(1.96)^2(0.84)(0.16)}{(0.05)^2} = 207 \quad \text{.....} \quad \text{(eq. 10)}$$

220 questionnaires were collected but 8 questionnaires were dropped as they did not meet the threshold required by the study, therefore 212 questionnaires were used for analysis.

3.5.3 Data collection

Primary data was collected using structured questionnaires. Enumerators were trained on how to administer the questionnaires and a pre-test survey was done to identify any possible weaknesses. The data collected mainly included farmer and farm characteristics, risk attitude data as well as risk management strategies employed by the farmers.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the results of the study. The first section presents the socioeconomic characteristics of the sample. The subsequent sections present the risk attitudes of dairy farmers, their risk management strategies, their perceptions towards the most important risk management strategies, and the factors that determine choice of risk management strategies. These results were generated using SPSS version 21, STATA 11 and Ms Excel 2013.

4.1 Socioeconomic characteristics of the sample

Table 2 presents summary statistics for continuous variables used in subsequent probit regressions. The summary statistics were generated using SPSS version 21.

Table 2: Summary statistics for continuous variables used in probit regression

Variables	n	Minimum	Maximum	Mean	Std. Deviation
HHH Education (years)	212	0	18	8.726	4.041
Dairy Experience (years)	212	1	63	22.512	14.702
Household Size (number)	212	1	9	3.708	1.744
Tarmac distance (Kms)	212	0.2	10	2.500	2.134
Total land size (acres)	212	0.2	8	2.619	1.993

Source: survey data, 2014

Farmers interviewed in this study were mainly smallholder farmers with an average land holding of 2.62 acres. The average household size was 3.7 members which is lower than the national average of 4.4 (GoK 2010b). The average distance to tarmac road was 2.5 Kilometres with Kangema Sub County having a lower average of 1.34 Kilometres and Kahuro Sub County an average of 3.44 Kilometres. This implies that Kangema Sub County had better access to the market than Kahuro Sub County. The average years in dairy farming of the household heads was

22.5. This indicates that majority of the youth do not engage in dairy farming which could be attributed to majority of the youth migrate from rural to urban areas thus less participation in agriculture. Results also showed that the average education level was 8.7 years of formal school which indicates that majority of the population had attained primary education which is currently 8 years. Figure 5 illustrates the highest level of education attained by the household heads.

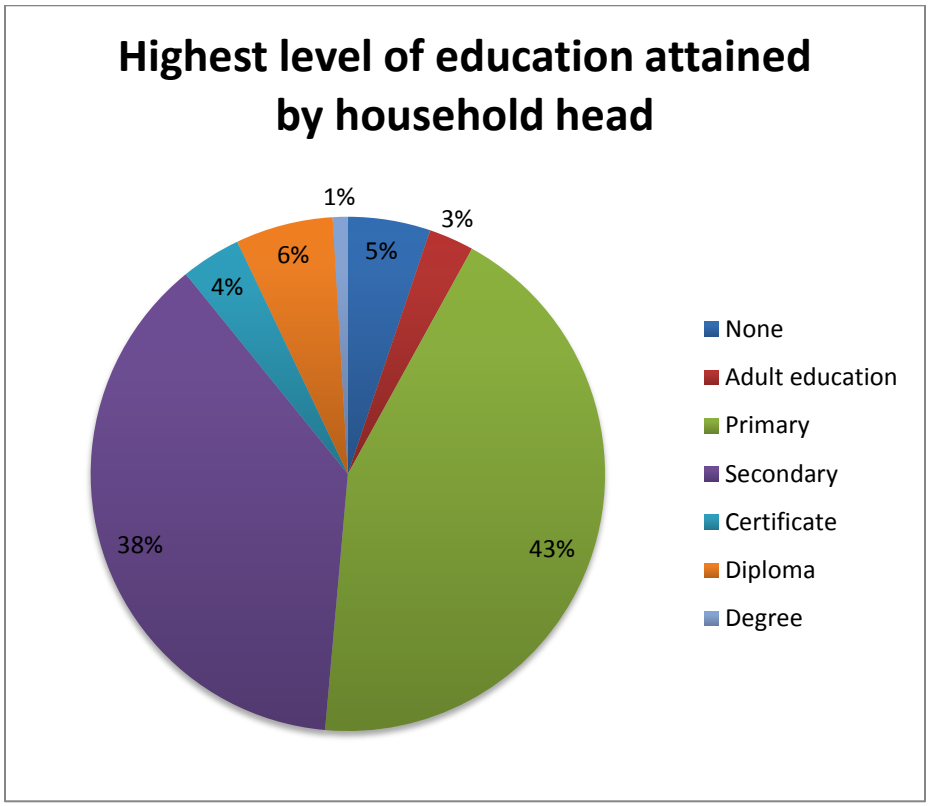

Figure 5: Education level of household heads

Source: survey data, 2014

Primary school was the highest level of education attained by majority of the population's household heads (43 percent) with degree as the highest level of education attained by only 1 percent of the population's household heads. This is lower than the national average of 51 percent who have attained primary education and 2 percent who have attained university education (GOK, 2010c). About 5 percent of the household heads had not attained any formal

education which is lower than the national average of 17.3 percent of population with no formal education (GOK, 2010c).

Table 3 illustrates summary statistics for dummy variables used in subsequent probit regression.

Table 3: Summary statistics for dummy variables used in probit regression

Variables		Percent	Mean
HHH Gender:			0.81
	Female	19.3	
	Male	80.7	
Main Occupation:			0.77
	Others	23.1	
	Farming	76.9	
Farmer group membership:			0.23
	No	77.4	
	Yes	22.6	
Cooperative membership:			0.26
	No	73.6	
	Yes	26.4	
Extension Access:			0.7
	No	29.7	
	Yes	70.3	
Credit Access:			0.48
	No	52.4	
	Yes	47.6	

Source: survey data, 2014

Majority (81 percent) of the households sampled were male headed. Results show that 23 percent of the household heads belonged to a farmer group while 26 percent belonged to a dairy cooperative. Kangema sub county had more households (33.7 percent) belonging to a dairy cooperative as compared to Kahuro sub county which only had 20.5 percent of the households belonging to a dairy coopearative. This may be attributed to the fact that New KCC has a cooling

plant in Kangema Sub County. Slightly less than half (47.6 percent) of the households had access to credit and 70.3 percent had access to extension services in the last three years.

Figure 6 shows that majority (77 percent) of the household heads practiced farming as their main occupation while only 6 percent were casual laborers as their main occupation.

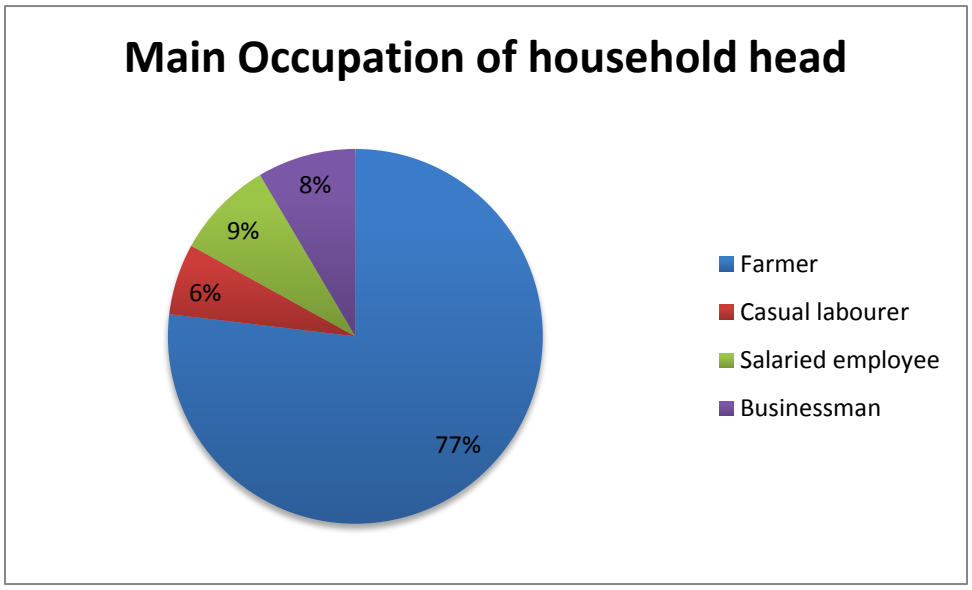

Figure 6: Main occupation of the household head

Source: survey data, 2014

It is also important to note that farmers had different reasons for keeping dairy cows which is illustrated in Figure 7.

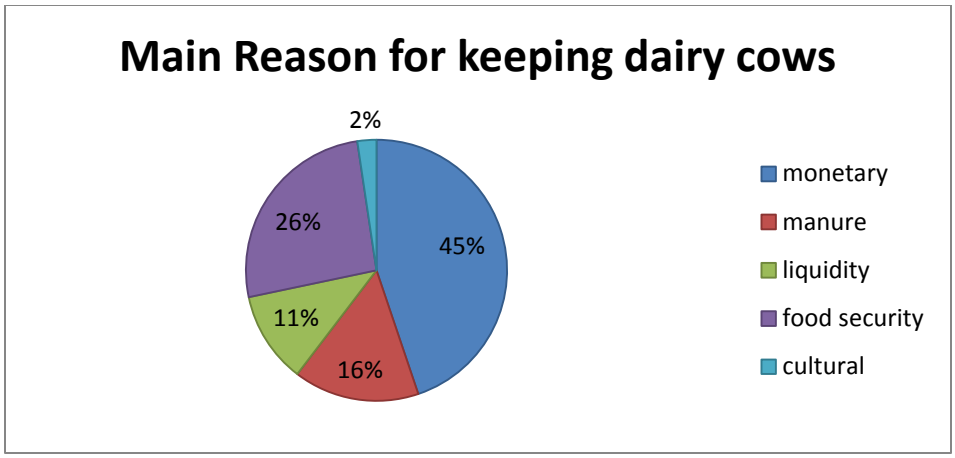

Figure 7: Main reason for keeping dairy cows

Source: survey data, 2014

Slightly less than half of the households (45 percent) keep dairy cows for monetary reason which is to sell milk as a source of income. Some 26 percent of the households practice dairy farming as a way of improving their food security status through enhancing their physical and economic access of the milk. The farmers perceived that it was cheaper to produce their own milk as opposed to buying from their neighbours and they also stated that it helped to improve their nutritional status (Muehlhoff et al., 2013). Therefore majority of the households in Murang'a County practice dairy farming mainly for income and for food security. Some 16 percent keep dairy cows for manure that is used for biogas and also as organic fertilizer while 11 percent keep dairy cows for purposes of future sale. Only 2 percent practiced dairy farming as a tradition.

According to the United Nations (2005) categorization, 63 percent of the household heads belonged to the economically active age group which is 15 to 64 years as presented in Figure 8.

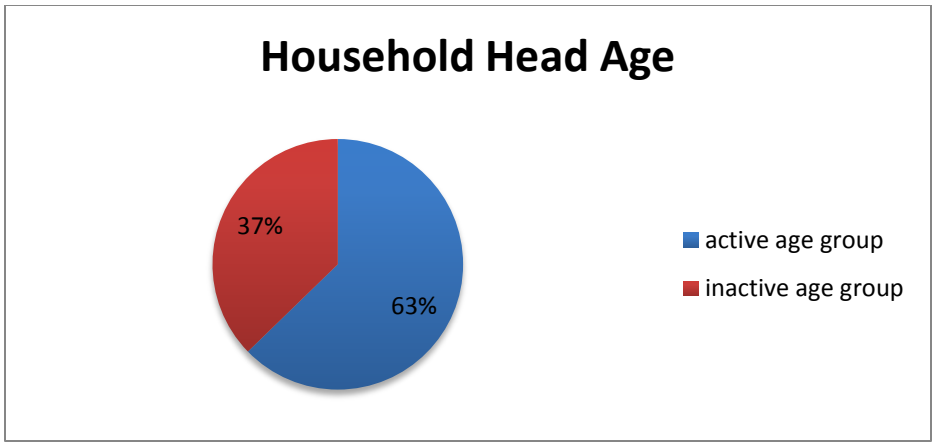

Figure 8: Household head age

Source: survey data, 2014

It is also important to note that some farmers practice dairy farming for their own milk consumption and not for sale. Three percent of the sampled households did not sell milk but only produced for their own consumption as illustrated in Figure 9. Majority of the farmers (28 percent) sold to a dairy processing company commonly known as Njire, located in Kangema Sub-County, citing timely payments as their main reason for selling to the company. Both dairy cooperative and neighbours each had 21 percent of the farmers selling to them. Local restaurants and local shops had the least number of farmers (7 percent and 2 percent respectively) supplying to them, in as much as local restaurants offered better prices than New KCC and Njire. This is attributed to the fact that local restaurants and shops are not many to require supply from majority of the farmers, therefore only a small proportion of farmers would have them as their main buyers.

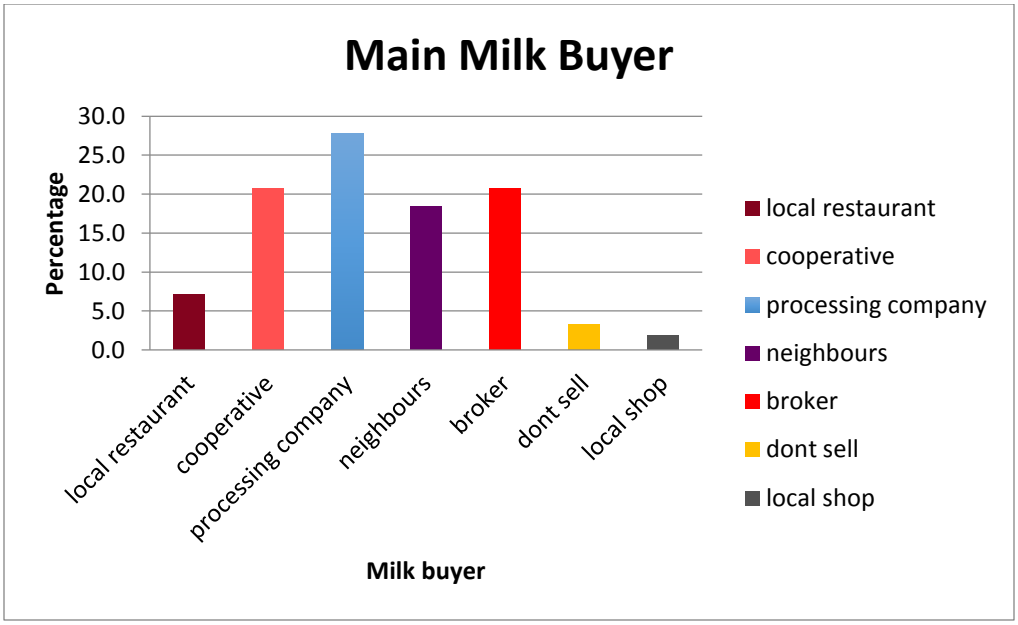

Figure 9: Main milk buyer

Source: survey data, 2014

4.2 Risk attitudes of smallholder dairy farmers in Murang'a County

Table 4 shows that 73 percent of all farmers interviewed were risk averse while only 5 percent were risk neutral. The results were obtained using Certainty Equivalent approach as illustrated in Section 3.4.1.

Table 4: Risk attitudes of smallholder dairy farmers in Murang'a County

Risk Attitude	Percent (n=212)
Risk averse	73.1
Risk neutral	4.7
Risk loving	22.2
Total	100.0

Source: survey data, 2014

The risk averse farmer is afraid of taking risks while the risk loving farmer actively engages in risky investments and the risk neutral farmer mostly cares about the expected returns and not the risks involved.

The expected monetary value (EMV) is the average of the minimum milk price and the maximum milk price available to the farmer. Farmers' CE were obtained as explained in section 3.4.1. If the CE was greater than the EMV then the farmer was classified as risk loving while if CE was less than EMV, the farmer is risk averse and if they are equal the farmer was classified as risk neutral. These results are consistent with a study among food crop farmers in Agona Duakwa, Ghana who found that 67.5 percent of farmers were risk averse and 10 percent were risk loving (Dadzie and Acquah 2012). In addition a study on risk attitudes of conventional and organic hazelnut producers in Turkey also found that majority (67 percent and 81 percent respectively) of the farmers were risk averse (Demiryürek et al., 2012). Belhenniche, et al., (2009) also found that 55 percent of farmers were risk averse while Korir (2011) found that all farmers interviewed were risk averse.

Therefore the results answer the research question that the risk attitudes of Murang'a dairy farmers are: (i) 73 percent risk averse (ii) 5 percent risk neutral and (iii) 22 percent risk loving.

4.3 Major risk management strategies used by smallholder dairy farmers

The risk management strategies shown in Table 5 were summarized using IBM SPSS Statistics 21.

Table 5: Major risk management strategies used by smallholder dairy farmers

Risk management variables	Percentage of use (n=212)
Strict hygiene measures	96.7
Regular vaccination	93.4
Close monitoring of inputs	91.0
Agricultural diversification	88.2
Wastes for feed	83.5
Proper debt management	72.2
Advice from livestock extension officers	66.5
Trainings on dairy development	64.6
Training on markets	63.2
Spraying	62.7
Savings as a precautionary measure	60.4
Training on cost reduction strategies	59.4
Cooperative for credit access	42.5
Learning through agricultural/Brookside show	40.6
Off-farm casual employment	39.6
Forward pricing	34.0
Personal medical insurance	33.0
Labour additions	32.1
Non-farm casual employment	27.8
Salaried employment	26.4
Selling milk via cooperative	24.5
Dismissing labourers	22.6
Cooperatives for input access	21.7
Buying feeds via cooperative	18.4
Buying feeds via group	16.5
Livestock insurance	2.4

Source: survey data, 2014

Applying strict hygiene measures was the most practiced strategy with 96.7 percent of the farmers using the strategy while buying livestock insurance was the least practiced strategy at 2.4 percent. Regular vaccination was also highly practiced at 93.4 percent and employing agricultural diversification as a risk management strategy was also highly practiced at 88.2 percent. Using dairy cooperatives to buy feeds and buying feeds as a farmer group was lowly practiced at 18.4 percent and 16.5 percent respectively.

The above strategies were further subjected to exploratory factor analysis using STATA 11 to summarize the information into a reduced number of factors as shown in Table 6.

Table 6: Factor analysis results (orthogonal varimax rotation with Kaiser Normalization)

Risk Management Variables	**Factor 1**	**Factor 2**	**Factor 3**
Advice from livestock extension officers	0.82		
Training on dairy development	0.47		
Training on markets	0.9		
Training on cost reduction strategies	0.9		
Learning through agricultural/*Brookside* shows	0.21		
Forward pricing		0.35	
Labour additions		0.49	
Cooperatives for input access		0.76	
Selling milk via cooperative		0.7	
Cooperative for credit access	0.24	0.33	
Dismissing labourers		0.46	
Non-farm casual employment			0.71
Off-farm casual employment			0.73
Salaried employment			0.56
Factor name	Training	Financial	Income diversification
(blanks represent abs(loading)<.2)			
Scale reliability coefficient:	0.8	0.7	0.7

Source: survey data, 2014

Some variables were excluded from factor analysis after failing to attain a factor loading of 0.2 which means that they did not load highly on any factor. The final matrix was subjected to Bartlett test of sphericity which tests the null hypothesis that variables are not inter-correlated (Hair et. al., 1995; Bartlett, 1954). The Bartlett test was significant at 0.0000 thus the null hypothesis was rejected indicating a strong relationship among the variables thus factor analysis is appropriate for the data. The data was further subjected to Kaiser-Meyer-Olkin (KMO), a Measure of Sampling Adequacy (MSA) to test whether the dataset is suitable for factor analysis. In order for the dataset to be suitable for a factor analysis, the KMO measure must exceed 0.5

(Hansson and Lagerkvist, 2012; Kaiser, 1974; Kaiser, 1970) while Antony and Rao (2007) considered a KMO of 0.9 as marvelous and a KMO of 0.5 as miserable. The results showed that the KMO for this data was 0.7 thus indicating that the data is suitable for factor analysis. Orthogonal Varimax with Kaiser Normalization rotation was used to facilitate interpretation of the factor matrix while ensuring that the factors are independent. The number of factors to be extracted was based on Kaiser's criterion which states that factors with eigenvalue greater than 1 should be retained (Kaiser, 1960). Using this criterion, 3 factors were retained namely: training strategies, financial strategies and income diversification strategies.

The following variables had a high loading on Factor 1: advice from livestock extension officers, training on dairy development, training on markets, training on cost reduction strategies and learning through agricultural/Brookside shows. A cross loading of using cooperatives for credit access also had a significant loading on factor 1 majorly because cooperatives also participate in farmer trainings. Flaten et al., (2005) also had some variables that had cross loadings on two factors. Factor 1 was therefore termed as training strategies.

Forward pricing, labour additions, using cooperatives for input access, selling milk via cooperative, using cooperatives for credit access and dismissing laborers all loaded highly on Factor 2. Factor 2 was therefore termed as financial risk management strategies.

Factor 3 had positive relation with non-farm casual employment, off-farm casual employment and salaried employment. The loadings for this factor were all greater than 0.5 and Factor 3 was therefore termed as income diversification risk management strategies.

Cronbach's alpha was used as a reliability test to assess how well variables measure a single latent variable (Hair et al. 2010). The closer the alpha is to 1, the more the variables measure the

latent variable (factor). Cronbach's alpha values were found to be 0.8, 0.7 and 0.7 for Factors 1, 2 and 3 respectively. This demonstrates an adequate reliability of the factors.

The 26 variables have now been reduced to three factors.

If a farmer practices at least one of the strategies contained in any of the three factors, then they are said to have adopted using the factor (strategy). For instance if a farmer uses at least off-farm casual employment as a risk management strategy then they are deemed to have adopted the income diversification risk management strategy. Figure 10 illustrates the percentage of farmers using each strategy as condensed using factor analysis,

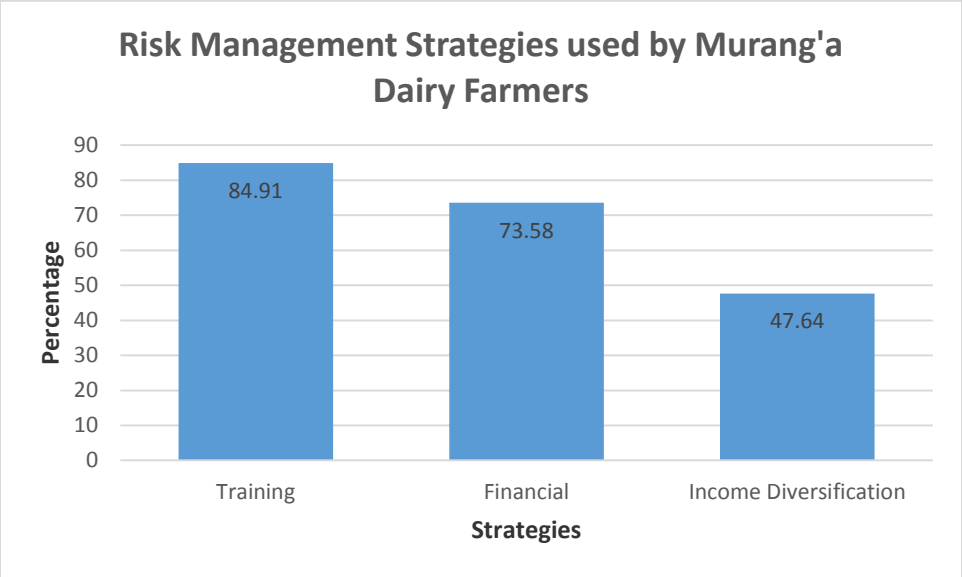

Figure 10: Risk management strategies used by Murang'a dairy farmers

Source: survey data, 2014

About 85 percent of the farmers were found to be using training as a dairy risk management strategy while 74 percent used financial management and 48 percent used income diversification as a dairy risk management strategy.

Table 7 shows the proportion of farmers using all the three strategies, a combination of any two strategies and farmers who only use one strategy.

Table 7: Proportion of farmers using a combination of the risk management strategies

Number of strategies	Percentage (n=212)
1	23.1
2	45.3
3	31.6
Total	100.0

Source: survey data 2014

Majority of the farmers (45 percent) were using a combination of any two risk management strategies while only 23 percent of the farmers were using only one strategy. These reduced strategies were further used in analyzing objective four of the study.

Therefore the results answer the research question that the major risk management strategies employed by dairy farmers are: (i) training risk management strategies (ii) financial risk management strategies and (iii) income diversification risk management strategies.

4.4 Farmers perception of the most important risk management strategies

Table 8 shows summary statistics of farmers' perception of the most important risk management strategies. This was obtained using STATA 11.

Table 8: Dairy farmers' perceptions of the most important risk management strategies

Perception of importance of risk management strategies	Mean (n=212)	Std. Deviation
Regular vaccination	4.55	0.774
Strict hygiene measures	4.51	0.8
Close monitoring of inputs	4.51	0.851
Agricultural diversification	4.42	1.025
Savings as a precautionary measure	4.18	1.183
Trainings on dairy development	4.17	1.227
Advice from livestock extension officers	4.15	1.236
Proper debt management	4.15	1.251
Training on cost reduction strategies	4.03	1.326
Training on markets	4.02	1.335
Personal medical insurance	3.96	1.296
Learning through agricultural/brookside show	3.94	1.386
Forward pricing	3.76	1.509
Spraying	3.63	1.508
Wastes for feed	3.6	1.293
Cooperative for credit access	3.52	1.565
Cooperatives for input access	3.28	1.58
Livestock insurance	3.24	1.503
Buying feeds via cooperative	3.22	1.615
Selling milk via cooperative	3.16	1.567
Off-farm casual employment	3.08	1.639
Buying feeds via group	2.9	1.675
Salaried employment	2.83	1.579
Labour additions	2.66	1.533
Non-farm casual employment	2.62	1.606
Dismissing labourers	2.35	1.435

Source: survey data, 2014

Farmers were asked to rate the importance of each risk management strategy on a five point likert scale. The likert scale was graded as follows: 1= not at all important, 2= not important, 3= average, 4= important and 5=very important.

According to Table 8, regular vaccination, applying strict hygiene measures and close monitoring of inputs had the highest mean of 4.55, 4.51 and 4.51 respectively. This means that majority of the respondents rated this strategies as very important strategies. The strategies that

had the lowest means are: having salaried employment, labour additions during rainy seasons, having non-farm casual employment and dismissing laborers during dry seasons which had means lower than 2.9. This suggests that majority of the respondents perceived these strategies as not at all important and not important.

The above perceptions on strategies were subjected to factor analysis in order to condense the information into a set of factors with minimum loss of information. This enables easier and more meaningful interpretation and is useful for the subsequent probit regression in Objective four. Table 9 shows the results of factor analysis using Stata 11.

Table 9: Factor analysis results (Oblique promax rotation with Kaiser Normalization)

Perception of importance of risk management strategies	**Factor1**	**Factor2**	**Factor3**	**Factor4**	**Factor5**
Livestock insurance					0.7932
Personal medical Insurance					0.8342
Advice from livestock Extension officers		0.7809			
Training on markets		0.8739			
Training on dairy development		0.6228			
Cost reduction strategies trainings		0.8583			
Forward pricing	0.7319				
Buying feeds via Cooperative	0.7371				
Agricultural Diversification	0.5025				
Cooperative for input access	0.7385				
Selling milk via Cooperative	0.8367				
Credit access via Cooperative	0.5932				
Non-farm casual employment			0.7471		
Off-farm casual employment			0.9054		
Salaried employment			0.8465		
Labour additions				0.8006	
Labour dismissal				0.8548	
Factor name	financial	training	income diversification	labour	insurance

(Blanks represent abs (loading) <.5
Source: Survey data 2014

Nine variables were excluded from the final matrix after failing to load highly on any factor. The final matrix was tested for appropriateness of factor analysis using Bartlett test and KMO. The Bartlett test of sphericity was significant at 0.0000. The null hypothesis was therefore rejected indicating that the variables are correlated and factor analysis is appropriate for the data. The KMO measure for this data was found to be 0.8 which is considered as meritorious by Antony and Rao (2007) indicating that the data is suitable for factor analysis. The Cronbach's alpha of the final matrix was 0.8662 further indicating that the matrix is factorable (Hair et al. 2010).

Exploratory factor analysis was conducted and 5 factors were retained. The number of factors to be retained was guided by the most commonly used Kaiser's criterion which requires that only those factors with an eigenvalue greater than 1 should be retained (Kaiser, 1960). These 5 factors explain 69 % of the total variance which is considered as satisfactory in social sciences (Hair et al., 1995). Oblique promax rotation with Kaiser Normalization was used to facilitate interpretation of the factor matrix.

Based on the variables that loaded highly on Factor 1, it was interpreted as financial risk management strategies. The variables that loaded highly on this factor are: forward pricing, buying feeds via Cooperative, buying feeds via Cooperative, using cooperative for input access, selling milk via Cooperative and credit access via Cooperative. Factor 1 accounted for 33.2 percent of the total variance.

Factor 2 was interpreted as training risk management strategies with four variables loading highly on this factor and accounted for 12.4 percent of the total variance. These variables are: obtaining advice from livestock Extension officers, receiving training on markets, receiving training on dairy development and trainings on cost reduction strategies.

Factor 3 termed as income diversification risk management strategies accounted for 9.8 percent of the total variance. Non-farm casual employment, off-farm casual employment and salaried employment loaded highly on this factor.

Labour additions and labour dismissal loaded highly on factor 4 and accounted for 7.5 percent of the total variance. Factor 4 was therefore interpreted as labour management risk management strategy. Livestock insurance and personal medical insurance loaded highly on factor 5 which was therefore termed as insurance risk management strategy. This factor explained 6 percent of the total variance. The Cronbach's alpha statistics were calculated to measure the extent to which variables measure a latent factor. The Cronbach's alpha statistics for factor 1,2,3,4 and 5 were 0.84, 0.84, 0.82, 0.78 and 0.66 respectively which is above the threshold of 0.6 (Hair et al. 2010). These factors were then used as independent variables in the subsequent probit regression models.

Therefore the results answer the research question that farmers perceive the following to be the most important risk management strategies: (i) financial strategies (ii) training strategies (iii) income diversification strategies (iv) labour management strategies and (v) access to insurance strategy.

4.5 Factors that determine choice of risk management strategies among smallholder dairy farmers

To address objective four of the study, three probit models were estimated to analyze factors that determine choice of risk management strategies, using STATA version 11.0. These results are presented in Table 10.

Table 10: Marginal effects of the probit models for choice of risk management strategies

	INCOME DIVERSIFICATION			TRAINING			FINANCIAL		
Variables	**dy/dx**	**Std. error**	**P>z**	**dy/dx**	**R. Std. error**	**P>z**	**dy/dx**	**R. Std. error**	**P>z**
HHH Gender	0.147	0.075	**0.049****	-0.060	0.053	0.255	-0.129	0.051	**0.012****
HHH Education	0.008	0.008	0.281	0.001	0.005	0.851	0.007	0.004	0.102
Years Dairy Experience	-0.001	0.002	0.673	0.000	0.001	0.860	-0.002	0.001	0.237
Membership farmer group	0.020	0.064	0.754	0.157	0.068	**0.021****	-0.005	0.059	0.927
Membership Cooperative	-0.097	0.069	0.159	0.096	0.061	0.114	0.207	0.072	**0.004*****
Extension Access	-0.037	0.064	0.564	0.223	0.038	**0.000*****	-0.005	0.043	0.907
Credit Access	0.045	0.056	0.425	-0.088	0.041	**0.031****	0.303	0.033	**0.000*****
Agro-ecological zone1	-0.075	0.061	0.217	-0.123	0.049	**0.012****	0.058	0.038	0.129
Household Size	0.051	0.068	0.452	-0.076	0.039	**0.051****	-0.004	0.039	0.916
Wealth Index	0.032	0.051	0.527	0.020	0.011	**0.064***	0.017	0.011	0.121
Risk attitude	0.045	0.030	0.135	-0.017	0.021	0.422	0.077	0.020	**0.000*****
Tarmac distance	-0.027	0.013	**0.044****	-0.016	0.007	**0.021****	0.005	0.008	0.502
Total land size	0.026	0.036	0.466	0.009	0.024	0.722	-0.067	0.032	**0.035****
Financial strategies perception	-0.055	0.031	**0.077***	-0.021	0.022	0.326	0.070	0.017	**0.000*****
Training strategies perception	0.002	0.030	0.940	0.040	0.017	**0.020****	0.022	0.017	0.196
Income diversification strategies perception	0.273	0.020	**0.000*****	0.033	0.022	0.131	-0.031	0.021	0.148
Labour strategies perception	0.001	0.028	0.962	0.030	0.023	0.191	0.122	0.021	**0.000*****
Insurance strategies perception	-0.028	0.027	0.292	0.012	0.016	0.468	0.025	0.020	0.201
	McFadden's R^2 = 0.390 **Log likelihood = -89.565** **LR χ^2(18) = 114.29** **Prob > χ^2 = 0.000** **Number of obs. = 212**			**McFadden's R^2 = 0.505** **Log likelihood = -44.492** **LR χ^2((18) = 90.938** **Prob > χ^2 = 0.000** **Number of obs = 212**			**McFadden's R^2 = 0.623** **Log likelihood = -46.123** **LR χ^2((18) = 152.553** **Prob > χ^2 = 0.000** **Number of obs = 212**		

*****, **, * significance levels at 1, 5 and 10 percent respectively**

Source: Survey data 2014

Prior to estimating the probit models, some diagnostic tests were carried out. Presence of multicollinearity was assessed using Variance Inflation Factor (VIF). According to Gujarati (2004) if the VIF exceeds 10 then there is presence of multicollinearity. All the variables used in the model had a VIF less than 2 with a mean VIF of 1.42 therefore the existence of multicollinearity was ruled out (see appendix I). Heteroskedasticity was tested using Breusch-Pagan test which tests the null hypothesis that the error variances are homoscedastic (Wooldridge, 2004). The null hypothesis was rejected for the income diversification strategies model which had a high p-value of 0.2351 indicating absence of heteroskedasticity. The other two models, financial strategies and training strategies models had significant p-values of 0.0034 and 0.0000 respectively thus indicating the presence of heteroskedasticity. This problem of heteroskedasticity in the two models was corrected by estimating robust standard errors as suggested by Wooldridge (2004). After running the three probit models some tests were also carried to ensure reliability of the results (see appendix II).

Link test was used to test whether the model was correctly specified. If the model is correctly specified one should not find additional independent variables that are statistically significant. Stata uses an additional variable 'hat squared' to test this which should not be statistically significant for a properly specified model (Pregibon, 1980). The three probit models all had insignificant 'hat squared' variables (see appendix II) which indicates that the models did not have any omitted relevant variables thus they were correctly specified.

The Area under the Receiver Operating Characteristic Curve (AUROCC) is often used as a measure of the predictive power of the model. A model that has no predictive power has an AUROCC of 0.5 and a perfect model has an AUROCC of 1 therefore the closer the AUROCC is to 1, the more the model has predictive power (Green and Swets, 1966; Swets, 1996; Pepe, 2003;

StataCorp, 2013). All the three models had an AUROCC greater than 0.85 thus indicating that the models have good predictive power (see appendix II).

The Likelihood Ratio (LR) statistic for the income diversification, training and financial models were 114.3, 91.7 and 155.6 which were all significant at 1 percent level of significance (see Table 10). This indicates that at least one of the regression coefficients in each model is not equal to zero which confirms that the models had strong explanatory power. This also shows that the models adequately passed the goodness of fit test. Table 10 therefore shows the estimated results of the three probit models.

As presented in Table 10 using income diversification strategies is influenced by: (i) gender of the household head (ii) distance to the tarmac road (iii) perception on financial strategies and (iv) perception on income diversification strategies. Training strategies were found to be influenced by: (i) membership to a farmer group (ii) access to extension services (iii) credit access (iv) agro-ecological zone (v) household size (vi) wealth index (vii) distance to the tarmac road and (viii) perception on training strategies. Factors found to significantly influence use of financial strategies include: (i) gender of the household head. (ii) membership to a dairy cooperative (iii) credit access (iv) risk attitude (v) total land size (vi) perception to financial strategies and (vii) perception to labour strategies.

Gender of the household head significantly influenced both income diversification Risk Management Strategies (RMS) and financial RMS. The probability of choosing income diversification RMS was positive among male headed households, while the probability of choosing to use financial RMS was positive among female headed households. This may be attributed to the fact that in most rural areas the primary responsibility for women is to take care of the household. Research shows that women provide 80 to 90 percent of the time needed for

child rearing, household food preparation and other household tasks (Ilahi, 2000). Women are also involved in unpaid farm activities such as planting, weeding, ploughing and harvesting. The combined time burden of both household maintenance and farm activities makes the women work longer hours than men and this is more predominant in developing countries (Termine, 2010 and Ilahi, 2000). This makes women less likely to work in full time jobs therefore the men have to take up that role of seeking employment in order to improve household incomes (OECD, 2012 and FAO, 2010). The women headed households are also faced with the same risks facing male headed households but they are not exempt from the fact that most of their time is spent on household maintenance and household farm activities. They are therefore forced to look for alternative risk management options such minimizing costs and profit maximization. In the dairy industry this is mainly through forward pricing, labor management and using cooperatives both for input access and as a milk buyer which is basically using financial RMS. Therefore the male headed households opted for income diversification RMS while the female headed households chose financial RMS

Membership to a farmer group positively and significantly increased the likelihood of a farmer choosing to use training RMS by 16 percent. Fischer and Qaim (2012) found that access to information is one of the benefits of belonging to a farmer group. Through the farmer groups, dairy farmers are able to have information on trainings available thus increasing their likelihood in participating in the trainings. Oduol et al., (2013) also found that farmers can easily access training when they belong to a farmer group because many organizations that provide training prefer to work with farmers in a group as it helps minimize their costs. This therefore explains the results that farmers within a group are more likely to use training RMS as opposed to farmers who do not belong to a farmer group.

Access to extension services increased the probability of choosing training RMS by 22 percent which was significant at 1 percent level of significance. One of the functions of extension agents is to share agricultural information as well as linking farmers to other stakeholders related to the agricultural sector. Mathenge et al., (2010) found that public extension agents are the most common source of agricultural information in Kenya. However despite the critical importance attached to extension agents, budgetary allocations for extension services have declined and extension to farmer ratio has also been declining (GoK, 2007b). This has resulted to a change in extension approaches from training and visit approaches to methods such as farmer field schools, agricultural shows, farm demonstrations among others (GoK, 2012). Previously extension service provision used to be a role of the central government but it has now been devolved to county governments and has also realized the entry of private sector and NGOs in provision of extension services. In Murang'a County the number of livestock farmers far outweighs the number of livestock extension officers Therefore, the extension officers offer trainings to farmers within a group because it would be practically impossible to offer trainings to individual farmers. Fischer and Qaim (2012) also found that farmers within a group have better access to extension agents who offer technical training to farmers. In this regard extension services are linked to farmer group membership and they both have a positive influence on training participation. This confirms the result that farmers who belong to a farmer group and farmers who have access to extension services both have a higher probability of participating in trainings.

Membership to a dairy cooperative increases the probability of using financial RMS by 21 percent which was significant at 1 percent level of significance. Ortmann and King (2007) summarized the functions of agricultural cooperatives as facilitating access of both input and output markets. They generally offer opportunities that smallholder farmers would not achieve

individually. In this study, farmers belonging to dairy cooperatives were further asked to state the benefits gained as a result of their membership. Some of the benefits stated were credit access, milk marketing, buying feeds via the cooperatives and access to other inputs such as Artificial Insemination (A.I) and veterinary services. The form of credit offered by the cooperative was in kind and not cash. Farmers would buy feeds via the cooperative or even use the cooperative's A.I services on credit and later offset the short term credit with their monthly milk payments. All these services offered by the dairy cooperative help in managing farmers' financial risk thus the result of farmers belonging to dairy cooperative are more likely to use financial RMS.

Access to credit had significant influence on both training RMS and financial RMS. It is positively related to financial RMS and significant at 1 percent level of significance. The probability of a farmer choosing to use financial RMS increases by 30 percent if a farmer has access to credit. However, access to credit is negatively related to training RMS meaning that access to credit reduces the probability that a farmer chooses training RMS by 9 percent. Farmers stated their main sources of credit in cash include; farmer groups, financial banks, microfinance banks, SACCOs and friends while agricultural cooperatives offer credit in kind. According to Kebede (1995), credit can be used as a tool for market stability and also for covering consumption shortfalls of farm households thus the reason for positive relationship with financial RMS. Farmers with access to credit are able to diversify into non-farm activities thus leaving them with less time available for training. These farmers therefore resort to investing in other forms of information access such as television, radio, mobile phones and internet thus the lower their likelihood of using training RMS.

Belonging to agro-ecological zone 1 reduces the probability of choosing training RMS by 12 percent. Farmers in agro-ecological zone 1 majorly practice tea and dairy farming which is a

high rainfall zone receiving more than 1000 mm of rainfall annually. According to GoK (2010a), cash crops and livestock farming are practiced in this zone. From the results farmers in this zone are less likely to participate in farmer trainings. This may be attributed to the fact that most of their time is spent in the farm. A typical smallholder farmer in this zone spends around 8 hours of their day in the tea farm and around 2 hours tending to their dairy cows. This therefore leaves the farmer with no time to attend farmer trainings.

Household size was found to be negatively associated with choosing training RMS. This means that an increase in the household size reduces the probability of a farmer choosing to use training RMS by 8 percent. Dairy farmers with a large household size do not prefer to use training RMS mainly because they use family labor in both crop and livestock production. This therefore consumes most of their time and they do not get a chance to attend farmer trainings.

Wealth index had a positive influence on farmers' decision in choosing training RMS. As wealth increases, the probability of a farmer choosing to use training RMS increases by 2 percent. Wealthy farmers might have more information concerning available farmer trainings thus increasing their probability of participation. They are also likely to afford to pay for increased transaction costs that comes with training.

Risk attitude had a positive influence on a farmer's decision to use financial RMS and was significant at 1 percent level of significance. This means that the more risk loving a farmer is, the more they are likely to choose financial RMS. Risk loving farmers are more likely to engage in risky events with the expectation of high returns as opposed to risk averse farmers. This therefore increases their probability of taking on financial RMS with the hope of getting higher returns from dairy farming.

Distance to the tarmac road was found to significantly influence both income diversification RMS and training RMS at 5 percent level of significance. Increase in distance to the tarmac road by 1 Kilometer reduced the probability of choosing income diversification RMS by 3 percent and training RMS by 2 percent. Increase in distance to the tarmac road may be used as a proxy of access to the market or access to towns. Therefore the further away a farmer is from towns and market, the lower the likelihood of the farmer participating in training and income diversification RMS. This may be explained by the time taken to travel to the training location or to seek for employment may be a lot of time which may end up increasing transaction costs. The greater the distance may also mean inaccessibility of the towns where trainings are likely to take place and inaccessibility of the market where farmers are likely to get employment.

A one acre increase in total land size reduced the probability of a farmer choosing financial RMS by 7 percent. Farmers who have large land sizes are more likely to have high incomes thus explaining their lower likelihood to implement the financial RMS covered in this study.

Farmers' perception towards financial RMS significantly influenced both the choice of income diversification RMS and financial RMS. Increased perception on the importance of financial RMS reduced the probability of choosing income diversification RMS by 6 percent while it increased the probability of choosing financial RMS by 8 percent. Therefore farmers who perceived financial RMS as an important risk management strategy chose to use financial RMS as opposed to income diversification RMS. In addition, farmers' perceived importance of training RMS had a positive influence on choice of training RMS. The more a farmer perceives training RMS to be important, the more the likelihood of choosing to use training RMS. Farmers' perception on the importance of income diversification RMS positively influences the decision to use income diversification RMS. The greater the perceived importance of income

diversification RMS, the more likely a farmer is to choose to use income diversification RMS. Finally, perceived importance of labour RMS had a significant influence on the decision to use financial RMS with a 1 percent level of significance. The more a farmer perceived labour strategies to be important, the more likely they were to choose financial RMS. The above farmers' perceptions on risk management strategies had significant influence with the respective risk management strategies therefore the study concludes that perceptions influence behavior.

Therefore the results answer the research question that the socioeconomic factors that determine choice of risk management strategies are: (i) gender of the household head (ii) distance to the tarmac road (iii) membership to a farmer group (iv) access to extension services (v) credit access (vi) agro-ecological zone (vii) household size (viii) wealth index (ix) membership to a dairy cooperative (x) risk attitude (xi) total land size (xii) perception on financial strategies (xiii) perception on labour strategies (xiv) perception on income diversification strategies and (xv) perception on training strategies.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Summary and Conclusions

The purpose of this study was to examine and assess the risk attitudes and risk management practices of small holder dairy farmers in Murang'a County, Kenya. The specific objectives of the study were; i)To examine the risk attitudes among the smallholder dairy farmers in Murang'a county, these were determined using the direct measurement method, based on the expected utility theory and using the Certainty Equivalent approach (CE). ii) To assess the major risk management strategies used by the small holder dairy farmers. These were determined using descriptive analysis method where farmers were asked to answer simple YES/NO questions to find out the main strategies they use. iii) To assess the farmer's perception of the most important risk management strategies. Since there are several risk management strategies that could be used, farmers were asked to rank the importance of the strategies on a likert scale of 1 to 5 with 1 being not at all important and 5 being most important. The Exploratory factor analysis procedure was then applied to condense the information. iv) To evaluate socioeconomic factors that determine choice of risk management strategies that was analyzed using probit models.

In assessing the risk attitudes among the small holder dairy farmers, it was determined there are 3 main risk attitudes; i)Risk averse, where the farmer is afraid of taking risks and chooses an investment with lower returns but sure expected income. ii) Risk neutral, where the farmer only cares about the expected returns and not the risks involved, thus does not take risks or pay to avoid them. iii) Risk loving, where the farmer actively engages in risky investments with an expectation of higher returns. Using the Certainty Equivalent approach the study found that 73

percent of all farmers interviewed were risk averse while only 5 percent were risk neutral and 22 percent were risk loving.

The second objective was to assess the major risk management strategies employed by the smallholder dairy farmers in Murang'a County. These were assessed and summarized using descriptive statistics and factor analysis. The general purpose of factor analytic techniques is to find a way of condensing the information contained in a number of original variables into a smaller set of new composite dimensions with a minimum loss of information. In this instance, the information was summarized into 3 major factors namely; training strategies, financial risk management strategies and income diversification risk management strategies. It was determined that 85 percent of the farmers used training as a risk management strategy while 74 percent used financial management and 48 percent use income diversification as a risk management strategy.

To address objective four of the study, probit models were estimated to explore factors that determine choice of risk management strategies, using STATA version 11.0. The results indicated that, using income diversification strategies was influenced by gender of household head, distance to tarmac road, perception of financial strategies and perception of income diversification strategies. Training strategies were found to be influenced by membership to a farmer group, access to extension services, credit access, agro-ecological zone, household size, wealth index, distance to tarmac road and perception on training strategies. Use of financial strategies was influenced by gender of household head, membership to a dairy cooperative, credit access, risk attitude, total land size, perception of financial strategies and perception on labor strategies

5.2 Policy Recommendations

This study highlights the major socio-economic factors affecting small holder dairy farmers in Murang'a County. These factors could be taken into account by both the county and national government to develop informed risk management policies in the dairy sector. Consequently this will lead to high and stable incomes for farmers and regular supply of dairy products at affordable prices.

The study recommends an integrated approach to risk management through formation of a knowledge and activity sharing platform which should be initiated by the County government. A knowledge and activity sharing platform is a way of bringing together multiple stakeholders within an agricultural value chain to identify solutions to shared challenges. The stakeholders of the recommended Murang'a dairy knowledge and activity sharing platform would be: both male and female farmers, private and government extension officers, dairy cooperative officials, financiers, insurance companies, input suppliers, milk processors and researchers. This platform would facilitate uptake of risk management strategies in dairy farming through joint action of the stakeholders.

The results indicate that majority of the farmers are risk averse therefore they would be potential clients for insurance packages. Wealthy farmers, farmers with access to extension services as well as farmers belonging to farmer groups are also likely to use training RMS therefore the insurance firms would be able to sell their products through farmer training sessions as they educate the dairy farmers on financial risk management. Uptake of these insurance packages would help in stabilizing dairy farmer incomes.

Given that female headed households were more likely to use financial RMS as opposed to male headed households, extension officers should therefore develop women training programs aimed

at disseminating information on good financial risk management strategies within the dairy industry. This would be essential since financial RMS was perceived as one of the most important risk management strategies within dairy farming. The trainings can be done by financiers and extension officers, through the use of farmer groups and also through organizing farmer field days. The trainings should also be designed to educate farmers on the best risk management practices within the dairy sector since risk management perceptions were found to influence economic behavior.

Extension officers in collaboration with dairy cooperatives could help in forming farmer groups since membership to a farmer group and dairy cooperative influence the uptake of training RMS and financial RMS respectively. This will enable the farmers have better access to information and more cost effective to extension officers. In addition, the extension to farmer ratio has been declining over the years and it would be more effective for them to disseminate agricultural information through training farmer groups. This in turn will also help the government to maximize on the extension officers' resource and at the same time increase the number of farmers who have access to extension services. These recommendations would help the dairy farmers effectively manage risk and have a more stable income. In addition they would also support the government implement dairy development as a flagship project within the economic pillar of the Vision 2030.

5.3 Suggestion for further research

This study focused mainly on the risk attitudes of small holder dairy farmers, the major risk management strategies they use and the factors influencing their choice of RMS. Therefore, there is need for further research on profitability impact of the adopted risk management strategies.

The results may help identify the best risk management practices that would generate high incomes for increased welfare of the dairy farmers.

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APPENDIX I: Variance Inflation Factors

Variance inflation factors results for multi-collinearity test

Variable	**VIF**	**1/VIF**
totallands~e	1.710	0.585
wealthinde~A	1.670	0.598
Financial_~s	1.640	0.610
HHH_School~s	1.530	0.654
DairyExper~e	1.530	0.655
Income diversification~s	1.500	0.665
Training_s~s	1.500	0.668
HHH_Gender	1.490	0.673
cooperativ~A	1.460	0.684
credit_acc~s	1.450	0.692
households~A	1.420	0.705
extension_~s	1.410	0.707
agroecological_zone	1.350	0.741
Insurance_~s	1.270	0.787
Labour_str~s	1.230	0.812
farmergrou~p	1.200	0.830
tarmacdist~A	1.190	0.843
Risk_attit~1	1.170	0.857
Mean VIF	**1.420**	

APPENDIX II: Models Tests

Financial Strategies probit model

Correctly classified = 91.04%
Area under ROC curve = 0.9607

Linktest

Financial	**Coef.**	**Std. Err.**	**z**	**P>z**
_hat	1.065	0.154	6.91	0
_hatsq	-0.084	0.058	-1.45	0.147
_cons	0.087	0.165	0.53	0.596

LR chi2(2) = 153.53 Prob > chi2(2) =0.00 pseudo R2 = 0.6272 n = 212

Training strategies probit model

Correctly classified = 87.74%
Area under ROC curve = 0.9418

Linktest

Training	**Coef.**	**Std. Err.**	**z**	**P>z**
_hat	0.978	0.229	4.28	0
_hatsq	0.019	0.144	0.13	0.896
_cons	-0.010	0.188	-0.05	0.956

LR chi2(2) = 90.96 Prob > chi2(2) =0.00 pseudo R2 = 0.5055 n = 212

Income diversification Strategies probit model

Correctly classified = 79.25%
Area under ROC curve = 0.8846

Linktest

income diversification	**Coef.**	**Std. Err.**	**z**	**P>z**
_hat	1.001	0.119	8.41	0
_hatsq	0.003	0.109	0.03	0.975
_cons	-0.003	0.139	-0.02	0.984

LR chi2(2) = 114.29 Prob > chi2(2) =0.00 pseudo R2 = 0.3895 n = 212

APPENDIX III : Survey Questionnaire

Survey Questionnaire **Household ID…….**

UNIVERSITY OF NAIROBI

AGRICULTURAL ECONOMICS DEPARTMENT

Risk Attitudes and Risk Management Strategies Survey Questionnaire

Murang'a County

Please note that any information given will be treated with utmost confidentiality and will only be used for research purposes only.

SECTION A: IDENTIFICATION

Name of enumerator…….Date of interview……..……..

Start time……..End time……

Checked by……...On date……

Sub County…….Ward……

Location……...Sub-location…….

Village…….

- Does the household keep dairy cows? 1. Yes 2. No

Name of the respondent……..

Respondent relation to household head …… **(Code A)**

Name of household head ……

Phone number of the respondent…….

CODE A

1. Head **2.** Spouse **3.** Parent **4.** Child **5.** In laws **6.** Grandchild **7.** Employee **8.** Other……..

1. Which livestock do you own?

Livestock type	Ownership (1=yes, 2=no)	Number	How many did you sell in the last one year?	Selling price	How many did you buy in the last one year?	Buying price	How many did you consume in the last one year?
1. Dairy cows grade							
2. Dairy cow local							
3. Dairy cow cross							
4. Bulls *(ndegwa)*							
5. Heifer *(mori)*							
6. Calves *(gachau)*							
7. Goats *(mburi)*							
8. sheep (ngondu)							
9. chicken *(nguku)*							
10. other Poultry							
11. donkey *(funda)*							
12. turkey *(bata musinga)*							
13. rabbits *(mbuku)*							
14. bee hive *(njuki)*							

2. Who is the main decision maker of the dairy farming? ……**(code A)**

CODE A

1. Head **2.** Spouse **3.** Parent **4.** Child **5.** In laws **6.** Grandchild **7.** Employee **8.** Other……..

SECTION B: RISK SOURCES

3. Rank the main diseases and pests affecting your cows

Diseases and pests (Codes H)	Rank	CODES H	
		1. East Coast Fever/ECF *(ngaai)*	7. Foot and mouth
		2. Mastitis	8. Eye problem
		3. Sagana *(ndigara)*	9. Ticks *(nguha)*
		4. Anthrax *(murira)*	10. Tapeworm *(nduguro)*
		5. Bloating *(kuhuhita)*	11. Worms *(njuka)*
		6. Foot rot *(kubutha maguru)*	

4. Which is the most significant source of risk that affects your dairy enterprise in terms of economic performance?

Use the likert scale of 1 to 5 to rate them…..where 1=not at all significant, 2=minor significance 3=moderately significant 4=major significance 5=extremely significant

Source of Risk	**1=not at all significant**	**2=minor significance**	**3=moderately significant**	**4=major significance**	**5=extremely significant**
1. Weather variability					
2. Pests/parasites					
3. Diseases					
4. Labour availability					
5. A.I availability					
6. Salt availability					
7. Drugs availability					
8. Processed feed availability					
9. Napier grass availability					
10. Milk price fluctuations					
11. Transport availability					
12. Cash availability					
13. Milk marketing problems					
14. Theft					
15. Death					
16. Lack of government support					
17. Low milk yield due to poor breed					
18. Credit availability					
19. Personal health					

5. Why do you keep dairy cows?

1. Monetary 2. Manure 3.for future sale/liquidity 4.food security 5. Cultural 6. Others……

SECTION C: INCOME

6. Total milk income per day

	Rainy Season			Dry Season		
	Morning	**Midday**	**Evening**	**Morning**	**Midday**	**Evening**
Production per day (litres)						
Consumption per day (litres)						
Quantity sold per day (litres)						
Selling price per litre						
Total milk income per day						

7. Do you do any value addition to your milk? 1. Yes (if yes go to question 8) 2. No (if no go to question 9)
8. Income from value added products per day

	Quantity sold per day (litres)	**Selling price per litre**	**Total income per day**
Mala			
Yoghurt			
Ice-cream			

9. What do you do when you have surplus milk produced? .....
   ……
10. Did you have other sources of income during 2013/2014? 1. Yes (if yes go to question 11) 2. No (if no go to question 12)
11. If yes to question 10 above, specify

Source of income		**Total income per month**	**Total income per year**
1. Labor/ employment			
2. Pension			
3. Crop sales	Bananas sales		
	Coffee sales		
	Tea sales		
	Maize sales		
	Horticultural crops		
	Others		

Source of income	Total income per month	Total income per year
4. Livestock sales:		
5. Rent		
6. Business proceeds (e.g. shop)		
7. Machine hire		
8. Manure		
9. Fodder/Napier grass		
10. Others ……..		

SECTION D: RISK MANAGEMENT STRATEGIES

12. Please answer the following questions

Type of risk	Risk Management Strategies	Tick the box below if the farmer uses the strategy	How important do you consider the strategy in terms of improving income?				
			1= not at all important	2= not important	3= average	4= important	5=very important
Production risk	1. Livestock insurance						
	2. Fodder irrigation during the dry season						
	3. Buying feeds during the dry season						
	4. Diversification						
	5. Precautionary savings						
	6. Regular vaccination						
	7. Spray my animals						
	8. Apply strict hygiene measures						
	9. Improved dairy breed						
	10. Talk to extension officers to find out new dairy technologies						
Personal risk	Possess medical/life insurance to ensure that my family will not suffer in case of illness or death.						
	1. Attend trainings to enhance my skills.						

SECTION E: RISK ATTITUDES

Elicitation of Certainty Equivalents: Realistic but Hypothetical scenario:

13. Which company buys milk in this location? ……

14. How much does this company offer to buy your milk? .....
15. If you do not sell to the company above, what is the maximum price you can get? ……. (Max)……
16. If you do not sell to the company above, what is the minimum price that you can get? ..... (Min)……
17. Where do you sell your milk? ..... [1. Neighbors] [2. nearby schools] [3. Local restaurants] [4. Local shops] [5. Self-help group] [6. Cooperative society] [7. Processing companies] [8. Broker] [9. Others (specify) …….]
18. Why do you choose to sell there and not to other places? ..... [1. Type of payment mode eg cheque or cash] [2. prompt payment] [3. delivery cost] [4. Price] [5. market accessibility] [6. conditions required for your milk] [7. Others……..]
19. Selling to Company above (question 13) is a sure income while selling to the market is risky income and both have an equal chance of occurrence. How much money will make you indifferent between choosing to be contracted to supply milk to company above (question 13) and choosing to sell to the market?

    …….

20. On a scale of 1 to 5 rate the following: Would you prefer to sell to the market or to sell to company above (question 13)?
    1. Strongly agree 2.agree 3. Unsure 4.disagree 5. Strongly disagree
21. What is the ranking of main source of livestock feed?

Source of feed	**Rank**	**Cost per month**
Own farm fodder		
Buy fodder		
Processed feed		

22. What are the main costs of inputs?

Input	**Quantity per day**	**Cost per Unit**	**Total cost per month**	**Total cost per year**
1. Labour for dairy				
2. Processed Feeds				
3. Fodder (If not bought, how much would they buy them?)				
4. Salt				
5. A.I				
6. Vaccination and medication				

SECTION F: RISK MANAGEMENT STRATEGIES

23. Please answer the following questions

Type of risk	Risk Management Strategies	Tick the box below if the farmer uses the strategy	How important do you consider the strategy in terms of improving income?				
			1= not at all important	2= not important	3= average	4= important	5=very important
Price risk	1. Forward contracting with a school, hospital, company or neighbor etc						
	2. Forward pricing with KCC etc						
	3. Feed substitution (growing fodder)						
	4. Buying feeds through my cooperative						
	5. Buy feeds through my group (church, friends, farmers, women, youth etc)						
	6. Engage in different agricultural enterprises eg sell coffee, eggs etc						
	7. Employment						
	8. Labour management						
	9. Feed cows on waste such as potato peelings						
	10. Closely monitor feeding of the cows to ensure efficient management of inputs.						
	11. Talk to extension officers to find out about new market for milk and its products.						
	12. Talk to extension officers to find out where I can fetch higher prices for milk and its products						
	13. Communicate with the cooperative to find out new markets, input access and product pricing.						
	14. Sell milk via cooperative						
	15. Attend the agricultural show or Brookside dairy show to find out new technologies and market opportunities.						

SECTION G: SOCIAL CAPITAL

24. Are you a member of any group? 1. Yes (if yes go to question 25) 2.No (if no go to question 26)

25. If yes to question 24 above, what type of group is the member registered in?

Type of group the household member is registered (circle the appropriate)	**What are the activities of the group (codes A)**	**Codes A**
1. Farmer group		1. Produce marketing 2. Input access 3. Savings 4. Loan access 5. Funeral assistance 6. Medical assistance 7. Merry go round 8. Table banking 9. Others (specify) ……
2. Women's group (project based eg KWFT)		
3. Youth group (project based eg youth bunge)		
4. Savings and credit association		
5. Church group		
6. Welfare		
7. Self-help / Chama		
8. Others (specify) ……..		

26. Are you a member of any dairy cooperative? 1. Yes (if yes go to question 27) 2.No (if no go to question 29)

27. Type of membership 1. Group 2. Individual

28. Which cooperative do you belong to?

Which cooperative do you belong to? (circle the appropriate)	**What are the benefits gained from being a member of the dairy cooperative (codes B)**	**Codes B**
1. Kikama		1. Milk marketing 2. Savings 3. Credit facilities/Loan 4. Input access (feeds and salt) 5. Production information/seminars 6. Veterinary 7. A.I *(kuheo mubira)* 8. Others …….
2. Umoja		
3. Kahuro livestock breeders		
4. New nginda		
5. Murarandia		
6. Wango		
7. Highland		
8. Gaichanjiru		
9. Kagunduini		
10. New muruka		
11. Ngararia		
12. Ithiru		
13. Ruchu		
14. Kahumbu		

29. Have you ever had any contact with a dairy extension officer? 1. Yes (if yes go to question 30) 2. No (if no go to question 35)

30. If yes to question 29 above, when was the last contact (year) …….

31. If yes to question 29 above, what was the information gained from the officer?	1. Best production practices 2. Market information 3. Medical information (on pest and diseases) 4. Others (specify)…….
32. If yes to question 29 above, did you use the information given by the officer?	1. Yes (if yes go to question 33) 2. No (if no go to question 34)
33. If yes to question 32 above, was it helpful to your dairy farming?	1. Yes (if yes go to question 35) 2. No (if no go to question 35)
34. If no to question 32 above, why did you not use the information?	……

35. Have you borrowed any loan in the last three years? 1=Yes 2= No

SECTION H: ASSETS OWNED

36. What other household assets do you own?

Building materials of main house	**Response**	**Codes**
Wall material (code E)		**CODE E:** 1. Stone 2. Bricks 3. Mud 4. Wood 5. Iron sheets (mabati) 6. Others……..
Floor material (code F)		**CODE F:** 1. Earth 2. Cement 3. Tiles 4. Wood 5. Others……
Roof material (code G)		**CODE G:** 1. Iron sheets (mabati) 2. Tiles 3. Grass 4. Others……

Name of the Asset	Ownership (1=Yes, 2=No)	Number
Farm Implements		
Water pump *(bobo)*		
Knapsack sprayer *(bobo)*		
Panga		
Generator		
Chaff cutter		
Power saws		
Coffee processing machine		
Fork jembe		
Hoe		
Spade		
Slasher		
Mattock *(thururu)*		
Sledge hammer *(kibui)*		
Sickle		
Panga		
Computer		
Name of the Asset	**Ownership (1=Yes, 2=No)**	**Number**
Axe *(ithanwa)*		
Transport		
Push cart /mkokoteni		
Motorcycles		
car/lorry/pickup/taxi/		
Bicycles		
Tractor		
Household implements		
Solar panel		
Gas cooker		
Electric stove		
Charcoal stove /jiko		
Kerosene stove		
Sofa sets or seats		
Tables		
Communication		
Mobile phone		
Television		
Radio		

SECTION I: FARM CHARACTERISTICS

37. Farm size

Variable	**Land (acres)**	**Earnings/Cost**
Ownership with title		
Ownership without tile		
Rented in land		Cost…….
Rented out land		Earnings……..
Total farm size		
Land used for napier grass *(thara)*		

38. Fill in the table below

Variable	**Response**	**Variable values**
1. Main source of water		1. Borehole 2. Rain water harvesting 3. River 4. Piped water 5. Well *(githima/irima)* 6.Others (specify) …….
2. Distance to the nearest water source (km)		……
3. Distance to tarmac road (km)		……
4. Distance to the main market (km)		……
5. Distance to where you buy your main dairy inputs (km)		……

38. Do you know what insurance is? 1. Yes 2. No

39. Would you like to take up insurance? 1. Yes 2. No

SECTION J: RISK MANAGEMENT STRATEGIES

40. Please answer the following questions

Type of risk	Risk Management Strategies	Tick the box below if the farmer uses the strategy	How important do you consider the strategy in terms of improving income?				
			1= not at all important	2= not important	3= average	4= important	5=very important
Finance risk	1. Savings that I can use using low income periods.						
	2. Belong to a cooperative/group that can give me credit to advance my dairy enterprise or during bad times.						
	3. Pay off my debts in time to avoid accumulating penalties.						
	4. Off-farm employment (casual laborer, government employment, industrial employment) to increase my income.						
	5. Sell off some assets in times of drought or a bad season to get income						
	6. Dismiss my labourers during the dry seasons						
	7. Look for employment during bad seasons in other sectors.						

41. What would you love the county government or the national government to do for you to improve your dairy enterprise?

……

SECTION K: HOUSEHOLD CHARACTERISTICS

ID	Name of household member {Start with household head (HHH)}	Year of birth (e.g. 1936)	Gender (0=Female, 1=Male)	Relationship to current HHH (Code A)	Marital status (Code B)	Highest level of education completed (Code C)	Years of schooling	Main occupation (Code D)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
				CODE A **1.** Head **2.** Spouse **3.** Parent **4.** Child **5.** In laws **6.** Grandchild **7.** Employee **8.** Other……	**CODE B** 1. Single 2. Married 3. Divorced 4. Widowed	**CODE C** 1. None 2. Adult education 3. Primary (KCPE) 4 .Secondary (KCSE) 5. College (certificate) 6. College (diploma) 7. University (degree) 8. University (masters) 9.		**CODE D** 1. Farmer 2. Casual labourer 3. Salaried employee 4. Businessman 5.Other (specify)……

Variable for the household head	Variable values
2. What else do you do other than the main occupation?	1. Salaried employee 2. Casual labourer 3. Businessman 4. Farmer 5. Other (specify)……
3. Years of farming experience	……..
4. Years of dairy farming experience	……..