Risk management and the potential of cattle insurance in Tigray, Northern Ethiopia

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By

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DECLARATION

I hereby declare that the work described in this thesis is, except where otherwise stated, entirely my own work and has not been submitted as an exercise for a degree at any other university.

Signed,

Knife Gebreegziabher Bishu

February 17, 2014

Dedicated

to

My dad

Gebreegziabher Bishu

and

My mom

Amit Teklehaimanot

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Abstract

Agriculture in developing countries is characterized by natural and human induced risks that result in low levels of productivity, income and technology adoption and generally inefficient production techniques. The problems of low livestock production are linked to farmers' risk attitude in the adoption of modern agricultural inputs and their poor risk management strategies. Livestock risk places substantial pressure on farmers' livelihoods and farmers use various informal risk management strategies. However, the informal risk management strategies are mostly inadequate in mitigating various risks. In this regard, there is a need to assess sound risk management strategies suitable for smallholder farmers.

This study explores the role of livestock insurance to complement existing risk management strategies adopted by smallholder farmers. Using survey data, this thesis analysed risk management issues and the potential for cattle insurance. First, it provides insights into farmers' risk perception in livestock farming, in terms of likelihood and severity of risk, attitude to risk and their determinants. Second, it examines farmers' risk management strategies and their determinants. Third, it investigates farmers' potential engagement with a hypothetical cattle insurance decision and their intensity of participation. Factor analysis is used to analyse risk sources and risk management, and multiple regressions are used to identify the determinants; a Heckman model used to investigate cattle insurance participation and intensity of participation.

The findings show different groups of farmers display different risk attitude in their decision-making related to livestock farming. Results showed that production risk (especially livestock diseases) was perceived as the most likely and severe source of risk.

Disease control (especially the use of veterinary service) was perceived as the best strategy to manage risk overall. Disease control and feed management were the important strategies to mitigate the production risks (cattle mortality and morbidity). Disease control and participation on safety net program were found to be important to counter households' financial risks.

With regard to the hypothetical cattle insurance scheme, 94.38% of households were interested to participate in cattle insurance. Out of those households that accepted cattle insurance, 77.38% of the households were willing to pay the benchmark annual premium of 4% of the animal value while for the remaining households this was not affordable. The average number of cattle that farmers were willing to insure was found to be 2.71 at this benchmark. Results revealed that income (log income) and education levels influenced positively and significantly farmers' participation in cattle insurance and the number of cattle to insure.

The findings prompt policy makers to consider livestock insurance as a complement to the existing risk management strategies to reduce poverty in the long run. Although this study was confined to northern Ethiopia, the findings may have policy implication for other developing countries.

Keywords: *risk perception, risk management, factor analysis, livestock insurance, Tigray, Ethiopia.*

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List of acronyms

ADBG	African Development Bank Group
ADLI	Agricultural Development Led Industrialization
BoANRD	Bureau of Agriculture and Natural Resources Development
BoARD	Bureau of Agriculture and Rural development
BoPF	Bureau of Plan and Finance
CSA	Central Statistical Agency
DECSI	Dedebit and Credit Saving Institution
DPPC	Disaster Prevention and Preparedness Commission
EMA	Ethiopian Mapping Authority
EWS	Early Warning Systems
FAO	Food and Agriculture Organization of the United Nations
FDRE	Federal Democratic Republic of Ethiopia
FSP	Food Security Programme
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
HDR	Human Development Report
IAEA	International Atomic Energy Agency
ILRI	International Livestock Research Institute
IPCC	Intergovernmental Panel Convention on Climate Change
MDGs	Millennium Development Goals
MoA	Ministry of Agriculture
MoARD	Ministry of Agriculture and Rural Development
MoFED	Ministry of Finance and Economic Development
NDPPF	National Disaster Prevention and Preparedness Fund
NMA	National Meteorological Agency
NMSA	National Meteorological Services Agency
NPDPM	National Policy on Disaster Prevention and Management
OECD	Organization for Economic Co-operation and Development
PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
PSNP	Productive Safety Net Program
RRC	Relief and Rehabilitation Commission
TLU	Tropical Livestock Unit
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
WBISPP	Woody Biomass Inventory and Strategic Planning Project
WDR	World Development Report
WFP	World Food Programme

CHAPTER ONE

1. INTRODUCTION AND OVERALL AIMS

1.1 Background

The majority of the world's poor people live and work in rural areas. Their livelihood and survival depend heavily on agriculture (Davies et al., 2009). In most low-income countries, rural households depend on mixed crop and livestock production, which is exposed to weather and human induced risks (Tarawali et al., 2011; Herrero et al., 2010; Yesuf and Bluffstone, 2009). Human population growth, increasing urbanization, and rising incomes have fuelled unprecedented growth in the demand for livestock products in the developing world (Delgado et al., 2008; IAEA, 2006). This presents opportunities for poor people who rear, process or market livestock or livestock products (Delgado et al., 2008).

People throughout much of the developing countries live in poor and high-risk environment. Per capital income and per capita consumption are low (Townsend, 1994). Agricultural production and investment decisions in these countries are affected by risks like drought, erratic monsoon rains, flooding, crop pests and livestock diseases, sickness or death of plough animals, human illness and income fluctuations (Yesuf and Bluffstone, 2009; Townsend, 1995; Townsend, 1994). Yesuf and Bluff (2009, pp.1034) argues that 'because of poorly developed or absent credit and insurance markets, it is difficult to pass these risks on to third parties.' As a result, it is often the case that households are reluctant to make investments when they involve risk. Yesuf and Bluffstone (2007) argues the presence of risk also tends to induce poorer households to become risk averse and reluctant to adopt new technologies, even at the expenses of higher returns. According to Dercon (2009) risk is seen as a cause of persistent poverty since shocks cause serious losses of physical assets and human capital

Ethiopia's economy is mainly based on agriculture, accounting for 83.8% of total national employment (CSA, 2008a). The proportion of the population below the

poverty line is 29.2% (MoFED, 2010). Ethiopia like other developing countries depends on agriculture to curb poverty and bring overall economic development. It is argued that economic development can be achieved in developing countries by improving rural development since the majority of the population depends on rural areas (Tadesse, 2012). In this regard, Ethiopia have recognized the importance of rural development and designed various economic policies with agricultural and rural development as an engine of economic and social development (Tadesse, 2012). Some of the main policies, strategies and programs in Ethiopia include Agricultural Development Led Industrialization (ADLI), Environmental Policy of Ethiopia, Plan for Accelerated and Sustainable Development to End Poverty (PASDEP), Food Security Program (FSP) and the recent Five Year Growth and Transformation Plan (FYGTP).

National Policy on Disaster Prevention and Management (NPDPM) was issued in 1993 (MoFED, 2002). Prior to the issuance of this policy, relief resources were distributed directly to drought-affected populations freely. Much of the support for the chronically food insecure households was met through emergency food assistance. This approach was insufficient and unpredictable and failed to address underlying causes of food insecurity (MoARD, 2010). On the contrary, the approach of NPDPM has discouraged free relief distribution to the able-bodied population with the aim of integrating the relief resources with development interventions. Several of the most important elements of the Disaster Prevention and Management policy are the Early Warning System (EWS), established to monitor and give warning of disasters ahead of time, the Emergency Food Security Reserve (EFSR) and the National Disaster Prevention and Preparedness Fund (NDPPF) (MoFED, 2002).

Besides, in the year 2005 Ethiopia began implementation of a more comprehensive approach to address food insecurity problem under its Food Security Program (FSP). The key element of the FSP is the Productive Safety Net Program (PSNP). Under the PSNP more predictable food and cash transfers are made to chronically food insecure households in return for labour on public work projects, in particular community-based watershed rehabilitation (MoARD, 2010).

However, risk and shocks are imposing a significant challenge to Ethiopia by affecting food security, poverty reduction and development efforts (NMA, 2007). The magnitude of both poverty and food insecurity is much greater in drought-prone rural areas than in urban areas. The major causes of food insecurity include land degradation, recurrent drought, pest and livestock diseases, inadequate infrastructure and poor risk management strategies (Hess and Wiseman, 2007). The result is that many Ethiopians remain vulnerable to weather-related and other types of shocks (Hess and Wiseman, 2007). The risk management strategies need to be integrated with the existing policies and strategies in order to realize poverty reduction and sustainable development. Ethiopia still requires further work to strengthening the financial and institutional capacity to mitigate the risks and uncertainties of the agricultural sector.

Ethiopia is believed to have the largest livestock population in Africa. Ethiopia's cattle population for the rural sedentary areas is estimated to be 50.8 million. Out of total cattle, 99.19% are local breeds and the remainder are hybrid and exotic (CSA, 2010). However, the contribution of the sub-sector to the country's economy remains far below its potential mainly because of feed shortage, disease and poor management system (Tesfay, 2010; Gebremedhin et al., 2004).

In general, risk and shocks such as livestock feed shortage, livestock mortality and morbidity, market, financial and institutional constraints; and human sickness imposes considerable economic and welfare costs to smallholder livestock farmers. In addition, inadequate and poorly managed risk could not reduce farmers' exposure to risk and shock and as a result livestock failed to provide the required output. This implies that indentifying major sources of risk and devising sound risk management strategies in the livestock farming are essential in the sustainability of livelihood to smallholder farmers. Indeed, information on risk management strategies and the role of livestock insurance in smallholder farming in African context is under researched. The principal focus of this thesis is, therefore, identifying the major sources of risks, examining the existing risk management strategies and assesses the potential role of livestock insurance in the livestock farming.

1.2 Problem in focus

In Sub-Saharan Africa, agriculture is important to increase economic growth, reducing poverty and food insecurity. Of the total population of the region in 2003, around 66% lived in rural areas and more than 90% of the people depended on agriculture for their livelihoods (WDR, 2008). Rural livelihoods, which in many regions of Sub-Saharan Africa are based on subsistence farming are vulnerable to various risks and shocks such as drought, pest and diseases, human illness and market constraints. A single drought may threaten the lives of large number of farmers and their livelihood (Tachiiri et al., 2008).

The major constraints to livestock production in developing countries are the animal feed and health constraints (IAEA, 2006). With intensification of mixed crop-livestock systems in Sub-Saharan Africa, the quantity and quality of feed resources has decreased through the loss of communal grazing areas and increased pressure on arable land for food production (Delve et al., 2001). Thus, providing adequate and good quality feed to livestock to raise their productivity will continue to be a major challenge to policy makers all over the world (IAEA, 2006).

The livestock sub-sector in Ethiopia including Tigray region is an important and integral component of the agricultural sector. Livestock in the region are sources of draught power for traction and transportation, cash income from sale of live animals and livestock products, food such as milk, butter and meat for household consumption, manure for fuel and fertilizer to maintain soil fertility (Gebremedhin et al., 2004).

However, the contribution of the livestock sub-sector to the regional economy has been constrained primarily by lack of livestock feed, livestock diseases and market constraints (Tesfay, 2010; Gebremedhin et al., 2004; MoA, 2010). Communal grazing lands have become severely degraded because of long time free grazing system and population pressure (Gebremedhin et al., 2004). There are also various types of cattle diseases (notably foot-and-mouth disease, lumpy skin disease, anthrax, blackleg, brucellosis, tuberculosis and trypanosomiasis) (BoARD, 2009). According to MoA (2010) livestock diseases remain as the most important constraints to the development

of the livestock subsector in Ethiopia and livestock diseases are disrupting the existing subsistence farming as well as hampering the export of animal and animal products in the country. Another study reported that shortage of animal feed and livestock health problems were the forefront problems of livestock development in North western Ethiopia (Moges and Bogale, 2012).

The Five-Year Growth and Transformation Plan (FYGTP), under implementation, from 2010/11-2014/15, views agriculture as the key driver of economic development with particular attention given to scaling-up best agricultural practices to provide a foundation for expansion of the industrial sector. In this plan, risk and shock were acknowledged as the main constraints in the agricultural sector (MoFED, 2010).

Farm animals are considered a key productive asset, a store of wealth and a source of nourishment for the poor worldwide but livestock are severely affected by epidemic diseases, feed shortage, drought and other weather related disasters. Losing livestock is directly affecting household livelihoods, nutrition and resilience. Recent empirical findings show that shocks that cause households to lose their productive assets can have irreversible impacts and trapping households in long-lasting poverty (Hess and Wiseman, 2007; Barrett, 2006). Rural populations dependent on crop and livestock farming are significantly impacted by natural and human induced risks and shocks (Tachiiri et al., 2008). However, improving the productivity and sustainability of smallholder farming is the main pathway out of poverty (WDR, 2008).

According to Anderson (2003, pp.1) 'Most poor people presently reside in rural areas and they are exposed to many risks while often lacking instruments to manage the risks adequately and so are highly vulnerable'. Providing appropriate risk-management instruments and supporting the critically vulnerable is a key pillar in an effective and sustainable rural poverty-reduction strategy in low income countries.

In this regard, management strategies both formal and informal are useful in developing countries (Cervantest-Godoy, 2013). Informal coping strategies applied to hazards like drought often include methods for spreading risks throughout a community, taking advantage of kin relationships and social capital (Klopper et al., 2006; Roncoli et al., 2001), and take various forms (Meze-Hausken, 2000). First, the

households accumulate capital, often in the form of livestock, which they can sell in times of need. Second, they engage in alternative activities, such as handicrafts, petty trading, stone mining which can generate income independent of rains. Third, they diversify their farming techniques, allowing some farming income in all years. Fourth, they engage in informal risk spreading across kin and social networks, helping each other out when individual families face difficult circumstances.

These informal coping strategies, however, are challenged by extreme events that threaten an entire community simultaneously, or which occur in successive years, draining a community's capital reserves, particularly livestock (White et al., 2005). Informal risk sharing does not work when an entire community is hit by one or multiple years of covariate risks, like drought or disease outbreak. Moreover, these strategies come at a significant cost. For example, diversifying households farming activities, such as planting low-yield seed varieties because of their drought tolerance, often means engaging in activities that are less productive activities, but which hedge risks (Linnerooth-Bayer and Mechler, 2006).

In relation to coping strategies in Tigray, a study by Haile (2007) reported that in case of disaster the poorest households are worried primarily with food consumption about their daily diet because they are difficult to cope with. Then households face extreme unfavourable trade-offs. They must engage in short term responses which provide an immediate gain in income such as selling of productive assets like livestock, engaging children in the labour market and migration. These coping strategies can be at a very high long term cost, such as the cost of re-establishing the destroyed livelihood.

On the other hand, the formal risk management strategies include those of market-based activities (namely, agricultural insurance and credit) (Cervantest-Godoy, 2013). The livelihoods of smallholders are severely affected by income and asset risks in the absence of formal risk management strategies such as insurance and credit markets (Vigh, 2008). Agricultural insurance as risk management strategies is not developed in the developing countries and this lack of agricultural insurance causes inefficiency in production choices of the farmers (Fafchamps, 2003; Alderman and Paxson, 1994) and formal risk management strategies like micro-insurance is recommended as an

option for poor households to better adapt to risk and shock (Osgood and Warren, 2007).

The stock of literature boasts empirical studies about risk perception and management strategies in livestock farming that have contributed significant knowledge about various sources of risk and management strategies (Hall et al., 2003; Harwood et al., 1999; Wilson et al. 1988; Martin, 1996; Wilson et al., 1993; and more recently Gebreegziabher and Tadesse, 2014; Meuwissen et al., 2013; Valvekar et al., 2011; Akcaoz et al., 2009; Al-Kouri et al. , 2009; Ogurtsov et al., 2008; Akcaoz and Ozkan, 2005; McCarthy and Henson; 2005; Flaten et al., 2005; Meuwissen et al., 2001). However, similar studies in the context of Africa that explore risk management and potential role of livestock insurance using multivariate analysis and econometric model are very rare in the smallholder livestock farming.

Improving welfare of farmers can be achieved through better understanding of farmers risk perception and management strategies. Understanding risk behaviour of farmers help for policy intervention to design viable risk management options that would reduce the vulnerability of livestock-dependent households to risks and shocks, improve their resilience to future shocks, and protect their livelihoods from collapsing in the face of shocks. According to Doss et al.(2008) subjective risk perceptions are valuable because they incorporate an individual's understanding of the objective risks, the individual's expectations about his or her own exposure to risks, and his or her ability to mitigate or cope with the adverse events if they occur. Gebreegziabher and Tadesse (2014) argued that identifying smallholder farmers' specific risk sources and suggesting effective risk management strategies at household level could contribute to poverty alleviation since poverty reduction depends not only on growth but also on the capacity to absorb and manage the shocks.' Hence, indentifying risk sources and developing viable risk management strategies are important for the poor farmers in order to cope up with shocks and enhance their resilience. This thesis therefore attempts to explore farmers attitude to risk, risk sources, management strategies and potential role of livestock insurance in Tigray, Northern Ethiopia. The objectives and research questions of the thesis are presented in section 1.3.

1.3 Objectives and research questions

Identifying the main sources of risk and improving risk management strategies at farm level can help to strengthen the food security of farming households in particular and poverty reduction in general. Thus, a study on livestock risk and management strategies of livestock farming is useful to understand risk and then to influence policy, which hopefully, can mitigate food insecurity and vulnerability. The general objective of this thesis is to examine perceptions of risk, management strategies and the potential of cattle insurance in Tigray, Northern Ethiopia. Specifically, the research objectives are:

1. To understand farmers' perception of cattle risk.
2. To examine farmers' perception of existing livestock risk management strategies.
3. To investigate farmers' potential participation in hypothetical cattle insurance and their likely intensity.

In light of the aforementioned research objectives, this study aims to answer the following research questions:

1. How do farmers perceive risks related to cattle farming?
2. What do farmers perceive as relevant risk management strategies?
3. What might be the determinants of farmers' decision to participate in a hypothetical cattle insurance scheme and the intensity of participation?

1.4 Outline of the thesis

The thesis deals with risk management strategies and potential of cattle insurance in Tigray, Northern Ethiopia and comprises eight chapters. Chapter One presents the general introduction and overall aims of the study, background, problem, objectives, research questions and outline. Chapter Two provides country background, including natural and human condition, agricultural sector, poverty and unemployment, policy framework and disaster management program. Chapter Three provides an agricultural

risk and risk management: a review of literature including introduction, definitions and terms, types and sources of agricultural risks, agricultural risk management strategies, agricultural insurance, risk and coping mechanism in the study region and conceptual framework. The aim of the literature review presented in the thesis is to show relevant literatures that have done on the area and it can help to identify knowledge gaps in research. Chapter Four describes the research hypothesis that incorporate: introduction, determinants of households' risk aversion, determinants of likelihood and severity of risk sources, determinants of the perceived risk management strategies and determinants of cattle insurance participation and intensity. Chapter Five deals with research methodology that include: introduction, study area and sampling design, model specification and statistical analysis.

Chapter Six presents the empirical analysis of livestock farmers' perception of risk. Using exploratory factor analysis the major sources of livestock risk factors (likelihood and severity) were identified. Then, socioeconomic determinants of risk factors were analysed with the help of regression model. Chapter Seven deal with perceptions of risk management strategies. Major risk management factors identified and its determinants were analysed. In Chapter Eight, factors influencing farmers' potential cattle insurance decision are analysed. It discusses the factors influencing farmers' interest in a hypothetical cattle insurance participation and the number (extent) of cattle to insure for a given premium rate. Concluding remark, contribution to academic literature and policy, limitations and issues for further research are provided in Chapter Nine.

CHAPTER TWO

2. COUNTRY BACKGROUND

2.1 Location, natural condition and population

Ethiopia is located in the horn of Africa between approximately 3° 24' to 14° 53'N latitude and 32° 42' to 48°12'E longitude. The country covers a land area of about 1.13 million km^2. It shares boundaries to the east and southeast with Djibouti and Somalia, to the north with Eritrea, to the south with Kenya, and to the west with the Sudan and South Sudan (see Figure 2.1).

Ethiopia is a country of great geographical diversity with high and rugged mountains, flat topped plateau, deep gorges, river valleys and plains. The altitude ranges from the highest peak at Ras Dashen (4,620 meters above sea level) in Gonder, down to the Danakil depression (120 meters below sea level) (NMSA, 2001). According to Hurni (1998) a more detail agro-ecological classification in Ethiopia indicates that there are Wurch, Dega, Weyna-Dega, Kolla and Bereha zones. *Wurch* zones are areas of extreme high altitude over 3,200 meters above sea level and with very low temperature. An altitude of 2,300-3,200 meter above sea level is *Dega*, 1,500-2,300 meter above sea level is *Weyna-Dega*, 500-1,500 meter above sea level is *kola* and an altitude below 500 meter above sea level is *Bereha* (desert). Wurch and Dega zones refer to highland areas with an altitude of over 2,300 meters above sea level while Weyna-Dega represents mid-highlands with an elevation of 1,500-2,300 meter above sea level. Lowlands are known as either Kolla or Bereha and have an altitude of less than 1,500 meter above sea level (Degefe and Nega, 2000).

Areas below 1,500 meters in altitude are commonly classified as lowlands while altitudes above 1,500 meters are classified as highlands (NMSA, 2001). In Ethiopia, the highlands constitute around 45% of the total area of the country and the remaining 55% is the low lands (Degefe and Nega, 2000). Mean annual rainfall distribution has maxima (over 2,000 mm) over the south western highlands and minima (below 300 mm) over the south eastern and north eastern lowlands. Mean annual temperature

ranges from below 15 degree Celsius over the highlands to over 25 degree Celsius in the lowlands (NMSA, 2001).

There is an essential difference between the highlands and the lowlands in terms of rainfall, temperature, cropping pattern, vegetation cover, population distribution, livestock distribution, economic activities and lifestyle. In terms of rainfall occurrence one can generally identify three seasons in Ethiopia namely: dry season (Bega) (October- January), short rainy season (Belg) (February-May) and long rainy season (Kiremt) (June- September). The Ministry of Agriculture (MoA, 1995) reported that the highlands contain 88% of the human and 70% of the livestock population. Ethiopia is the "water tower" of Northeast Africa and there are 12 drainage basins in the country. Most of the rivers in these basins cross the national boundary. The total available water (mean annual flow) is estimated at 111 billion cubic meters and the ground water potential is about 2.6 billion cubic meters; the potentially irrigable land in the country has been estimated at 3.7 million hectares (NMSA, 2001).

Figure 2.1: Map of Ethiopia
Source: Abegaz, 2005

2.2 Agricultural sector

Ethiopia's economy is mainly depends on agriculture, Gross Domestic Product (GDP) composition in 2010 by sector shows: agriculture 41.5%, industry 13.3% and service 46.9% with overall real GDP growth rate of 10.1% (MoFED, 2010). In Ethiopia, a mixed crop and livestock farming is the dominant livelihood system for smallholder farmers (Tesfay, 2010). Livestock is produced mainly under two major production systems: the sedentary mixed crop-livestock production system and the nomadic pastoral or agro-pastoral production system (Negassa et al., 2011). The proportion of farmers in Ethiopia growing only crops was 18 percent in 2001/02 and decreased to nine percent in 2007/08, while the percentage of farmers keeping livestock only was eight percent in 2001/02 and decreased to five percent in 2007/08. On the other hand, the proportion of farmers with both crop and livestock holdings was 74% in 2001/02 and this increased to 86% in 2007/08 (Negassa et al., 2011).

Diversification allows producers to mitigate the risk of crop failure or losses of livestock, while livestock is also an important input to crop production and vice versa. Both the mixed crop-livestock and the pastoral production systems are characterized as small-scale, low-input, and less commercially oriented (Negassa et al., 2011).

In terms of contribution to the national economy, livestock contributes about 16% of GDP, 27–30% of the agricultural GDP and 13% of the country's export earnings (MoARD, 2007). In Ethiopia, milk production is dominated by smallholder farmers. The total volume of raw milk produced varied from 0.9 million tons in 2000 to 1.3 million tons in 2008, reflecting an annual growth rate of 4.4 percent (Negassa et al., 2011). More than 95% of total milk production comes from cattle, while pastoralists also produce milk from camels and goats (Negassa et al., 2011).

Like most regions of Ethiopia, Tigray is largely dependent on agriculture. For the year 2009/10, agriculture share of regional GDP was 38.7%, compared to 19.4% for industry and 41.9% for service sector (BoPF, 2010).

Tigray is known for its serious land degradation problem. This is manifested in the form of soil erosion, deforestation, declining bio-diversity resources and soil moisture stress. Environmental and natural resource degradation in the region has caused serious drought problems and the frequency of drought is increasing over time (Teffere, 2003). In the history of Ethiopian civilization, agricultural development in the Northern highlands of Ethiopia, particularly in Tigray has undergone a series of evolutionary developments in both crop and livestock production (Hagos et al., 1999). Nonetheless, agricultural production and productivity has remained very low mainly due to small landholdings (average 0.5 hectare per household), use of traditional farming systems, land degradation and low soil fertility, recurrent drought and prevalence of pests. As a result, household agricultural production is often unable to sustain families for more than 3-4 months per year (Frankenberger et al., 2007).

Smallholder farmers in Tigray manage crop and animal production in an integrated way, to maximize returns from their limited land and capital and minimize production risk through diversification of income sources (Abegaz, 2005). The major crops grown in the region include: sorghum, teff, barley, finger millet, wheat, maize, and a variety of pulses. BoPF (2010) reported that the year 2005/6, 14.9 million; in 2006/7, 17 million; in 2008, 16.4 million; in 2009, 19.6 million and in 2010, 34 million quintal of crops were produced. With regard to the usage of agricultural inputs, in the years 2005-2009: 1,059,872 quintal of fertilizer, 676,808 quintal of higher quality crop seeds and 1,242 quintal higher quality vegetable seeds were distributed to the farmers. However, the usage of agricultural inputs to farmers is constrained by shortage of inputs, unwise use of inputs and limited governmental budget.

According to Abegaz (2005) the farm animals in the region also provide draught power for cropping, income by selling live animals and livestock productivity, fertilizer for crops and natural pasture lands in the form of manure. Dried animal manure is also used as fuel. Crop residue and grass are used as feed for livestock. Outputs from livestock, such as milk, meat and eggs are important sources of food for the farm household. Sales of animal products and live animals are important sources of cash and means of savings.

In Tigray region , there are about 3.24 million cattle (6.37% of the national herd), 1.15 million sheep (4.42% of the national), 2.62 million goats (11.93% of the national), 5,4 00 horses (0.3% of the national), 456,000 donkeys (7.98% of the national), 4,920 mules (1.34% of the national), 32,300 camels (3.99% of the national), 4.37 million poultry (10.14% of the national) and 195,7 00 beehives (4.25% of the national) in the rural sedentary areas (CSA, 2010). In Tigray, the estimated number of vaccinated cattle was around 1.84 million. The number of diseased cattle was 0.47 million and the number of treated cattle was around 0.23 million. The number of cattle that died from disease was around 0.24 million and the ones that died from other reasons was 0.10 million (see Table 2.1). Comparing Tigray with the national, the proportion of vaccinated cattle was 12.42% of the national, diseased cattle was 5.62% of the national and treated cattle was 5.36% of the national. In Tigray, the proportion of cattle died from disease was 6.54% of the national and died from other reasons was 11.74% of the national.

Table 2.1: Cattle size, vaccinated, diseased, treated and died.

Geographic area	Cattle size	Cattle vaccinated	Cattle diseased	Cattle treated	Cattle died from disease	Cattle died from other causes
Ethiopia	50,884,005	14,796,122	8,454,729	4,311,038	3,659,167	870,811
Tigray	3,242,931	1,837,917	474,887	231,067	239,379	102,275
% of Tigray	6.37	12.42	5.62	5.36	6.54	11.74

Source: CSA (2010)

The availability of feed resources and the nutritional quality of the available feeds are the most important factors that determine the productivity of livestock (Tesfay, 2010). However, animal feed in terms of quality and quantity is the major problem in the region (Abegaz et al., 2007). Animal feeds in the study region are classified as crop residue, green fodder (grazing), hay from natural pastures, industrial by-products (noug cake, wheat bran, brewery residue and sunflower cake) and to some extent introduced forage crops (CSA, 2008b; UNECA, 1997).

In the highland and mid altitude areas of Tigray, various food crop residues and stover from cereals (teff, barley, wheat, maize, sorghum and millet), and limited oil crops (noug, linseed, groundnut, safflower, sesame, and rape seed) and pulse crop residues

(beans, chickpeas, haricot beans, field peas, lentils) provide a considerable quantity of dry season feed supply (Tesfay, 2010). It should, however, be noted that the major use of these crop residues is restricted to cattle especially draught oxen. In the lowlands of Tigray, the major crop residues are derived from sorghum, maize, millet, and some oil seeds. In such areas, the availability of vast rangelands contributes markedly to annual livestock feed requirements (Tesfay, 2010). Tigray has an estimated 878,322 hectares of arable land available for the production of cereals, pulses, and oil seeds (Tesfaye, 2010) and contribute about 45% of the animal feed demand (BoANRD, 1997).

According to Tesfaye (2010), the estimated crop residues from cultivated land in Tigray found to be about 1,229,651 tones dry matter (DM) per year. The use of crop residue; however, is limited by its poor digestibility and low feeding value due to low nitrogen, deficiency in some minerals and vitamins, and disproportionately high lingo-cellulose content. Furthermore, the use of crop residues across the whole region is limited by lack of wider use of technologies such as urea treatment that improve the feeding value of the crop residues (Tesfay, 2010).

Total grazing land in Tigray is estimated at 47,431 km^2 (that is 6.6% of the national). Tropical livestock unit (TLU) per square kilometre (km^2) of grazing land for Tigray region is increased from 44 thousand TLU in 2001/02 to 55 thousand TLU in 2007/08. For Tigray, TLU per $km^2$of grazing land is above half for each year (Table 2.2). The reason for increase in TLU per km^2 in Tigray region could be due to greater population density, larger herd sizes, and relatively fixed grazing land resources (Tilahun and Schmidt, 2012). Tesfay (2010) also revealed that natural grazing in Tigray is diminishing over time due to the high degree of chronic degradation and shrinking grazing land size.

Table 2.2: Tropical livestock unit per km^2 of grazing land

	Total grazing land	Tropical livestock units per km^2 grazing land (in thousands)			
Geographic area	(km^2)	2001/02	2005/06	2006/07	2007/08
Ethiopia	722,128	74	73	77	87
Tigray	47,431	44	46	51	55
% of Tigray	6.60	59.50	63.0	66.20	63.20

Source: (Tilahun and Schmidt, 2012)

Ruminant production systems in Tigray are heavily dependent on native grazing lands: grazing is the second most important source of feed after crop residues and accounts for 35% of the total feed input (BoANRD, 1997). The majority of the region's rangelands (46%) are found in the western zone and; the central, southern and eastern zones have rangeland coverage that accounts for 22%, 19% and 12% of the regional total, respectively (WBISPP, 2004). Rapid increase in human population and increasing demand for food, meant that grazing lands are steadily shrinking due to the conversion of prime grazing lands to crop lands, and are now largely restricted to areas that have low farming potential such as hill tops, swampy areas and roadsides.

Tesfay (2010) reported that native hay is better in terms of its feeding value than crop residues if timely cut and proper handling and storage measures are applied, but it is limited in coverage. The use of agro industrial by-products such as oil seed cakes, milling by-products, molasses and improved forage is limited to the emerging private dairy and fattening farms and the scope for their wider use by smallholder producers is low due to constraints related to availability and price.

2.3 Poverty and unemployment

In Ethiopia, the real per capita income was USD 392 in 2010/11 (MoFED, 2012). The dependency ratio for Ethiopia calculated to be 92.3% based on census of 2007 data (CSA, 2008a). Ethiopian Human Development Index (HDI) of 2012 is calculated to be 0.396 which was below the average of 0.475 for countries in Sub-Saharan Africa (HDR, 2013). The Bureau of Plan and Finance (BoPF) reported for the year 2004\05, the poverty rate of Tigray region (citizens whose daily income is less than one dollar) was 48.5%. For the year 2009/10 the level of poverty was 32.8%, unemployment rate was 19% and per capita income was USD 232. Under the recent Growth and Transformation Plan (GTP) of 2010/11-2014/15, the low case scenario indicated the expected level of poverty was 26%, unemployment rate was 15% and per capita income was USD 295. Under the high case scenario, the average level of poverty, unemployment and per capita income is expected to be 23.8%, 13% and USD 347, respectively (BoPF, 2010).

2.4 Policy framework

When the current Government of Ethiopia came to power in 1991, it inherited a weak command economy characterized by fiscal deficit of 8.7% of GDP and current account deficits of 6.9% of GDP and an external debt burden equivalent to 33% of GDP (MoARD, 2010). Since the first Structural Adjustment Program (SAP) (1993–1996), the Ethiopian Government has implemented various development plans designed to promote broad-based and equitable economic growth to eradicate poverty (Engida et al., 2011). It therefore embarked on far-reaching reforms to achieve broad-based economic growth in a stable market economy. The financial services sector was opened to competition from the private sector. Equally, regulations were put into place to encourage both domestic and foreign investment, particularly in agriculture and agro-processing (Chanyalew et al., 2010).

In line with this, in 1994 the Ethiopian government formulated a long term strategy, Agriculture-Development–Led Industrialization (ADLI) that emphasizes the need to develop the agriculture sector to fuel the growth of industrial and other sectors of the economy as well as for assuring food security. According to MoFED (2002) the ADLI strategy includes the provision of technology packages to farmers through the extension systems; the enhancement of the capacity of the extension system through training and increasing its human resources; provision of credit to farmers; enhancing input and output markets; initiating and facilitating the development of cooperatives to enhance their role in marketing and service provision; developing infrastructure for irrigation and water harvesting and enhancing agricultural research capacity.

To address ADLI goals, the government of Tigray designed an agriculture development strategy for the region to be based on the rehabilitation, conservation, and development of natural resources, known as conservation-based agricultural development policy, which includes the food security strategy (FSS) as its major component. The overall objective of the Food Security Strategy (FSS) is to ensure food security at the household level, while the rural development policies and strategies of ADLI focus on ensuring national food self-sufficiency (MoFED, 2002).

The first version of the food security strategy was issued in 1996 and revised in 2002 highlighting the government's plan to address the causes and effects of food insecurity in the country (Van der Veen, and Gebrehiwot, 2011). The strategy envisages developing an agriculture-based economy by raising farm productivity and income. Furthermore, the food security measures aim to promote and strengthen micro and small-scale enterprise development, improving the food marketing system, promoting and strengthening supplementary employment, income generating schemes, and credit services to address the demand side problems. Following the conservation-based agricultural development strategy and food security strategy, the regional government has launched a series of development and poverty reduction programs. Consequently, different programs such as natural resource conservation, human capital development, infrastructure and reform of financial markets have been implemented over the past years to improve food security both at the household and regional level (Van der Veen, and Gebrehiwot, 2011).

This recent empirical study attempts to investigate the effectiveness of government policy interventions at different scales addressed to improve food security in Tigray region (Van der Veen, and Gebrehiwot, 2011). The findings of the study revealed that the region has made some impressive development gains in improving regional food self-sufficiency, indicating the importance of government interventions in improving food security both at the household and regional level. The findings of their study (Van der Veen, and Gebrehiwot, 2011) reveal that food availability and food self sufficiency at the regional and district level improved over the period 2000-2008. The food self sufficiency ratio (SSR) in the region increased by 8.6%. As a result, the food deficit declined by 32% over the time period.

According to Woldehanna (2004) Ethiopia prepared its Interim Poverty Reduction Strategy Paper (IPRSP) in 2000 and the full poverty reduction strategy paper (PRSP) named as Sustainable Development and Poverty Reduction Programme (SDPRP) was finalized in 2002. The SDPRP was implemented for the duration of 2002/03-2004/05. The Ethiopian SDPRP was built on four pillars, namely (a) Agricultural Development-Led Industrialization (ADLI) and food security, (b) Justice System and

Civil Service Reform, (c) Decentralization and Empowerment, and (d) Capacity Building in Public and Private sectors. Of the four building blocks, ADLI is designed to develop the agricultural sector, reduce poverty, ensure food security, and ultimately bring industrialization. The other three blocks are designed to enhance the effectiveness of ADLI in reducing poverty and ensuring food security (Woldehanna, 2004).

The Ethiopian Poverty Reduction Strategy Paper (PRSP) called SDPRP has identified key sectors such as agriculture, health, education, water, and road. Among which agriculture was the most important element for reducing poverty of the mass of people living in rural areas. During the program period of SDPRP, the real GDP, on average, was targeted to grow by at least 7% per annum and the government committed to meeting the Millennium Development Goals (MDGs) such as eradication of extreme poverty and hunger, universal primary education, gender equality and empower women, reduce child mortality and improve maternal health by 2015. Finally, the performance evaluation of SDPRP indicated that the major achievement in the year 2003/04 was an economic growth of 11.6%, driven mostly by recovery from the drought, strengthened support to exports and private sector, improved responsiveness of services, access to finance, access to land and maintenance of macroeconomic stability, as inflation reduced from 15% to 9% (MoFED, 2005; MoFED, 2007).

Achievements registered under SDPRP were the basis for the successive Five Year phase (2005/06-2009/10) of Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) (MoFED, 2006a). The main development objective of the Ethiopian Government is poverty eradication. The PASDEP represents the second phase of the Poverty Reduction Strategy Program (PRSP) process, which has begun under the Sustainable Development and Poverty Reduction Program (SDPRP), which covered the past three years, 2002 -2005. During the PASDEP period, Ethiopia built on the development strategies pursued under SDPRP (expanding education, strengthening health service provision, fighting HIV/AIDS, Food Security Program, capacity-building as well as decentralization). It will also continue to pursue on the ADLI strategy, but with enhancements to capture the private initiative of farmers and support the shifts to diversification and commercialization of agriculture (MoFED, 2006b).

The Plan for Accelerated and Sustained Development to End Poverty (PASDEP) was the First Five Year Phase to attain the goals and targets set in the Millennium Development Goals (MDGs). The main objective of the PASDEP was to lay out the directions for accelerated, sustained, and people-centred economic development as well as to pave the groundwork for the attainment of the MDGs by 2015 (MoFED, 2006a). Ethiopia's strategy under PASDEP consisted of the following eight pillars: building all-inclusive implementation capacity; a massive push to accelerate growth; creating the balance between economic development and population growth; unleashing the potentials of Ethiopia's women; strengthening infrastructure; strengthening human resource development; managing risk and volatility; and creating employment opportunities (MoFED, 2006b).

In relation to this, the government had established two alternative growth scenarios under PASDEP. The first scenario (the base case) was established in line with the requirements of MDGs, while the second scenario (the high case) which equivalent to the 'MDGs Plus' scenario was based on the requirements of the country's vision. In the base case scenario, 7% annual average real GDP growth was targeted while the target in the higher case scenario was set at an average real GDP growth of 10%. In both scenarios the performance achieved in the time of PASDEP implementation was remarkable. The average growth performance achieved as measured by real GDP growth was 11% that exceeded the growth targets set under both scenarios of PASDEP (MoFED, 2006a). Some of the drivers of growth were big investment in human capacity, expanding infrastructure, commercialization of agriculture and private sector development, rural development programmes, strengthening of rural-urban linkage, building institutions and decentralizing the government administration.

Ethiopia's previous economic growth rate under PASDEP, at 11% per annum, was remarkable and well in excess of population growth (2.6%) and the growth rate (7% per annum) required for achieving the MDG goal of halving poverty by 2015 (ADBG, 2011). In Tigray region, it was planned in the previous strategic plan (2005/06 - 2009/10**)** of PASDEP to register an average growth rate of 10% annually and up to 2010, an average of 11 % growth was registered every year (BoPF, 2010). During the

time of PASDEP's implementation, substantial economic growth and significant progress on social and human development were also achieved in Ethiopia (Engeda et al., 2011).

Thus, the performance achieved in five years (2005-2010) of PASDEP implementation was remarkable. At the same time lessons were drawn from the major challenges under the implementation of PASDEP such as: high inflationary pressure partly induced by external factors, inadequate capacity for domestic revenue collection, low level of domestic savings and poor rainfall distribution (MoFED, 2006a). As part of poverty alleviation, SDPRP and PASDEP were also focussed on disaster prevention and vulnerability reduction (Abebe, 2010).

The five years Growth and Transformation Plan (GTP) for the period 2010/11-2014/15 is also directed towards achieving the Millennium Development Goals (MDGs), Ethiopia's long term vision and sustaining the rapid, broad based and equitable economic growth anchored on the experiences that have been drawn from implementing pro-poor and pro-growth development policies and strategies (MoFED, 2012).The country's long term vision, achievements of PASDEP and lessons drawn from its implementation are the bases for conceiving the five year Growth and Transformation Plan (MoFED, 2006a). The overriding development agenda of the GTP is to sustain rapid, broad-based and equitable economic growth path witnessed during the past several years and eventually end poverty (MoFED, 2012). Growth and Transformation Plan (GTP) is the Government's vision to propel Ethiopia into middle income country status by 2025 (ADBG, 2011).

GTP in comparison to past development plans of the country might differ due to its high economic growth and other development targets. According to the Ministry of Finance and Economic Development (MOFED), two growth scenarios are considered in the GTP: medium (base case) growth and high (high case) growth scenarios. Under the base case growth scenario, Ethiopia's economy is projected to grow at a rate of 11.2% that attained during PASDEP (MoFED, 2012). All MDG targets' were expected to meet under this scenario. Under the base case scenario, it is assumed that the economy will be able to grow provided that the same stable policies and strategies are followed at macroeconomic and sectoral levels as adopted previously; prudent

monetary and fiscal policy help to ensure inflation at single digits; and that tax collection and administration systems are strengthened so as to increase domestic revenue substantially. Under the high growth scenario, an annual average GDP growth rate of 14.9% is targeted. The basic assumption for the high case scenario is placing the economy on higher growth trajectory by doubling agricultural value added through scaling up the productivity level of smallholder farmers and pastoralists to the productivity level of model or successful farmers and pastoralists so as to stimulate the growth of other economic activities (MoFED, 2012).

The GDP growth in the high case growth scenario is thus significantly different from the growth in the base case growth scenario due to the large growth difference in the agricultural sector. In contrast, the growth targets in the industry and service sectors in the high case growth scenario are only slightly higher than in the base case growth (Engeda et al., 2011).

The GTP's strategic pillars are broad based economic and social developments that incorporate sustaining rapid and equitable economic growth, maintaining agriculture as major source of economic growth, creating conditions for the industry to play key role in the economy, enhancing expansion and quality of infrastructure development, enhancing expansion and quality of social development, building capacity and deepen good governance, and promote gender and youth empowerment and equity (MoFED, 2012).

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To implement the GTP, the regional government of Tigray has developed the following four basic directions to be implemented by all government institutions at all

levels (BoPF, 2010). The first is to assess and correct the establishment of development work forces of agricultural sector and other sectors at all levels. The second is implementing the national GTP by relating with the reality of Tigray region, and utilizing all opportunities that the national GTP creates for achieving the objectives set. The third basic direction is improving the capacity of the leadership, upgrading their skills of management and establishing the capacity of those who have proven to be new members of administration bodies. The fourth basic direction addresses the strengthening of participation of the public in all government activities.

To address the regional objective of the GTP, the regional government has set two case scenarios (base and high) to ensure the attainment of the regional objectives during the five years (2010/11-2014/15). The first is maintaining the registered 11.0% average growth in the coming five years under base case scenario. The second (high case scenario) is scoring an average growth of 14.9% annually, doubling the gross demotic product (GDP) of the region in the five years (2010/11-2014/15). The regional government, however, is trying to achieve the high case scenario GDP growth to shorten duration of poverty reduction in the region (BoPF, 2010).

2.5 Disaster management program

Ethiopia has a long history of both major and minor disasters, triggered by various types of hazards. By far the most common is drought. Recent analyses have noted that the “once in ten years” narrative of drought in Ethiopia is changing, influenced at least in part by climate change (Lautze and Maxwell 2006). In Ethiopia, the frequency of drought was ten times in some areas while twice in most part of the country between 1990 and 2007 (Coates et al., 2010).

Disasters have massive human and economic costs and they may cause many deaths, severe injuries, and food shortages (Sena and Weldemichael, 2006). Most incidents of severe injuries and deaths occur during the time of impact, whereas disease outbreaks and food shortages often arise much later, depending on the nature and duration of the disaster. Anticipating the potential consequences of disasters can help determine the

actions that need to be started before the disaster strikes to minimize its effects (Sena and Weldemichael, 2006). Risk and shocks are the main challenge to Ethiopia, affecting food security, poverty reduction and sustainable development efforts. Considering this, the Federal Democratic Republic of Ethiopia (FDRE) has already put in place policies, strategies and programs that aim to enhance the adaptive capacity and reduce the vulnerability (NMA, 2007).

The Relief and Rehabilitation Commission (RRC), was established by the Derg (former military government) in the aftermath of the 1973/74 food crisis. Its mandate was limited to an ex-post delivery of relief to drought and famine affected population. In 1993, following the overthrow of the Derg by the current government, a National Policy on Disaster Prevention and Management (NPDPM) was issued. In 1995, the RRC was abolished, and replaced by the Disaster Prevention and Preparedness Commission (DPPC) (Coates et al., 2010). DPPC legislation seeks to prevent disaster (like drought) by targeting the basic causes which ensure them, build resources and institutional capacity well in advance of disasters and put the necessary logistics in place to be able to alleviate during the disaster (Abebe, 2009).

DPPC was given a broad mandate that included preparedness and prevention, although its main mandate was still to respond to emergencies. Substantial investment was made in a national early warning (EW) system, initially focusing on the agricultural highlands. This system was extended to pastoral areas in the wake of the 1999/2000 crisis in order to address risk and shock on pastoral areas. A national strategic grain reserve of the Emergency Food Security Reserve Administration (EFRSA) was established to enable a more rapid response in the event of a crop failure from drought. In 2004, the DPPC was renamed as the Disaster Prevention and Preparedness Agency (DPPA), with a revised mandate to focus on emergency response (Coates et al., 2010).

To combat the persistent problem of food insecurity and to move away from the previous system of annual emergency appeals, the Ethiopian government and a consortium of donors launched in 2005 a new social protection program called the Productive Safety Net Program (PSNP) (Andersson et al., 2011). The annual budget

of PSNP was nearly US $500 million that reaching more than 7 million Ethiopians (Gilligan et al. 2008). Most notably, the Productive Safety Net Programme (PSNP) has introduced a multi-annual, predictable and increasingly cash-based mechanism for providing support to the chronically food insecure (Hess and Wiseman, 2007).

The Productive Safety Net Program (PSNP) in Ethiopia is the largest social protection program in Sub-Saharan Africa outside of South Africa (Andersson et al., 2011). The PSNP is a public program through which food-insecure people are employed in public work for five days a month during the agricultural slack season. This is intended to enable households to smooth consumption so that they will not need to sell productive assets in order to overcome food shortages. The public work is also intended to reduce seasonal liquidity constraints and to stimulate investments as well (Andersson et al., 2011).

The PSNP has undertaken in two mechanisms: participation in public work activities and direct support. Public works are used to mitigate the impacts of climatic and food insecurity risks on chronically food-insecure farmers by providing employment to "able-bodied" labourers. Public works include environmental protection measures to create valuable public goods such as tree planting on public land and soil and water conservation measures. It is the core component of the safety net program and creates a market for unskilled labour, primarily by involving them in labour-intensive, community-based activities. Direct support is a minor component and delivers assistance to members of the community who cannot participate in public works but need help (like the old age members) (Andersson et al., 2011). The Ethiopian PSNP has three objectives: smoothing food consumption in chronically food insecure smallholder households by transferring food or cash in order to buy food during the 'hunger gap' months; protecting household assets by avoiding damaging 'coping strategies' such as selling productive assets or taking on high interest loans to buy food; and building community assets by selecting public work activities that create infrastructure with developmental potential (such as feeder roads) (Devereux and Guenther, 2009).

The PSNP is one of several components of the Ethiopian government's Food Security Program. The other components are subsidies for voluntary resettlement and a

package of programs jointly called Other Food Security Programs (OFSP). OFSP includes a wide range of activities that differ by regions, but the main element is a package of loans for agricultural and non-agricultural activities. The federal plan is that 30% of the PSNP beneficiaries should also be covered by OFSP. To this end, the effect of this set of programs was that, since households would no longer need to sell off assets as a result of income shocks, their productive assets will increase over time. Finally, these food-insecure households are expected to escape from their chronic situation in five years (Andersson et al., 2011).

The other important innovation in the Ethiopian context has been the design of a weather-index based crop insurance that was developed and tested for implementing the Ethiopia Drought Insurance Pilot Project. The pilot project has been supported by WFP. The pilot used a weather derivative to demonstrate the feasibility of establishing contingency funding for an effective aid response in the event of contractually specified severe and catastrophic shortfalls in precipitation in the year 2006 (Hess and Wiseman, 2007). The objective of the pilot project was to contribute to an ex-ante risk-management system in order to protect the livelihoods of Ethiopia's vulnerable populations who are not included in the PSNP, but who are at-risk of income and asset losses resulting from severe and catastrophic drought (Hess and Wiseman, 2007).

The other is the crop insurance that was being implemented in different parts of Ethiopia. In relation to this, HARITA (2009) indicated that an innovative public-private collaboration project on weather index micro-insurance for the cereal crop teff was underway in the village of Adi-Ha, Tigray. Including poor farmers in index-base teff insurance based on labour contribution (farmers work in soil and water conservation and rehabilitation programs) instead of paying cash was a way of addressing farmers' affordability problem. However, there is a need to study the impact of this micro-insurance for farmers in terms of risk mitigation and livelihood. Similar pilot project on crop insurance was also undertaken in countries such as Kenya, Malawi, Zambia, Pakistan and Bangladesh.

The agricultural sector in general and smallholder and pastoralist farming in particular is an important livelihood strategy for almost all farmers in Ethiopia. The government

of Ethiopia has put in place policies and strategies that aim to improve agricultural productivity, enhance adaptive capacity and reduce vulnerability. Disaster Prevention and Preparedness Agency (DPPA) is putting operational framework for disaster management that places premium on formulating strategies towards prevention and risk reduction measures, while at the same time laying stress on a coordinated and concerted effort for relief and recovery. These development efforts merit investigation to establish their role in alleviating the need for food insecure households taking short term coping strategies that have long term negative impacts on farmers' livelihood.

Accordingly, the aim of this study is to investigate risk perception and management strategies and explores the role of livestock insurance as a risk management strategy in rural livestock farming. In this study, major sources of risk, attitude to risk, relevant risk management strategies and role of livestock insurance and its determinants is analysed in the drought prone region of Tigray, Northern Ethiopia. Literature review on types of risks, risk management strategies, agricultural insurance and conceptual framework is presented in the subsequent chapter.

CHAPTER THREE

3. AGRICULTURAL RISK AND RISK MANAGEMENT: A REVIEW OF THE LITERATURE

3.1 Introduction

Agriculture is often characterized by high variability of production outcomes. Unlike most other entrepreneurs, agricultural producers are not able to predict with certainty the amount of output that the production process will yield due to external factors such as weather, pests, and livestock diseases (Wenner, 2005; World Bank, 2005). The economic stability of an entire rural area can be jeopardized by crises caused by different types of natural disasters, from climatic events to livestock or plant diseases. Weather risks are a major source of uncertainty for farms. Drought or excess rain is responsible for livestock loss all over the world (Anton, 2008; Bielza et al., 2008; IPCC 2007). The impact of natural hazards such as weather variability, climate extremes, and geophysical events on economic well-being and human sufferings has increased alarmingly (Linnerooth-Bayer and Mechler, 2009).

Due to risk and shocks in agriculture, it leads not only to uncertainty in the level of production, but also to uncertainty in output prices. This can result in severe income losses and to fluctuations in consumption (Haile, 2007). Low and middle-income countries, and especially the vulnerable within these countries, suffer the most (Linnerooth-Bayer and Mechler, 2009).

Given their limited ability to offset these risks and shocks, many rural households suffer from extreme farm income fluctuations. The prevalence of risk and shocks is not new and farmers have developed ways of reducing and coping with risk (e.g. crop diversification, selling livestock, storage, borrowing and safety net) (Haile, 2007). In addition, insurance and other risk financing strategies are viewed to recover from negative income shocks through risk pooling and transfer (Linnerooth-Bayer and Mechler, 2009).

3.2 Risk: Definitions and related terms

The word ‘risk’ is a common and widely-used part of today’s vocabulary, yet somewhat surprisingly, there is still no broad consensus on the meaning of this term (Legesse and Drake, 2005). Knight was the first to distinguish risk from uncertainty. He distinguish between measurable uncertainty and unmeasurable uncertainty, we may use the term ‘risk’ to designate the former and the term ‘uncertainty’ for the latter (Knight, 1921). Knight's famous definition of ‘risk’ relates to objective probabilities while ‘uncertainty’ relates to subjective probabilities (Holton, 2004). Most authors find a more useful distinction between uncertainty as imperfect knowledge and risk as exposure to uncertain unfavourable economic consequences (Legesse, 2006; Hardaker et al., 2004; Holton, 2004; Hardaker et al., 1997). Knowledge of farmers’ attitude towards risk is important in determining how farmers behave for new agricultural practices. According to Kouame and Komeman (2012) the theory of insurance demand shows that risk averse households will voluntarily purchase insurance if it is offered to them. However, an empirical study in Cote d'Ivoire showed inconsistent results with this theory of insurance demand. That is, high risk aversion negatively affects the demand for insurance.

There is a great deal of argument over whether risk is subjective or objective or some combination of both (Campbell, 2006; Mitchell, 1999). Particularly, there are two different views or philosophies whether risk is objective or subjective. The former are the scientific realist researcher that believes in objective risk while the latter are the relativist researcher that believes in subjective risk (Mitchell, 1999). However other study (Hansson, 2010, pp.231) argued that ‘risk is both fact-laden and value-laden and risk as objective as well as subjective components’. Mitchell (1999) reported that objective risk must exist in theory but what is lacking is the ability to measure it. Mitchell (1999) argues that experts can measure time risk, financial risk, physical injury and partly physical harm objectively but psychosocial risks (like depression) are subjective which are difficult to measure although psychometric scales, in some cases, could be devised to measure such phenomena.

Empirical research indicates that risks are some of the determinants of technology adoption, production, marketing and the investment decisions of farm households

(Paudel et al., 2000; Mazid and Elizabeth, 1992; Smidts, 1990). According to Haile (2007) risks and uncertainties impact households' production and consumption decisions and knowledge of how subsistence farm households make economic decisions under risk provides useful information for policy makers.

Risk and uncertainty play a significant role in almost every important economic decision. People differ in the way they take decisions involving risk and uncertainty due to differences of risk attitude (Reynauld and Couture, 2011). Risk attitude is the extent to which a decision-maker seeks to be a risk-taker, risk-averse or risk neutral (Ogurtsov, 2008). Knowledge of farmers' attitude toward risk has important implications for the adoption of new farm technologies and the success of rural development programs (Wik and Holden, 1998; Grisley and Kellog, 1987).

Risk, defined as the chance of loss or the loss itself, may threaten the economic security of the household (Valdivia, 1996). Risk in this thesis refers to the 'probability that an undesirable state of reality (adverse effects) may occur as a result of natural events or human activities' (Legesse and Drake, 2005, pp.383).

Risk attitude and risk perception are two different concepts. Whereas risk attitude deals with decision-makers' interpretation of the content of the risk and how much they like or dislike the risk (risk seeking and risk aversion), risk perception instead deals with the decision-maker's interpretation of the chance to be exposed to the content of the risk (Pennings et al., 2002). Risk perceptions may be influenced by values, beliefs, knowledge and culture (Slegers, 2008).

Risk perceptions are subjective measures of risk which are based on subjective evaluation of the individual (Hansson, 2010; Georgakopoulos and Thomson, 2005; McCarthy and Henson, 2005). 'There is no statistical evaluation involved in risk perception and it is the felt belief of the individual that formulates the level of risk perceived' (McCarthy and Henson, 2005). The two terms 'subjective risk' or 'perceived risk' are used interchangeably in literature (Hansson, 2010). Knowledge on risk perception is an important precondition for devising risk management strategies (Legesse and Drake, 2005). Farmer's perception on source of risk and risk

management in response to various risks can have an impact on resource use patterns and thereby on productivity (Legesse, 2000).

Risk management strategies adopted by farmers reflect their personal perceptions of risk (Beal, 1996). Risk management is a process of reducing uncertainty through risk defusing like agricultural diversification, share cropping and insurance (Kostov and Lingard, 2003). Diversification such as mixed farming, wage labour, dispersed cropping fields and livestock pastures and temporary migration smoothes income to the household by reducing both predictable and unpredictable fluctuations (Valdivia et al., 1996). According to Holzmann and Jogersen (1999a) risk management strategies incorporate: *prevention* strategies to reduce the probability of an adverse event occurring, *mitigation* strategies to reduce the potential impact of an adverse event and *coping* strategies to relieve the impact of the risky event once it has occurred

The first, and arguably the highest priority in risk management is to invest in preventing or mitigating human and economic losses. Insurance instruments are one of the many options in managing risks of natural hazards (Linnerooth-Bayer and Mechler, 2009). Insurance is a financial arrangement in which the insured pays a small amount (premium) up front in return for the insurer's promise to pay a much larger sum (claim) in the event of adverse effect (Roth and McCord, 2008).

Furthermore, depending on the type of risk correlation there are micro (idiosyncratic) risks that are peculiar to individuals or household and aggregate (covariant) risks that are common to wider population. Idiosyncratic risks are not correlated risks and affect individual farms or farmers (Townsend, 1995). Household illness, injury, disability, old age, death, crime, unemployment and harvest failure are types of idiosyncratic risks. Risks of aggregate shocks are typically covariant (systemic) and are often correlated across farms in a country and across sectors in the economy. Examples of aggregate (macro) risks include earthquake, flood, drought, environmental problems, inflation, epidemics, war, output collapse, political default on social programs, balance of payment and financial crisis (Holzmann et al., 2003; Holzman and Jorgensen, 2001; Holzmann and Jorgensen, 1999b).

3.3 Types and sources of agricultural risks

There are various types of risks that are associated with the agricultural sector, as shown in Table 3.1. Production risk is one of the significant causes of farm income variability associated with drought, flood, and excess rainfall at harvest, frost, livestock diseases, insects and pests. Some of the strategies and tools addressing production risk involve diversification, irrigation, site selection, genetic selection, insurance, sanitation programme, production contract, crop protection, tillage system and nutrient management (European Commission, 2001; Legesse, 2006; O'Occoner et al., 2008; OECD, 2009; Drollette, 2009a, 2009b).

Marketing risks which could be referred to as price risks (Drollette, 2009a) are associated with changes in demand and supply. Changes in demand are related with change in consumers' taste, preference and disposable income. But change in supply is caused by numerous factors that may impact on supply such as: input cost, technology, weather, trade policy and government policy. Emergence of new markets, market access and market availability also results in market risks. In addition, the price of a substitute or complement may impact on demand and supply. To address marketing risk, there are strategies and tools such as using recent market information to update market plan, understand consumers taste and preference and their ability and willingness to pay for the item. Moreover, being engaged oneself in price contracts, futures and options and joining marketing cooperatives are important tools that help to mitigate the marketing risks (Bielza et al., 2008; O'Oconner et al., 2008; European Commission, 2001).

Financial risk is basically the inability of the farm's cash to meet obligations when it is due. Some of the sources of financial risks are changes in interest rates, foreign exchange value and value of financial assets. It is also associated with inflation, access to credit, debt-to-asset ratio, loan repayment, debt financing and cash flow. Some of the tools and strategies that minimize financial risks are: maintain equity (cash and non cash) reserve, negotiate longer term debt repayment, increase solvency (decrease debt asset ratio), maintain liquidity of current ratio and control key financial ratios and expenses. In addition to this, updated strategic and farm business plan, use

of financial analysis information are potentially important (Drollette, 2009a; 2009b; OECD, 2009; Legesse, 2006).

Table 3.1: Major types and sources of agricultural risks

Types of risks	Source of risk
Production	Drought, flood, hail, frost, fire, wild animals, livestock diseases, livestock mortality, insects and other pests.
Marketing	Changes in demand and supply, market access, price variability and poor market information.
Financial	Changes in interest rates, foreign exchange value, inflation, access to credit, debt-to-asset ratio, repay loans, debt financing, cash flow.
Institutional	Changes in regional or national or international policy, laws and regulation, property rights.
Technological	Using obsolete technology, use of modern breeding, use of artificial insemination (AI), adoption of high yield external input.
Human	Lack of a trusting relationship, lack of consistent communication, three D's (divorce, death and disabilities), illness and conflict and shortage of labour.

Source: Bielza et al., 2008; Drollette, 2009a, 2009b; OECD, 2009; Legesse, 2006; Moschini and Hennessy,2001).

The sources of institutional risk are related to changes in national policies, laws and regulations and the influence of international policies. More specifically, agriculture may be impacted by policies and regulations involving trade, taxes, transportation, banking, and macroeconomics. Institutional risk can be countered through follow up of timely information on changes of policy, maintain network with institutional officials and more capability to analyze changes (Bielza et al., 2008; OECD, 2009; Legesse, 2006; Moschini and Hennessy, 2001).

Technological risk arises from using obsolete technology that affects competitiveness in terms of quality and quantity of production. In developing country it is also important to be aware about the use of new technology like high yield crop varieties, use of artificial insemination (AI) and adopting modern livestock breeding. Some of the risks associated with technology could be minimized through being informed about new developments, gather information at trade shows and from trade magazines, negotiate on-farm trials before purchase of the inputs, research and output

dissemination, training and capacity building and strengthening of agricultural extension (Moschini and Hennessy, 2001; Legesse, 2006).

Finally human risk in relations to farmers' relationship with economic agents and families has a major impact on agricultural sector. Human relationship with political leaders, consultants, input suppliers, buyers and other producers have a major impact on the business. Besides family problems related with divorce, death and disabilities, health problems, shortage of labour and conflict among household or community have a direct impact on the agricultural activity. Measures such as: consistent communications, periodic business reports, farm visits, regular family meetings, insurance and regular health check-ups, sound conflict management could minimise the human risks (Legesse, 2006).

The type of agricultural risk varies from region to region and from country to country and the effect of these risks is also varying accordingly. One of the major types of agricultural risks in poor countries is associated with production risk due to drought, flood, frost, crop diseases, animal mortality due to infectious disease, and so on. This production risk is directly or indirectly associated with price risks. For example, drought is usually followed by shortage of feed and fodders for livestock; and farmers sell their livestock at low price due to low demand at that time. There are many risks and uncertainties in the agricultural sector due to multiple factors such as: climate change, market failure, externalities, local and international policies, regional and continental markets, globalisation, peace and stability, politics and so on. Thus, it is crucial for farmers to have clear information about the types and sources of agricultural risks so as to counter the potential risks and shocks.

3.4 Agricultural risk management strategies

It is important to distinguish between strategies to cope with risk versus shock. While the former refers to strategies to deal with the prospect of being affected by an uncertain event, the latter refers response to a realized uncertainty. Ex-ante risk management and ex-post risk coping strategies can be defined as measures taken before and after experiencing shocks, respectively (Fafchamps, 2003). A more useful distinction is between strategies that seek to reduce risk itself and strategies that seek

to insulate welfare from risk, one could say, preventive and curative measures (Fafchamps, 2003). While the ex-ante risk management strategies are for long-term survival, the ex-post risk coping strategies are merely for short-term survival adjustment (Bhattamishra and Barrett, 2008; Freeman, 2008; Leeuwen, 2005; World Bank, 2005; Holzmann et al., 2003; Anderson 2001).

More concrete risk management strategies are grouped into three categories: prevention, mitigation and coping strategies. Agricultural risk prevention and mitigation are parts of the ex-ante risk management strategies and the risk coping strategy is part of the ex-post shock coping strategies (Holzmann and Jogersen, 1999a). Ex-ante risk management strategies focus on income smoothing while ex-post coping strategies focus on consumption smoothing (Valdivia et al., 1996). According to Morduch (1995) households can smooth income and most often achieved by making production and employment choices and diversifying economic activities. In this way, households take steps to protect them-selves from adverse income shocks before they occur. Households can also smooth consumption by borrowing and saving, depleting and accumulating nonfinancial assets and adjusting labour supply. These mechanisms take force following the shocks and help insulate consumption patterns from income variability.

In poor income countries due to lack of market institutions and lower public support, farmers are coping them-selves from risk and shocks through informal arrangements with low level of formal risk management and coping strategies (Ellis, 1998; Alderman and Paxon, 1992). Based on informal, formal and public provided mechanisms the main risk management strategies are categorized in Table 3.2.

Table 3.2: Classifications of risk management strategies

Arrangement strategies	Informal/personal	Formal /Market Based	Publicly provided
Risk prevention	-Choosing less risky production -Migration -Relocation to less risk prone area.	-In-service training -Financial market literacy.	-Macroeconomic policies -Labour market policies -Disaster prevention (flood control) -Investment in irrigation and roads -Prevention of animal diseases.
Risk mitigation	-Diversification in production -Social capital (ritual, gift-giving, informal risk pooling). -Share tenancy.	-Investment in financial assets -Microfinance -Off-farm work -Crop &livestock insurance - Production and marketing contract	-Tax system for income smoothing. -Insurance for unemployment, disabled and old age.
Risk coping	-Selling livestock and productive assets.	-Selling financial asset -Borrowing from banks	-Social assistance and subsidies -Public works and safety nets

Adopted: ; Melyukhina, 2011; Holzmann and Jogersen 1999a, 1999b; Valdivia et al., 1996

Risk protection (prevention) strategy involves taking actions that reduce the probability of the risk occurring. Examples would be building an irrigation system so that water supply can continue through a drought or applying vaccination to avoid livestock diseases. Risk protection is a pro-active strategy that helps households' with income smoothing. Mitigation strategies reduce the potential impact if the risk were to occur. As with preventive strategies, mitigation strategies are also employed before the risk occurs (Holzmann and Jogersen, 2000).

Risk mitigation strategy has a major impact on reducing farmers' risk sources. The main goal of this strategy is income smoothing. Holzmann and Jogersen (1999a) indicate that some of the major risk mitigation strategies are diversification, informal risk pooling and marketable risks (like formal insurance, production contract, marketing contract, hedging on futures markets). Furthermore, publicly provided support such as credit access, provision of insurance for unemployed and poor people are important to mitigate the risk.

Insurance is one of the known risk pooling mitigation tools. It is part of the ex-ante (risk mitigation) strategies. Community based emergency fund is an informal risk

mitigating strategies (informal insurance) in developing countries such as Ethiopia. Under this approach, in the case of cattle death, the community recover partly the value of dead cattle for the owner by buying meat after slaughter

With regard to production contracts, the contract typically give the contractor (the buyer of the commodity) considerable control over the production process. These contracts normally specify the production inputs to be used, the quality and quantity of the final product and the price to be paid to the producer. In a marketing contract, a farmer agrees to sell a commodity at a certain price to a buyer before the commodity is ready to be marketed. The farmer retains full responsibility for all production management decisions. The contracts can take many forms. They can be based on a fixed price or alternatively depend on the commodities futures price (European Commission, 2001).

Risk coping strategy is concerned with reducing the impact of the risk after it has occurred. It is a methods used by households to survive when confronted with unanticipated livelihood failure (Ellis, 2000). Once the disaster has occurred, governmental and non-governmental organisations provide support in terms of disaster relief and social assistance. In developing countries the disaster relief is mainly food aid and other types of basic necessities. Holzmann and Jogersen (1999b) and Valdivia et al. (1996) indicate that after the disaster households are engaged in activities like selling their livestock, drawing down food stock, increased child and female labour market participation, remittance, borrow money from various sources, taking children out of school, increased austerity (meal substitution, meal reduction, reducing household items, postponing health care expenditure).

3.5 Agricultural insurance

3.5.1 Insurance overview

Agriculture is inherently risky and it has large negative impacts on agricultural income, food security, and the capacity of the sector to develop and invest in its own sector. As a result, public policies along with Non-Governmental Organizations in many developing countries are trying to address this problem. In relation to this, there are various tools to manage agricultural risks with insurance being one of them.

Informal insurance is the one which is provided through informal decentralised risk-pooling arrangements such as mutual fund or community based fund and there may be legal or without legal basis on which agents can rely to make binding contracts and enforce promises, in comparison to formal insurance that has a clear legal ground (LeMay-Boucher, 2009; Platteau, 1997). A mutual fund is a special case of insurance where the funds are owned by the participants. In the case of a member incurring a loss, the loss is fully or partially compensated through the collected money already available in the fund and an additional collection among participants (European Commission, 2001). In developing countries a community based emergency fund is synonymous with a mutual fund. If the community emergency based fund and mutual fund are organised for a small administrative region, farmers know each other and this reduces problems of moral hazard and adverse selection.

In developing countries there are various informal arrangements such as marriage and savings in the form of real assets such as cattle, real estate and gold. The disadvantage of such type of risk management arrangement is when the risk is systemic shocks. During systemic shocks the domain of the risk impact is large on the society level in which case the available resources of the informal insurance arrangement cannot cover the loss (Ellis, 1998; Alderman and Paxon, 1992). According to the Association of Ethiopian Microfinance Institutions (AEMFI, 2009) empirical evidence has shown that poor households devise various means to mitigate risks associated with income shocks, disasters and other calamities. However, many informal insurance schemes are found to be inadequate and unreliable.

Microinsurance is the protection of low-income people against specific perils in exchange for regular premium payments proportionate to the likelihood and cost of the risk involved. This definition is essentially the same as one might use for regular insurance except for the clearly prescribed target market: people with low-income (Churchill and McCord 2012). Microinsurance is a risk pooling mechanism tailored to the needs of low-income families in terms of costs, duration, coverage and delivery. Purchasing micro-insurance is an action to take before a crisis occurs in order to protect against loss and farmers feel more security. Microinsurance is part of the formal insurance with bigger scale than informal insurance.

Similarly, formal insurance is a financial arrangement in which the insured pays a small amount (premium) up front in return for the insurer's promise to pay a much larger sum (claim) in the event of a defined adverse event (Roth and McCord, 2008; Mahajan, 2005; Holzmann and Jogersen, 2001). Micro-insurance is the same arrangement, applied to suit the needs of poor people, where both the premium and the claim amounts are small compared to regular insurance (Arun and Steiner, 2008; Mahajan, 2005).

If re-insurance or state guarantees are not available, the nature of the systemic risks makes it necessary for an insurance company to charge very high premiums which can be unaffordable for farmers in poor income countries. This means that comprehensive agricultural insurance schemes need strong support from the public sector and other stakeholders to provide broad coverage at an affordable price for the farmers.

However, there is a lot of debate in the literature with regard to the feasibility of formal agricultural insurance, especially in developing countries. Individual based livestock insurance is challenged with problems such as high administrative cost, adverse selection and moral hazard. Index Based Livestock Insurance (IBLI) avoids the problem of moral hazard but it is challenged due to basis risks. Index-based livestock insurance (IBLI) compensates clients in the event of a livestock loss. IBLI is used to protect against shared rather than individual risk, such as the risks associated

with weather fluctuations and disease out-breaks. Unlike individual insurance which assesses loses on a case by case basis and makes payouts based on individual client's loss realizations, IBLI offers policy holders a payout based on the external indicator which triggers a payment to all insured clients within a geographically defined space. However, it is possible to set up an innovative approach to manage the core challenges of agricultural insurance such as moral hazard, adverse selection, high administration cost, and basis risk.

In relation to this a study (Anderson, 2003) argued that agricultural insurance even with novel design (such as index insurance), there are implementation issues yet to be ironed out and it is premature to declare such index based agricultural insurance instruments to be routine good practice in rural areas of developing countries. It seems likely, however, that 'they will soon be widely recommendable, and probably handled routinely by the private insurance industry (Anderson, 2003, pp.183). Most agricultural insurance (crop and livestock insurance) in developing countries are still supported and managed by international institutions such as World Bank, World Food Program, Oxfam America and private insurance companies.

Compared to agricultural insurance, the same study (Anderson, 2003, pp. 188) argued that 'microfinance services are contributing importantly to helping poor people build their assets critical in protecting against risks ahead of time and coping with losses afterwards'. More generally, having a financial system serving rural areas in a flexible manner that recognizes the riskiness of life in such space is the best single approach to helping all concerned to manage their risks.

Similarly, other study in the context of developing countries (Dercon, 2009) argued that insurance is not necessarily the best policy intervention to deal with many types of risk, especially in context of high poverty for three reasons: First, rather than insurance, risk reduction and management may be the most relevant response for many types of risk such as conflict, crime and risk reduction are preventive human and animal health measures, water management, and environmental protection. Second, many types of risk are not easily insurable, simply because they cannot be actuarially priced since the risks are unknown due to incomplete basic data on health, longevity, and climate. Third, offering insurance does not remove the need to find

ways of lifting the poor out of poverty: insurance will prevent a worsening of poverty and may allow more risk-taking by the poor, but it is not a substitute for more general policies to promote income growth.

According to Dercon (2009) insurance markets suffer from serious informational problems (including adverse selection and moral hazard) possibly even greater than those faced by credit markets. It is, nevertheless, increasingly acknowledged that designing insurance products suitable for the poor has an important role to play in fighting poverty. Finally Dercon (2009) noted that insurance may not be a panacea, but it can offer a useful complement to other microfinance and more general interventions to fight poverty. Designing insurance products is relatively straightforward, but the uptake of these products by the poor is likely to be low at first. Building on existing mutual support institutions (like social groups) may offer a cost-effective, group-based mechanism to spread insurance targeted to the poor.

On the other hand a study by Roth and McCord (2008) argued that proper design of insurance based on local context approach can manage the core challenges of agricultural micro-insurance (moral hazard, fraud, adverse selection, high administration costs combined with low premiums and basis risk). Roth and McCord (2008) reported four case studies (livestock insurance in India, Oxen insurance in Burkia Faso, Crop index in Ukraine, Pig insurance in Vietnam) each deals with innovative ways to manage the core challenges of agricultural micro-insurance. Other study also supporting this argument (Mahul et al., 2009) and reported that designing Index Based Livestock Insurance (IBLI) in Mongolia is a good lesson that addresses problems related with asymmetry of information, adverse selection and moral hazard. According to Linnerooth-Bayer and Mechler (2009) IBLI of Mongolia is not based on weather, but rather on the overall mortality rate of adult animals in a given county determined by yearly census. As with other index-based systems, the Mongolian scheme minimizes moral hazard, but since the claim payment is triggered by the event such as harsh weather (the *dzud*) on the base of the index rather than individual losses, basis risk is a concern.

Chantarat et al. (2013) argue that a key challenge for developing effective index insurance revolves around indentifying an index that minimizes basis risk representing discrepancies between the contract's index-triggered indemnity payments and the insured's actual loss experience. However, household level performance analysis in the study (Chantarat et al., 2013) indicates that IBLI is most effective in protecting households from otherwise uninsured catastrophic covariate risks. Based on simulation findings, IBLI removed 25-40% of total livestock mortality risk.

A study by Association of Ethiopian Microfinance Institutions (AEMFI, 2010) assesses the potential of livestock indemnity insurance in Oromya, Ethiopia. AEMFI reviews the vulnerabilities of smallholder farmers related to livestock husbandry and evaluates the various risk management strategies employed in order to assess the feasibility of piloting livestock indemnity insurance. This study (AEMFI, 2010) reported that providing formal micro-insurance schemes to low-income households provided a sense of security with regard to the possibility of risk and a greater willing to invest in their farm activities.

Hence, evidence indicates that constraints on livestock insurance implementation could be minimised by employing sound insurance design that is compatible for the beneficiaries in the context of the region and household's livelihood strategies. In this study, assessing farmers' individual based livestock insurance demand based on a hypothetical insurance in Ethiopian context help policy makers to consider as a complementary for the existing risk management strategies.

3.5.2 Livestock insurance

Livestock insurance can cover losses resulting from death, disease and accidental injury to livestock. Individual based livestock insurance covers the loss of each animal. The cover of individual based livestock insurance is more costly, both because of the increased administration costs and the adverse selection costs. But individual based livestock insurance type of arrangement is important since there is no basis risk and it is complete risk transfer mechanisms (insurer paid for every animal loss).

Index based livestock insurance is a way of providing protection against correlated risks that cover an entire herd of animals in a geographical area. Individual animal losses are not assessed-instead it pays out to all policy holders in a geographical area when certain conditions are reached in the index. The index is selected to closely correlate with actual livestock losses and is based on certain historical patterns and should be objective and easily observable. Index based insurance solves three important problems namely adverse selection, moral hazard and high administrative costs. But IBLI results in basis risk (Roth and McCord, 2008) and it does not provide complete risk transfer as long as the loss depends on index of the geographical area not on individual animal loss.

In the context of mixed farming system of smallholder farmers like Tigray, individual based livestock insurance that cover individual animals is more feasible compared to index based livestock insurance for two important reasons. First, problems associated with adverse selection, moral hazard and administrative costs can be minimized if elders and religious leaders are involved on monitoring and approval at a time of cattle loss in their local areas. Based on personal communication with officer from insurance company in July, 2011, this approach was taken from Oromia insurance S.C, Ethiopia from the ongoing pilot study of individual based livestock insurance. Second, individual based livestock insurance can remove the basis risk and it is a complete risk transfer mechanism where farmers can be received proportional indemnity for their loss of animals. According to Chantarat et al. (2013) designing index based livestock insurance is more effective for pastoral or agro-pastoral areas to counter high administrative cost and moral hazard.

Short-term economic shocks have long-term consequences for low-income households that are forced to reduce investment in child health and schooling or to sell productive assets in order to maintain consumption (AEMFI, 2010). To cope risk and shocks there are various management strategies in the study area such as selling livestock, borrowing money, diversification in production, share cropping, informal risk pooling, migration, off-farm work, livestock disease prevention, safety net etc. However, the existing risk management strategies in Ethiopia are not sufficient to achieve the goal of reduced vulnerability and improved welfare. To fill the gap, the

thesis explores the potential of livestock insurance as a complementary of the existing risk management strategies.

3.6 Risk and coping mechanisms in Tigray region

Tigray region in northern Ethiopia is associated with various risks and constraints. Shortage of land, crop failure, pest infestation, disease, limited use of appropriate technologies, high cost of fertilizer and seeds, shortage of labour, shortage of improved breed livestock, and livestock death due to inadequate veterinary services and scarcity of animal feed were defined as the most prominent risks within the community (Frankenberger et al., 2007). The region climate is characterised by large spatial and temporal variation in rainfall and frequent drought (Gebrehiwot, 2012). As a result of the erratic nature of precipitation in Ethiopia, the country in general and Tigray region in particular have faced recurrent drought over the past decades with the frequency of recurrence increasing in recent years (Gebrehiwot, 2012).

Repeated shocks followed by traditionally late or inadequate humanitarian responses have led to loss of livelihood and increasing chronic food insecurity (Hess et al., 2006). A study on-farm and off-farm employment in Tigray revealed that growth in population in the region has resulted in a decrease in average farm size towards 0.97 hectares (Woldehanna, 2000). Market related constraints including a lack of timely information, price fluctuation and the inability to acquire fertilizer for irrigated crop production on credit. It was also mentioned that lack of a consistent and clean water supply and silt deposition in micro-dams are constraints which frequently reduce household productivity (Frankenberger et al., 2007).

According to Hess et al. (2006) the long-term impact of the 2002 drought in Ethiopia pushed as many as 1-2 million previously vulnerable people into destitution. Hess et al. (2006) reported that timely and predictable intervention such as agricultural insurance in a crisis can prevent households from having to engage in destructive risk-coping strategies, and would reduce the need for a massive emergency response.

The livelihood system in Tigray is primarily based on mixed farming with crop production and livestock holding. Households within this system also benefit from

proximity to urban centres that enables them to engage in small-scale trade and selling of daily labour. Poor households who do not have the capacity (labour, oxen for draft power) to cultivate their plots either enter into sharecropping arrangements or simply rent out their land. The poor also engage in daily labour activities mostly on construction sites in towns or on the agricultural land of better-off farmers. Some poor households cultivate crops using irrigation; others engage in small petty trade (e.g. selling spices and local beer) (Frankenberger et al., 2007).

At worst, coping strategies for poor household members included: skip their meals for the entire day, consuming seed stock and sending household members to eat elsewhere (Gebrehiwot, 2012). Livelihood strategies of the better-off households typically involve crop and livestock production on their own land as well as on rented land. Their livelihood strategies are characterized by a relatively high degree of income diversification, that is, they engage in several different income-generating activities such as selling dairy products, vegetables or spices and salt trading (Frankenberger et al., 2007). Evidence showed that farmers' ex-ante strategic response to rainfall risk is through choosing crops most suited to specific rainfall condition at a time of unpredictable rainfall. In addition, households' off-farm employment can be seen as an ex-ante and ex-post income smoothing strategy (Haile, 2007).

Farm households are involved in two types of off-farm activities: wage employment and self-employment. Wage employment includes paid community development work (often called food-for-work), farm work, and manual work in construction, masonry, and carpentry. Self-employment in own business includes petty trading, transporting by pack animal, fuel wood selling, charcoal making, selling fruits, making pottery and handicrafts and stone-mining (Woldehanna, 2000). Other commonly reported coping strategies were borrowing money, reducing both the quantity and quality of meals, relying on wild fruits and vegetables, selling livestock and reducing expenditures on clothing, using cactus in livestock feed, replacing high yielding long cycle sorghum and teff (scientific name *Eragrostis tef*) with low yielding short season varieties, labour migration, increased production of cash crops and participation in PSNP (Frankenberger et al., 2007).

There is substantial evidence that the transiently food-insecure households start with coping strategies which involve less costly actions such as the sale of non-productive assets or migration of family members. In later stages, however, households sell productive assets or engage in other more costly coping strategies, such as removing children from school and selling productive assets. Thus, the short-term shocks have long-term consequences and involve considerable hindrance to development (Hess et al., 2006). While the current emergency system supporting the transiently food-insecure is largely sufficient to save lives, it is unfortunately often not sufficient to save livelihoods (Hess et al., 2006).

To sum up, farmers in developing countries face multiple sources of risks such as production, market, financial, institutional and human risks. Farmers in developing countries such as Ethiopia are mainly affected by catastrophic risks of livestock epidemics and drought. In addition, market related risks including a lack of timely information, price fluctuation and high transaction costs associated with transport and communication services. To manage agricultural risks, farmers use ex-ante strategies and ex-post coping strategies. Ex-ante strategies such as risk prevention that commonly used in developing countries such as Ethiopia include migration, relocation, crop and livestock disease control, macroeconomic policy, disaster prevention programs and investment in infrastructure while ex-ante strategies of risk mitigation include diversification (mixed farming, off-farm and non-farm investments), informal risk pooling, agricultural insurance, microfinance and share cropping through leasing cultivated land.

Once a disaster happened, farmers would engage in ex-post strategies of risk coping strategies like selling livestock and productive assets, borrowing from money lender, removing children from school and humanitarian assistances. In most cases, such short term coping strategies are costly to farmers that may destroy the livelihood strategies of farmers in the long run.

Hence, understanding farmers' attitude to risk, risk sources and suggest viable risk management strategies that may able to reduce the vulnerability of farmers. The thesis

attempt to assess farmers' risk perception, investigate existing risk management strategies and explore the potential role of livestock insurance in smallholder farmers of Tigray region.

3.7 Conceptual framework

In this section, the theory of risk and livelihood strategies in the livestock farming is discussed and further developed. Theories related to policies and institutions, sources of risk, risk management strategies (ex-ante and ex-post), livelihood asset (households' capital) and socio-economic variables is discussed (see Figure 3.1).

To address the objectives and research questions identified in section 1.3, the conceptual frameworks help to show the relationships of variables in the hypothesis. That is, it has been identified key variables and their relationships and factors associated with risk and livelihood strategies. The conceptual framework shows how the policies and programs influence farmers' risk source, risk management strategies and livelihood assets; the influence of socioeconomic variables on risk sources, risk management strategies and on farmers' interest in cattle insurance decision. The interaction of socioeconomic and location variables with risk sources affect the outcome variable (perceived risk source and risk management), that is, farmers may perceive the risk sources to be increased or decreased. Similarly, the interaction of socioeconomic and location variables with risk management strategies affects the outcome variable, that is, farmers may perceive the risk management strategies either to be more important or less important. The outcome variables of the conceptual framework show the perception of likelihood and severity of risk sources and the relevance of risk management strategies.

In the conceptual framework below (Figure 3.1), the straight line arrow shows a direct effect either one way (A, C, H1H2, H3H4) or two way (B). The one-way arrow indicates the causal relationship between variables from one direction while the two-way arrow shows relationship in both directions. Arrow A and C show the influence of policies, programs and institutions on risk sources and risk management while

arrow B shows the influence of policies, programs and institutions on livelihood asset and vice versa.

In particular, the interest in the conceptual framework is to show the relationship of socioeconomic and geographical location variables on risk sources and risk management. In this regard, the arrow H1H2 and H3H4 shows the interaction of the hypothesized variables. H1H2 arrow represents the influence of socioeconomic and geographical location on risk sources and risk attitude, respectively. H3H4 arrow represents the influence of socioeconomic and geographical location on risk management and on farmers' interest in livestock insurance participation, respectively. The interaction of socioeconomic and geographical location with risk sources (arrow H1H2) and with risk management strategies (arrow H3H4) results in the outcome variables (arrow E). But the broken line arrow (arrow D) indicates the indirect influence of socioeconomic and geographical location on the households' livelihood asset.

Arrow A, policies, programs and institutions are factors out of the control of the farmers. These factors induce different type of risks to the farming activities such as production, market, financial, institutional, technological and human risks (Korir, 2011). Uncertain monetary and fiscal policies, uncertain tax policies, uncertain policy on market and land tenure systems are the major policy and institutional risks to farmers in rural area. For example, rural financial policies and strategies in relation to credit service such as escalating cost of capital and group lending methodology as collateral may discourage farmers to use credit services and this may induce financial risk and uncertainty, low farm investment and agricultural productivity. Information and communication technology (ICT) policies can also play a critical role in facilitating rapid, efficient, and cost effective knowledge management and it can minimize the risk and uncertainty of smallholder farmers on production and marketing of their produce (UNDP, 2012).

Arrow B, the livelihood assets are affected by policies, programs and institutions and vice versa. For example, households' farm land size or availability (natural capital) depends on land tenure system that determined by policies, institutions, culture, power relations and legislations of any country. On the other hand, increase in cultivated

land fragmentation due to increase in population in the rural area may lead to change existing policies and legislations. For example in the study area and some parts of Ethiopia, rural land fragmentation increased from time to time and the regional governments put in place rules and regulations that hinder land redistribution.

Arrow C, policies, institutions and programs influence farmers risk management strategies (ex-ante and ex-post) and thereby livelihood security. For example, under the ex-ante strategies policies and institutions directly affect livestock insurance market in terms of premium, payoff and the other obligations of the insured. Besides, policies, institutions and programs directly affect the ex-post risk coping strategies of the farmers. For example, the disaster management program supports the coping mechanism of farmers after a natural disaster through humanitarian and public assistances. Policies and institutions can improve through proper implementation of the disaster management program otherwise it would result in poor risk management strategies (ex-ante and ex-post). In general, consideration of this institutional and policy context is vital in analyzing risk and risk management in the livestock farming, because the policies and institutions determine how people can access and control resources, what rights and entitlements they have and decisions affecting their livelihoods.

Arrow D, The type of socioeconomic variables is indirectly affecting the livelihood asset and the outcome variables. For example, the higher level of socioeconomic variables such as family size, wealth, education and social capital and better agro-ecology can improve households' livelihood asset. On the contrary, a lower level of socioeconomic variables and poor agro-ecology factors results in poor livelihood assets and

Arrow H1H2 and H3H4, our interest in this framework is to assess the impact of socioeconomic and agro-ecology variables on risk sources and risk management factors so as to examine farmers' perception about the likelihood and severity of risk sources and the relevance of management strategies. Arrow H1H2 shows the influence of socioeconomic and location factors (independent variables) such as age of households, family size, education of household head, wealth, road, agro-ecology and social network on the perception of risk sources (such production, market,

financial, institutional and human risks) and risk attitude index (for detail see section 4.2 and 4.3). Likewise, arrow H3H4 indicate the influence of socioeconomic and location factors (independent variables) on the risk management factors (such as disease prevention, diversification, safety net) and interest in cattle insurance participation (for detail see section 4.4 and 4.5). Finally, the interaction of the socioeconomic and geographical location variables with risk sources and risk management strategies affect the outcome variable (arrow E) of the perceived risk sources and risk management strategies.

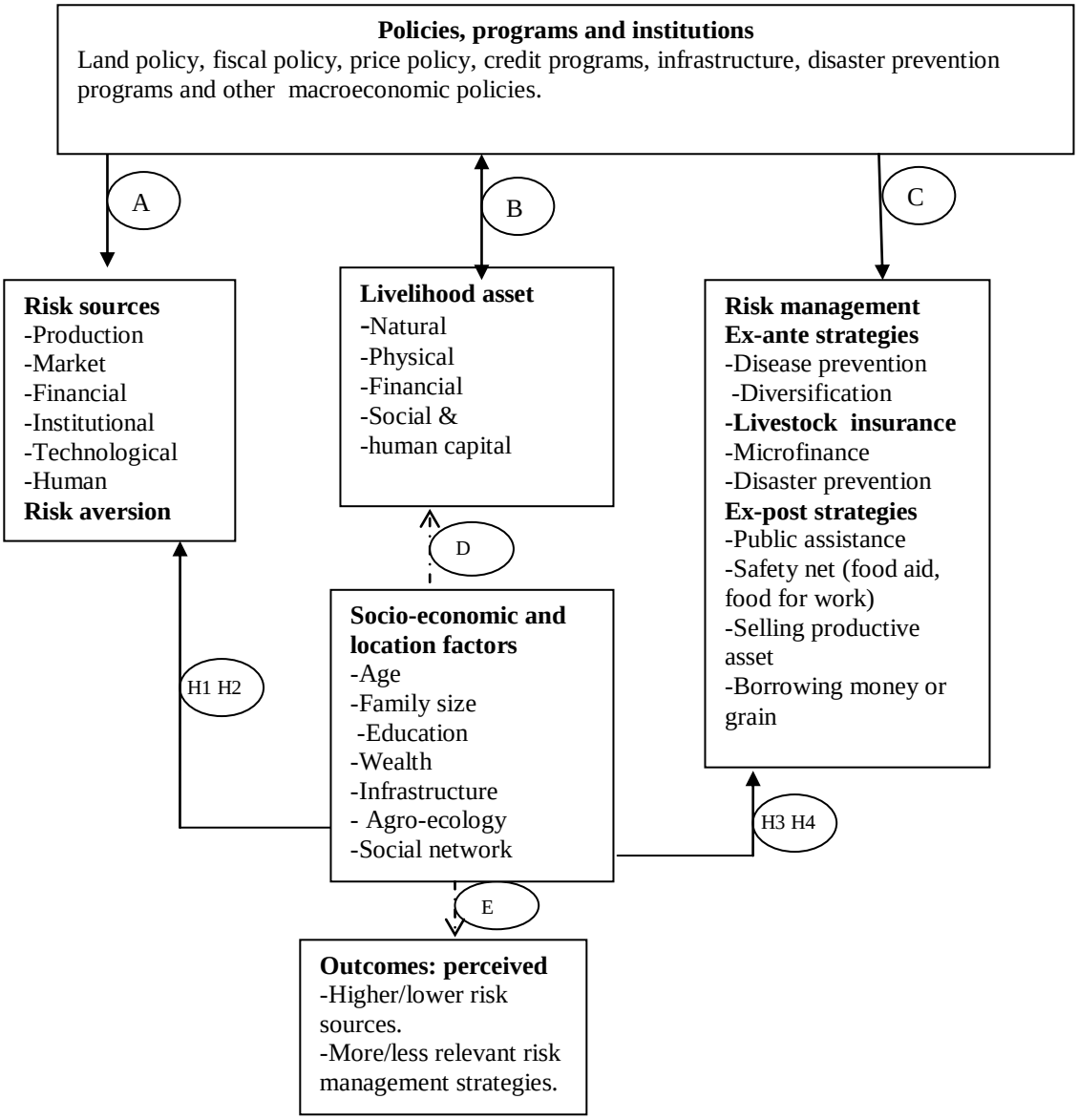

Figure 3.1: Perceived risk and livelihood strategy framework.

Note: the straight line arrow (one way or two way) shows direct effect while the broken line arrow shows indirect effect.

In general, various risks have always been part of the world's reality and people in hazard-prone areas have adapted to deal with extreme events, using their own capabilities, skills and knowledge. When hazards strike, people have always been ready to cope with the risk mainly by them-selves (Heijmans, 2001). Such sources of risks in the rural farming have short term and long term impacts. The short term impact following the post shock include: hunger, reducing consumption, selling of livestock and other productive assets and in the long term, the various sources of risks negatively affect farmer's livelihood sustainability and it results in a vicious circle of poverty.

The existence of the risk sources creates the need for effective risk management strategies as a means of protecting the welfare of the household (Valdivia et al., 1996). Risk management strategies in the pre-disaster phase (ex-ante strategies) are aimed at strengthening the capacities of households and communities to protect farmer's livestock farming and livelihood, through measures to avoid (prevention) and limit (mitigation) of the adverse effects of livestock risks. Sound risk prevention and mitigation comprise the development portion that have a positive impact on the long term fate of the household's livelihood and the ex-post risk strategies such as public provided safety net and humanitarian assistance comprise the short term impact on coping portion.

To address the objectives of this study in section 1.3 and to test the key hypotheses, the research hypothesis and research methodology are presented in the next chapter. The research methodology section incorporate brief introduction, study area and sampling design, model specification and statistical analysis while the hypothesis section incorporate determinants of risk attitude index, likelihood of risk occurrences and severity, perceived risk management and interest in cattle insurance participation and intensity.

CHAPTER FOUR

4. RESEARCH HYPOTHESES

4.1 Introduction

Hypothesis is included for statistical inferences of factor analysis and regression models in order to examine the major factors and the relationships between the independent variables and dependent variables. In this study, the purpose of hypothesis is to investigate the major factors in risk perception and management and their determinants; and factors influence cattle insurance participation. To determine the relationship of various factors and socioeconomic variables; the collected data use to test those relationships and try to draw conclusions about those relationships from the data collected. Hypothesis for the factor analysis help to identify the factors (latent variables) of risk sources and risk management a priori. In addition, the regression shows the influence of independent variables on dependent variables (factors). In this study, independent variables such as age of household, gender, education, family size, income, size of livestock, geographical location and other socioeconomic variables were included. The dependent variables are the latent variables (factors) computed from risk sources and risk management strategies. Besides, the dependent variable for insurance includes the potential of cattle insurance participation and the number of cattle to insure.

4.2 Hypothesis

This study hypothesized the major risk sources, attitude to risk and risk management strategies based on literature and local context. In this line, the relevant sources of risks for farmers in the livestock farming is hypothesized to be production, market, financial, institutional, technological and human risks (Drollette, 2009a, 2009b; OECD, 2009; Bielza et al., 2008; Legesse, 2006; Moschini and Hennessy, 2001). Risk attitude and risk sources are expected to be influenced by socio-economic variables, agro-ecology and institutional factors (Flaten et al., 2005; Legesse and Drake, 2005; Meuwissen et al., 2001).

It is hypothesized that farmers use various risk management strategies such as ex-ante strategies include disease prevention, diversification, microfinance, insurance, and off-farm work and ex-post coping strategies include selling livestock, selling assets and social assistance (Holzmann and Jogersen, 1999a , 1999b). It is also hypothesized that relevant risk management strategies are influenced by socio-economic variables, agro-ecology and institutional factors (Ahsan, 2011; Flaten et al., 2005; Legesse and Drake, 2005; Meuwissen et al., 2001). Furthermore, we hypothesized that fair number of farmers may be interested to participate in cattle insurance and insurance can be one option to counter livestock loss in the country.

Based on literature and local context, we identified socioeconomic and agro-ecology variables that influence risk attitude, likelihood of risk occurrence and severity, risk management and farmers interest in cattle insurance participation and the number of cattle to insure. For hypothesis in section 4.2, 4.3, 4.4 and 4.5, the description of variables is presented in Table 4.1.

Table 4.1: Description of variables used in regressions of risk and risk management

Age of household head (years)
Family size (number of family members in the household)
Education of head of household (years of schooling)
Cattle size (number of household's cattle)
Highland dummy[a] (1= highland area; 0= otherwise)
Midland dummy[a] (1= midland area; 0= otherwise)
Zero grazing dummy (1= zero grazing practice; 0 otherwise)
Walking time to main road (walking distance to nearest highway, in minutes)
Log income (log of household's annual income in Birr[b])
Gender of the household head (1 = male; 0 otherwise)
Livestock package dummy (1= if the household is member of the livestock package program; 0 otherwise)
Risk attitude index (increase in index shows risk taking behavior or less risk averse)
TLU (tropical livestock unit) (number)
Social network index (index developed from local associations membership and contact, increase in index increases social network)
Dependent ratio (proportion of dependents in a household whose age less than 15 years and greater than 64 years)
Share income (livestock share of annual income in ratio)
Size of land (household's cultivated land in ha)
Number of less productive cattle (number of cattle age < 2 & > 8 years)

[a] is geographical location variable compared with the benchmark group of the lowland dummy. [b] At a time of survey, 1 USD was equivalent to 17.2 Ethiopian Birr (as of October 17, 2011).

The hypothesis section is presented as follows: determinants of households' risk aversion, determinants of likelihood and severity of risk sources, determinants of the perceived risk management strategies, determinants of cattle insurance participation and intensity and conclusions.

4.2.1 Determinants of households' risk aversion

Variables such as age, family size, education, cattle size, locations (highland and midland), zero grazing, walking time to main road, income, gender and livestock package are expected to influence risk attitude index. The effect of independent variables on the dependent variables is based on the assumption *ceteris paribus* (all other factors remaining the same). The hypothesized relationship of variables in the regression are presented as follows and summarized in Table 4.2.

Age of household head is one of the main variables interest among the socio-economic and demographic explanatory variables that are hypothesized to influence households risk attitude behavior. Age of household might affect how individual farmer behave their risk attitude in relation to farm decision. Older people are a bit conservative and resistant to new agricultural practices and it is hypothesized that older household heads are more risk averse towards their farm decision. That is, *age* of household heads inversely related to *risk attitude* index (a higher value of risk attitude index implies less risk averse or more risk taker be\havior). In relation with this, Meuwissen et al (2001) reported that older household heads are more risk averse and Yesuf and Bluffstone (2009) indicated households containing older household heads and more children per adult were found more risk averse. A study by Smith and Baquet (1996) on 'Demand for Multiple Peril Crop Insurance (MPCI): Evidence from Montana Wheat Farms' hypothesized that older farmers may be more likely to be risk averse.

According to Yesuf and Bluffstone (2009) *family size* is inversely related to farmers *risk attitude* and higher family size households were found to have a lower risk-averse behaviour even if the relationship was statistically insignificant. With large family size, it is hypothesized a lower risk-averse behaviour. The reason is, larger family size contributes more labour towards farm production and management thereby less risk

averse for their decision. Thus, *family size* is hypothesized a positive relation to *risk attitude* (risk taking). Meuwissen et al (2001) reported that education is an important variable that influences farmers' risk aversion in relation to farm decisions. They reported that farmers' education has a positive relation to risk taking. In this line, we hypothesized that *education* increases farmers' knowledge and information that leads farmers to be less risk-averse behaviour in their farm decision. That is, household heads' level of *education* is positively related to *risk attitude index*; more educated household heads would perceive them-selves less risk averse.

In the mixed crop-livestock livelihood system, cattle serve in generating cash, buffering shocks and as indicator of wealth (Kassie et al. 2012). It was reported that the size of cattle is important variable that influence farmers' risk attitude behaviour. That is, farmers having more number of cattle had less risk-averse behaviour (Flaten et al. 2005). Farmers having more number of cattle perceive them-selves wealthier and feel more secure from various risks and shocks thereby behave less risk averse. In this regard, it is hypothesized a positive relationship between cattle size and risk attitude.

Geographical location *(highland and midland)* is expected to influence farmers *risk attitude*. Bante (2006) studied 'Risk aversion behaviour of farm households in Kobbo district, Ethiopia.' Bante used mean variance analysis and reported that farmers in the midland were found less risk averse than farmers in the lowland area due to diversity in cropping and less moisture stress of midland location compared to lowland. Both location variables (*highland and midland*) are therefore hypothesized to influence farmers *risk attitude* index positively compared to lowland location.

Grazing system has an impact on the health of the animal. Free grazing exposes animals to contagious diseases, internal and external parasites, tick born diseases, reproductive diseases such as brucellosis and infectious reproductive diseases (Gebreyohannes and Hailemariam, 2011). Zero grazing is where animals are tied and graze or fed where they are or kept indoors and fed in a cut and carry system (Gebreyohannes and Hailemariam, 2011). Households adopting zero grazing may minimize risks associated with cattle contact and disease prevalence. Farmers who bought cattle on credit may lose their animals due to diseases and results in financial

loss. It is thus hypothesized that farmers who adopt zero grazing minimizes cattle contact and loan default by minimizing cattle morbidity and mortality thereby farmers feel less risk averse. Thus, it is assumed that farmers adopting *zero grazing* are positively related to *risk attitude*.

Walking time to main road is expected to influence farmers risk attitude. As walking distance to the main road increases, farmers are not in a position to easily access input and output market, veterinary service, health service and credit service thereby farmers become more risk averse. Thus, it is hypothesized that *walking time to the main* road is inversely related to *risk attitude*.

Household annual income is an important variable influencing farmers risk attitude. Yesuf and Bluffstone (2009) reported that households that own more liquidity (i.e cash) correlated with lower risk aversion. That is, farmers with more liquidity were found less risk averse. Higher income farmers are more willing to adopt better agricultural practices in order to gain better agricultural output compared to the lower income farmers. It is therefore hypothesized that income (*log income)* of households is positively related to farmers' *risk attitude*.

Gender of household head is also considered to influence farmers *risk attitude*. Nelson (2012) reviewed and analysed previous published articles as to whether women are more risk averse than men, and found mixed results, concluding that risk attitude tend to vary over environments. Teweldemedhin and Kafidii (2009) in their study of 'Risk management strategies of cattle farmers in Namibia' reported female farmers are more risk averse than male farmers. Similarly, a recent study by Nmadu et al. (2012) in Niger State, Nigeria indicated that female farmers are more risk averse than their male. In the context of Ethiopian farmers, female headed households hypothesized to be more risk averse than male headed households since females are more vulnerable to socio-economic shocks than male counterparts. In this study, it is hypothesized that *gender* of household head has a positive relation with *risk attitude*.

Livestock package program is the other important variable that is expected to influence *risk attitude* of farmers. The livestock package program is provided to farmers along with the agricultural extension service. Thus, farmers who adopted the

livestock package program is provided training and advice mainly by development agents on how to select better breed animals, how to improve productivity and how to minimize risks. Farmers who adopted the livestock package program are in a better position in terms of knowledge and skill that minimize their risk aversion. It is hypothesized that farmers that adopted *livestock package* program is positively related to *risk attitude*.

Variables such as family size, education, cattle size, highland and midland agro-ecology, zero grazing, log income, gender and participation in livestock package program is expected to influence the risk attitude index (risk takers) positively. That is, higher family size, higher education level, higher cattle size, higher income, male headed households, farmers in highland and midland location, farmers practicing zero grazing and farmers' participation in the livestock package program are hypothesized to be risk takers compared to their counterparts. On the other hand, older household heads and farmers a greater distance (in terms of walking longer time) from the main road are hypothesized to be more risk averse.

Table 4.2: Hypothesized relationship of variables used in risk aversion

Independent variables	Risk attitude index[a]	Supporting literature	Remark
Age	_	Meuwissen et al. 2001; Yesuf and Bluffstone, 2009; Smith and Baquet, 1996	Age is predicted Negative sign on risk attitude in livestock risk (Meuwissen et al. 2001) and crop insurance (Smith and Baquet, 1996)
Family size	+	Yesuf and Bluffstone, 2009	Higher family size was found less risk attitude (lower risk aversion or more risk taking) in Ethiopia (Yesuf and Bluffstone, 2009)
Education	+	Meuwissen et al . 2001	Positive relation is predicted.
Cattle size	+	Flaten et al. 2005, Kassie et al. 2012	Farmers with more cattle farmers become less risk averse (Flaten et al. 2005).
Highland dummy	+		Predicted positive sign based on local context
Midland dummy	+	Bante, 2006	Highland farmers in Northern Ethiopia were found positive relation, that is, farmers in midland location are less risk averse (more risk taker) .
Zero grazing	+	Gebreyohannes and Hailemariam, 2011	Positive sign is predict based on local context
Walking time to main road	_		Negative sign predicted based on local context.
Log income	+	Yesuf and Bluffstone, 2009	Positive sign is predicted for Ethiopian farmers.
Gender	+	Nelson, 2012; Teweldemedhin and Kafidii , 2009; Nmadu et al. 2012	Positive sign is predicted in Namibia (Teweldemedhin and Kafidii , 2009) and Nigeria (Nmadu et al. 2012)
Livestock package	+		Positive relation predicted based on local context.

Note: [a] increase in risk attitude index would increases farmers' risk taking behaviour ; '+' and '-'denotes to hypothesized positive and negative relationship between independent variables and dependent variable (risk attitude index) , respectively.

4.2.2 Determinants of likelihood and severity of risk sources

Based on related empirical study and mainly local context, it is identified the determinants of likelihood occurrences and severity of risk source factors for our regression model. Variables such as age, family size, education, cattle size, locations (highland and midland), zero grazing, walking time to main road, income, gender and livestock package are expected to influence risk source factors (likelihood of occurrences and severity), ceteris paribus. The hypothesized regression relationships of variables are presented as follows and summarized in Table 4.3.

Production risk

Age of household head is expected to influence the perceived *likelihood* and *severity* of livestock *production risk* (cattle death, epidemic and non-epidemic diseases). However, the effect of age on likelihood and severity of livestock production risk is not determined *a priori*. On the one hand, age reflects farmers' experience, skill and knowledge (Gebrehiwot, 2012) on how to protect or minimize their livestock from production risks. On the other hand, older household heads may be physically weaker (Gebrehiwot, 2012) to manage properly their livestock thereby the perceived likelihood and the severity of production risk may be increased.

Family size is the other variable interest that influences the perceived *likelihood* and *severity* of *production risks*. Large *family size* provides more labour for herding and livestock management that finally minimizes livestock risk associated with cattle mortality and morbidity. Households with more family size may manage their livestock better and they might be less worried about the likelihood and severity of production risks compared to less family size households. It is therefore hypothesized that *family size* is inversely related to the perceived *likelihood* and *severity* of *production risk*.

Table 4.3: Hypothesized relationship of variables used in risk sources

Independent variables	Index of dependent variables					Supporting literature	Remark
	1	2	3	4	5		
Age	n	+	+	n	+	Gebrehiwot, 2012	The effect of age cannot be predicted a priori for 1 and 4 (Gebrehiwot, 2012). But based on local context it is expected positive sign for 2, 3, and 5.
Family size	_	_	_	n	n	Gebrehiwot, 2012; Haile, 2007	Family size is predicted negative for 1, 2 and 3 based on context. But the sign for 4 and 5 can be positive (Haile, 2007) or negative (Gebrehiwot, 2012; Tadesse, 2012).
Education	_	+	+	_	_	Legesse and Drake, 2005; Gebrehiwot, 2012;Tadesse, 2012	More educated is more aware about the probability of price/market risk at purchase (Legesse and Drake, 2005). Education is predicted negative sign for financial risk since more literate is more informed to increase profitability and income (Gebrehiwot, 2012; Tadesse, 2012). Other remaining relations are predicted on the base of context.
Cattle size	+	+	+	_	+	Gebremedhin et al., 2004	Cattle size is predicted negative sign for financial risk (Gebremedhin et al., 2004). Other variable relations are predicted based on local context.
Highland dummy	_	_	_	n	_	Legesse and Drake, 2005	Highland is less moisture stressed compared to lowland (Legesse and drake, 2005; Bante, 2006) that may minimize production risk (diseases) and market risk (forage demand and price). The remaining variables are predicted based on local knowledge.
Midland dummy	_	_	_	n	_	Bante, 2006	Midland is also less moisture stressed than lowland (Bante, 2006) that may minimize production and price risks. All variables are predicted based on local knowledge.
Zero grazing	_	+	_	+	n	Gebreyohannes and Hailemariam, 2011; BoARD, 2009	Zero grazing minimize production risk (diseases) (Gebreyohannes and Hailemariam , 2011) and human risk (herding) (BoARD, 2009). The remaining 2, 4 and 5 are predicted context wise.
Walking time to main road	+	+	+	+	+	Tadesse, 2012	Walking time to the main road discourages off-farm income and increase financial risk (Tadesse, 2012). Other variables are predicted based on local context.
Log income	_	_	_	_	_	Yesuf and Bluffstone, 2009	All variables are predicted negative sign. According to Yesuf and Bluffstone (2009) higher income farmers better insulate them-selves from shock to be less risk averse. Other variables are predicted based on local context.
Gender	_	_	_	_	_	Gebrehiwot, 2012; FAO, 2011	Male farmers own more resources and predicted to counter production and human risks (Gebrehiwot, 2012; FAO, 2011). While 2, 4 and 5 are related on context.
Livestock package	_	_	n	_	n		All relations are based on local knowledge and context.
Risk attitude index	_	n	n	n	n		Relationships are based on local context.

Note: '+' and '-'denotes to hypothesized positive and negative relationship, respectively; 'n' denotes hypothesized not determined a priori.Variables 1 to 4 are production, market, human and financial risks for likelihood and severity respectively. Variable 5 is institutional risk for likelihood only.

Education is believed to improve farmers' decision-making and thereby make them more likely to minimize risks and shocks associated with production. More educated head of households are less worried about the likelihood of occurrences and severity of productions risks. Hence, it is expected that household heads' level of schooling is negatively related to the perceived *likelihood of occurrences* and *severity* of *production risk*. *Cattle size* is expected to influence production risk since farmers with large number of cattle are difficult to manage properly and exposed to various risks, for example animal contact and diseases, accidental damage and deaths. Farmers who own large cattle may be more worried about the likelihood and severity of cattle mortality and morbidity. We hypothesized those farm households who own large *cattle size* positively related to the perceived *likelihood* and severity of *production risks.*

Location (*highland and midland*) is expected to address the variation of geography in terms of households' livestock *production risks*. Like other lowland parts of Ethiopia, the lowland area of the study region is affected by drought and disease prevalence compared to the highland and midland areas. The lowland areas are moisture stressed areas since evapo-transpiration is high compared to highland areas (Legesse and Drake, 2005); resulting in the scarcity of livestock drinking water, forage shortage and outbreak of diseases. The lowland areas are also poor in terms of infrastructure and social service such as roads and health services. It is therefore hypothesized that geographical location (*highland and midland*) is negatively related to the *likelihood* and *severity* of *production risks*.

Zero grazing is the other variable interest that influences households' livestock *production risk*. Gebreyohannes and Hailemariam (2011) reported that zero grazing was introduced in Tigray since 2005 and it is believed to improve livestock productivity and minimizes disease prevalence. Farmers adopting zero grazing are less worried about production risks related to cattle mortality and morbidity compared to their counterparts. Hence, we hypothesized that farmers adopting *zero grazing* practice is inversely related to the perceived *likelihood* and *severity* of *production risk*.

Walking time to main road is expected to influence livestock *production risk*. Walking time to main road is considered proximity to social services like veterinary service and market. Short distance to the main road as proxy to social service institutions can easily get an access for veterinary service thereby less worried about the likelihood and severity of production risks compared to farmers far away from the social services. Thus, it is hypothesized that *walking time*

to main road is positively related to the perceived *likelihood* and *severity* of *production risks*. Household *income* is presumed to influence farmers' livestock *production risk*. Yesuf and Bluffstone (2009) indicated that wealthier households can better insulate them-selves from risk and shocks. Higher income households are less worried about the likelihood and severity of production risks compared to lower income farmers. That is, higher income farmers are more successful to mobilize resources to mitigate risks associated with livestock diseases and mortality. Thus, we hypothesized income (*log income)* of households is negatively related to the perceived *likelihood* and *severity* of *production risks.*

Gender of household head is expected to influence the *likelihood* and *severity* of livestock *production risks.* Evidences showed that male headed households in developing countries have better opportunity in terms of access to resource and opportunity such as labour, cultivated land, modern input, education, credit and extension services compared to female headed households (Gebrehiwot, 2012; FAO, 2011). Thus, male headed households having better labour power are expected to manage their cattle and farm in a better way thereby cattle risks associated with disease prevalence, accidental damage and death are expected to decline. Hence, we hypothesized that *gender* (male headed households) is negatively related to the perceived *likelihood* and *severity* of livestock *production risks*.

Farmers' participation on *livestock package* is expected to influence livestock *production risks*. Farmers that are members of the livestock package program is expected to be aware with the extension program on how to adopt better breeding, improve productivity and minimize loss. Hence, it is hypothesized that farmers that are members of the *livestock package* program is inversely related to the perceived *likelihood* and the *severity* of livestock *production risks*. *Risk attitude* index is expected to influence the livestock *production risks*. Less risk averse farmers are more courage to adopt improved technology and farm decision like use of veterinary service, medication and improved forage thereby minimize the likelihood and severity of production risks. It is therefore hypothesized *risk attitude* index is negatively related to the perceived *likelihood* and *severity* of *production risks*.

Market risk

Age of household is expected to influence the market risks associated with forage demand and livestock price variability. Older household heads are physically less powerful for searching market information and moving longer distance for better market and they are more worried

about the farm market risks. It is therefore hypothesized that *age* is directly related to the perceived *likelihood* and *severity* of *market risks.*

The variable *family size* is expected to influence market risks associated with forage demand and livestock price variability. Larger family size may worry less about forage and livestock price variability compared to their counterparts; since larger family size can collect more forage and search better market information to minimize livestock price variability. Hence, we hypothesized that *family size* is negatively related to the perceived *likelihood* and *severity* of *market risks.*

Education of household head can influence market risks related to forage market and livestock price variability. Households with more level of schooling are more aware about the likelihood and severity of market risks such as livestock feed shortage and price variability compared to their counterparts. According to Legesse and Drake (2005) human capital (experience in farming and education) is positively related to the frequency of occurrence of higher price at purchase. It is therefore assumed that *education* is positively related to the *likelihood* and *severity* of *market risks*. Cattle size is believed to influence forage demand and livestock price variability. Farmers who own larger cattle may be worried more about forage demand (shortage of forage, price of forage and livestock price variability) and the livestock price variability compared to farmers that own smaller cattle. Therefore, *cattle size* is hypothesized to influence the perceived *likelihood* and *severity* of *market risks* positively compared to their counterparts.

Geographical location both *highland and midland* are relatively less moisture stressed areas and farmers may be worried less about livestock forage and livestock price variability compared to lowland. It is therefore hypothesized that geographical location (*highland and lowland*) is negatively related to the *likelihood* and *severity* of *production risks*.

Adopting *zero grazing* practice are expected to influence the perceived likelihood and severity of market risks associate with forage shortage, price of forage and price variability of livestock. Farmers adopting zero grazing are worried more about the likelihood and severity of market risks mainly of forage demand compared to their counterparts that utilize communal grazing. The variable *zero grazing* is hypothesized to influence the perceived *likelihood* and *severity* of *market risks* positively compared to their counterparts. Walking time to main road can influence market risks related to forage demand and livestock price variability. Longer distance from the main road increases transaction costs (transport and market information costs) associated with

forage and livestock market. It is therefore hypothesized that *walking time to main road* is positively related to the perceived *likelihood* and *severity* of *market risks*.

Income of households is expected to influence the perceived likelihood and severity of market risks. Higher income farmers may be worried less about forage market and livestock price variability compared to lower income farmers that are financially worried about the cost of forage and financial loss due to livestock price variability. Hence, the variable income (*log income)* is hypothesized to influence the *likelihood* and *severity* of market risks negatively. Gender (male headed household) is believed to have more access to market information through network than female headed household. Therefore, *gender* (male headed households) is hypothesized to influence the perceived *likelihood* and *severity* of *market risks* negatively compared to counterparts.

Livestock package member farmers are expected to have more market information through extension agents and public media. Thus, the variable *livestock package* is presumed to influence the *likelihood* and *severity* of *market risks* negatively. The variable risk attitude index is expected to influence the perceived likelihood and severity of market risks. However, the effect of risk attitude index on the perceived likelihood and severity of market risks may not determine *a priori*.

Human risk

Age of household head may affect the labour power engaged in farming and herding. Older household heads are physically weaker and busy in social affairs, therefore, labour power engaged in farming and herding would be minimal. It is therefore hypothesized that *age* of household influences the perceived *likelihood* and *severity* of *human risks* positively. In this study, human risk is associated with shortage of family labour and herders. Larger family households can provide enough labour for livestock activities and herding, thus it would minimize the scarcity of labour. Hence, we hypothesize that *family size* influences the perceived *likelihood* and *severity* of *human risks* negatively.

Education of household heads can influence the human risks in that more educated household heads may prefer to be engaged in off-farm and non-farm activities to earn better income compared to livestock farming. In addition, more educated household heads may send their children to school compared to their counterparts. Thus, more educated farmers may be

challenged with the shortage of labour that can be engaged in livestock farming and herding activities. We hypothesized that *education* is positively related to the perceived *likelihood* and *severity* of *human risks*. Larger cattle size demands more labour for activities such as feeding livestock, collecting dung and grass, milking cows and herding. It is therefore hypothesized that *cattle size* is directly related to the perceived *likelihood* and *severity* of *human risks*.

In the study area, *highland* and *midland* locations are relatively more densely populated compared to the lowland areas. Therefore, it is hypothesized that *highland* and *midland* locations influence the perceived *likelihood* and *severity* of *human risks* (shortage of herding and labour) negatively compared to their counterparts. Zero grazing practice is expected to minimize the shortage of labour in the study area (BoARD, 2009). The variable *zero grazing* is inversely related to the *likelihood* and *severity* of *human risks*. *Walking time to main road* can affect labour participation in livestock farm activities. Distance to the main road is proxy for market and towns, farmers that are far from the main road have less access for labour in the labour market. Hence, we hypothesize that the variable *walking time to main road* is positively related to the perceived *likelihood* and *severity* of *human risks*.

Income determines the households' ability to employ extra labour for farm activities thereby minimize the human risks. We therefore hypothesized that *income* influences the perceived *likelihood* and *severity* of *human risks negatively*. The variable gender of household head is expected to influence human risks. Male headed households are assumed to be in a better position to arrange more labour force than female headed households (Gebrehiwot, 2012). Thus, we hypothesized that the variable *gender* (male headed households) is inversely related to the perceived *likelihood* and *severity* of *human risks*. Variables such as *livestock package* and *risk attitude index* are expected to influence the perceived *likelihood* and *severity* of *human risks* without determining *a priori* sign.

Financial risk

Age of household head is expected to influence the likelihood and severity of financial constraints (small farm income and cash, low saving). Older household heads are more experienced with farming activities and may be in a position of better financial status. On the other hand, older household heads are physically weaker and less efficient in carrying out farm operations resulting in financial constraints. Hence, the effect of *age* on the perceived *likelihood*

and *severity* of *financial risk*s cannot determine *a priori*. Financial risk is associated with small farm income, cash shortage and lack of saving.

Family size can have an effect on financial matters of the households. However, the effect of *family size* on the perceived *likelihood* and *severity* of *financial risks* may be positively or negatively related. According to Gebrehiwot (2012) and Tadesse (2012) larger family size may imply more labour force that strengthens the food security and income of the farm activities mainly in subsistence farming. On the contrary, Haile (2007) indicated that larger family size households have a tighter budget constrains (insufficient farm income) due to substantial expenditure (food and non-food) compared to their counterparts. Education is assumed to increase the farmer's knowledge, improving the use of information relevant to farm productivity, profitability, non-farm income (Gebrehiwot, 2012; Tadesse, 2012). Increase in heads level of schooling minimizes worry caused by financial constraints of the household. Thus, we hypothesized that *education* of household head influence the perceived *likelihood* and severity of *financial risks* negatively. Farmers that own larger cattle are wealthier since farmers can sale their livestock and relatively less worried about financial risks (see Gebremedhin et al., 2004). Thus, we hypothesized that *cattle size* influences the perceived *likelihood* and severity of financial risks *negatively*.

Highland and midland locations are expected to influence the perceived financial risks. However, the relationship between locations *(highland and midland)* and the perceived *likelihood* and *severity* of *financial risks* may be positively or negatively related. Farmers adopting zero grazing are expected to invest more on productive activities such as improved breed cattle, feeding and animal health management thereby more worried about financial constraints compared to counterparts. Hence, it is hypothesized that *zero grazing* is positively related to the perceived *likelihood* and *severity* of the *financial risks.*

Roads and transport facilities are among the vital establishments that facilitate interactions among economic agents and can lead to higher income since households can easily participate in non-farm activities (Tadesse, 2012). Shorter distance to the main road facilitates farmers' participation on non-farm activities to generate extra income and financially stronger compared to farmers far away from the main road. Hence, we hypothesized that the variable *walking time to main road* influences the perceived *likelihood and severity* of financial risks positively. Higher income farmers are less worried about financial constraints compared to their counterparts. It is

therefore hypothesized that income (*log income)* is negatively related to the perceived *likelihood* and *severity* of *financial risks*.

Gender (male headed household) is presumed to be financially stronger and then less worried about financial risks compared to female headed household. A negative relationship is expected between *gender* (male headed households) and the perceived *likelihood* and *severity* of *financial risks.* In the study area, farmers that are members of the livestock package program better equipped with extension service and credit access and hence expected better financial status compared to their counters. Hence, we hypothesized that *livestock package* is inversely related to the perceived *likelihood* and *severity* of *financial risks. Risk attitude* index is expected to influence the perceived *likelihood* and *severity* of *financial risks* without *a priori* sign.

Institutional risks

Age of household can influence the perceived likelihood of institutional risks such as property right conflict, inadequate government support and lack of road/communication. Older household heads are physically weaker and more worried by institutional constraints, thereby demand more institutional supports such as government support and infrastructure compared to younger household heads. Thus, we expect that *age* is positively related to the perceived *likelihood* of *institutional risks.*

Family size influences the perceived likelihood of institutional risks without *a priori* sign. *Education* may enhance farmers' knowledge and ability to negotiate with other parties thereby resolve institutional risks. A negative relationship is expected between *education* and the perceived *likelihood* of *institutional risks*. Larger cattle ownership may be stressed with livestock drinking water and grazing land and resulting in property rights conflict and demands institutional support in terms of resolving conflict and infrastructure (roads or communication) expansion. Thus, we hypothesized that *cattle size* influences the perceived *likelihood* of *institutional risks positively*.

In the study area, locations such as *highland* and *midland* are relatively equipped with better infrastructure and there is minimal conflict for water and grazing lands in the rural area compared to the lowland. Farmers in the highland and lowland worried less about institutional risks compared to lowland location. Therefore, it is expected that locations (*highland and*

lowland) are inversely related to the perceived *likelihood* of *institutional risks*. The variable *zero grazing* can influence the perceived *likelihood* of *institutional risks* positively or negatively. Farmers that are far distance to the main road worried more about institutional constraints and demands governmental support such as road construction and transport facilities to minimize farmers' transaction costs. Hence, it is expected that *walking time to main road* is positively related to the perceived *likelihood* of *institutional risks*.

Higher income farmers can easily afford cost of transport and communication and they do have better transport facilities and they worried less about institutional risks compared to low income farmers. Thus, *income* is inversely related to the perceived *likelihood* of *institutional risks.* Male farmers can walk longer distance than female farmers and male farmers are more experienced to resolve conflict. Hence, male farmers are less worried about the institutional risks compared to female farmers. We therefore hypothesized that *gender* (male headed household) influences the perceived *likelihood* of *institutional risks* negatively. Variables such as *livestock package* and *risk attitude index* expected to influence the perceived *likelihood* of *institutional risks*, however, the effect may be positive or negative relation.

To sum up, older 'household heads' are expected to influence the perceived likelihood and severity of market and human risk more compared to their younger counterparts. In addition, it is hypothesized that age of household head influences the likelihood of institutional risk, with a positive relationship between older head and perceived likelihood of institutional risk. Respondents with larger family size perceive the likelihood and severity of production, market and human risks less compared to those with smaller family size. More educated farmers perceive the likelihood and severity of production and financial risks less, but they perceive the likelihood and severity of market and human risks more compared to their counterparts. More educated household heade also perceive the likelihood of institutional risks less compared to less educated household heads. It is hypothesized that farmers with larger cattle size (herd size) owner farmers perceive the likelihood and severity of production, market and human risks more and perceive the likelihood and severity of financial risk less compared to their counterparts. Larger cattle farmers perceive the likelihood of institutional risks more compared to their counterparts. It is expected that farmers in the highland and midland location perceived the likelihood and severity of production, market, human and financial less compared to their counterparts in the low lands. Institution risk was also expected to be perceived less by farmers in the highland and midland location compared to farmers in lowland location.

It is hypothesized that production and human risk would be perceive less but market and financial risks would perceive more by farmers practicing zero grazing. It is expected that farmers walking longer distance to the main road perceive the likelihood and severity of production, market, human and financial risks more compared to their counterparts. It is hypothesized that farmers walking longer distance to the main road also perceive the likelihood of institutional risk more compared to their counterparts. It is hypothesized that household income and male headed farmers perceive the likelihood and severity of production, market, human and financial risks less compared to their opposite groups. The likelihood and severity of production, market and financial risks is expected to be perceived less for farmers that participate in livestock package program compared to their counter groups. Risk taker farmers perceive the likelihood of production risk less compared to risk averse farmers.

4.2.3 Determinants of the perceived risk management strategies

It is identified the determinants of risk management factors (disease control, financial management, safety net, feed management, cooperatives and diversification) from local context and literature. Variables such as risk attitude index, age, family size, TLU, highland and midland locations, zero grazing, walking time to main road, income, gender, education, livestock package and social network index are hypothesized to influence the risk management factors. The hypothesized relationships of variables are presented as follows and summarised in Table 4.4.

Disease control

Risk attitude index is expected to influence farmers' perception on the relevance of disease control as risk management strategies. Flaten (2005) reported that less risk averse farmers are positively related to disease control as relevant risk management strategies. In the context of developing countries least risk averse farmers invest more in farm activities such as vaccination and medication in order to maximize productivity and minimize livestock loss. Hence, *risk attitude* index is hypothesized to influence *disease control* (use of veterinary services, disease prevention and sanitation) positively as relevant risk management strategies. That is, less risk averse farmers are expected to perceive disease control as relevant risk management tools compared to risk averse farmers.

Table 4.4: Hypothesized relationship of variables used in risk management

Independent variables		Index of dependent variables					Supporting literature	Remark
	1	2	3	4	5	6		
Risk attitude index	+	+	_	n	+	_	Flaten, 2005; Bezabih and Sarr, 2012	Risk attitude index predicted positive sign with livestock disease control (Flaten et al., 2005) but negatively on crop diversification (Bezabih and Sarr ,2012). 2, 3, 4 and 5 were predicted based on local knowledge.
Age	+	+	+	n	_	_	Flaten et al., 2005; Mensah et al.2012; Zerai and Gebregziabher, 2011; Haile, 2007; Valdivia, 1996	Age is reported positive sign on financial management in dairy farm (Flaten et al. 2005). Age is predicted negative sign for joining cooperative in Benin (Mensah et al. 2012) and on diversification (Zerai and Gebregziabher, 2011; Haile, 2007; Valdivia, 1996).
Family size	+	+	+	+	+	+	Haile, 2007	Family size is predicted positive sign for diversification in Ethiopia (Haile, 2007). Other variables are predicted on local knowledge.
TLU	_	_	_	+	_	n	Haile , 2007; Tolera, 2007	Livestock feed is critical problem in Tigray (Tolera, 2007) and TLU may affect positively to feed management.
Highland	_	n	n	_	+	n		All relations are based on local context.
Midland	_	n	n	_	+	n		On context base.
Zero grazing	+	+	+	+	+	_		Context base relations.
Walking time to main road	_	_	+	_	n	_	Tadesse, 2012	Distance to road is proxy to town, market and cattle medication (Tadesse, 2012) which negatively affect disease control. Other relations are predicted based on context.
Log income	+	+	_	+	_	+	Bezabih and Sarr 2012	Log income is predicted positively with crop diversification (Bezabih and Sarr, 2012). Other variables hypothesized based on context.
Gender	+	n	_	+	n	+		Variables are predicted on context base.
Education	+	+	_	+	+	+	Tesfamariam, 2012; Bezabih and Sarr 2012	More educated farmers are interested to participate in saving cooperatives (Tesfamariam , 2012) and in crop diversity (Bezabih and Sarr , 2012)
Livestock package	+	+	_	+	+	n		All variables are predicted based on context base.
Social network index	+	+	+	+	+	+		All relations are context base.

Note: '+' and '-'denotes to hypothesized positive and negative relationship, respectively; 'n' denotes hypothesized not determined a priori. Variables 1 to 6 are disease control, finance management, safety net, feed management, cooperatives and diversification, respectively.

Age of household is reflecting farmers experience on farm management such as disease prevention in the livestock farming. Thus, it is hypothesized that elder household heads are more experienced on how to prevent livestock diseases as risk management strategies to minimize livestock loss. A positive relationship is expected between household heads' *age* and the perceived relevance of *disease control* as risk management strategies. Other studies such as Ahsan (2011) revealed age (farmers' experience) is positively related to disease control as relevant management strategies but it was found insignificant. *Family size* that increases labour power on farm management could influence risk management strategies in terms of livestock disease control. It is therefore hypothesized *family size* positively influences the perceived relevance of livestock *disease control* as risk management strategies.

Size of livestock holding *(TLU)* is affecting the prevalence of disease among the same or different animal species. In the study region, different animal species such as cattle, equines and small ruminants lodge in a single shelter. As a result, for large size of livestock holding (TLU) the possibility of livestock contamination and disease prevalence increases and disease control may not be effective. Hence, it is hypothesized that farmers who own larger TLU may perceive disease control as less relevant management strategy. *TLU* negatively influence the perceived relevance of *disease control* as risk mitigation tool.

In the study region, the *highland* and *midland* location is relatively more favoured in terms of infrastructure and animal health services compared to the lowland areas. On the contrary, the lowland areas are more moisture stressed and exposed to livestock diseases. It is therefore in highland and lowland areas disease control in the livestock farming is less relevant compared to their counterparts. Hence, both the *highland* and *midland* geography is expected to influence the perceived *disease control* negatively as relevant strategy to manage risk.

Farmers that are practicing *zero grazing* are believed to have a better cattle management and it minimizes cattle contact thereby expected to deter disease prevalence. In this regard, it is hypothesized that farmers adopting *zero grazing* positively influences the perceived disease control as relevant risk mitigation tool. Shorter distance to roads and transport services takes households closer to towns and market (Tadesse, 2012) thereby easily accessible to cattle medication input and other veterinary services for effective livestock disease control. Hence, we hypothesize *distance to the main road* is inversely related to the perceived *disease control* as relevant risk management strategy. Higher income households can afford cost of livestock

disease prevention and control better than lower income. Thus, it is hypothesized that *income* of household positively influences the perceived *disease control* as relevant strategy to manage risk.

Male headed households are relatively wealthier in terms of resource (financial and non-financial asset) and they can afford cost of animal health than female headed households. Thus, the variable *gender* (male headed households) is hypothesized to have positively influence the perceived *disease control* as relevant risk mitigation tool. Household heads with more level of schooling is expected to be aware more about cost of livestock loss and the benefit of disease control. Hence, more literate farmers may perceive disease control as relevant strategy to manage risk. *Education* is positively influencing the perceived *disease control* as relevant strategy to manage risk.

Households that are members of livestock package program gain agricultural knowledge and skill can also influence farmers' disease control practice. Similarly *social network index* where farmers connected socially in terms of the number of local associations may influence farmers' livestock disease control. Greater social network index shows more interaction and information in farming practices. Both variables (*livestock package and social network index*) are hypothesized to influence the perceived disease control positively.

Financial management

Risk attitude index can influence the perceived financial management as relevant risk management strategies in the rural areas of Ethiopia. Less risk averse farmers use credit from micro-finance institutions and invest in farm and non-farm activities thereby perceive finance management (credit use, loan allocation and debt management) as relevant strategy. On the contrary, more risk averse farmers are reluctant to adopt credit due to fear of credit default and they perceive financial management less relevant strategy to manage agricultural risks. Thus, it is hypothesized that *risk attitude index* influence farmers' perceived *financial management* positively as relevant strategy to manage farm risks.

Age of household head is expected to influence financial management. According to Flaten et al. (2005) year of experience was found positively related to financial management as relevant risk management strategies. Older household heads may have longer experience on borrowing, loan allocation and financial management compared to younger heads. Hence, we hypothesize that

age of household head positively influence the perceived *financial management* as relevant tool to manage risks associated with financial default and crisis. Provision of credit to smallholder farmers is one strategy for promoting adoption of improved crop and livestock technologies in Ethiopia. In this regard, large family size is considered more labour power that they may demand more credit for farm and non-farm investment to ensure households basic necessity. Hence, we hypothesize that *family size* influences the perceived *finance management* positively as relevant risk management strategies.

In the study area, livestock is an important asset and it is a source of cash in times of need. Thus, farmers who own larger size of livestock holding (TLU) may less likely to use credit from micro-finance institution and give less attention to loan allocation and debt management compared to farmers with smaller size of livestock holding. It is therefore hypothesized that size of livestock holding (TLU) is negatively influence the perceived financial management tool as relevant management strategies.

Location (*highland and midland*) may have an influence on farmers' financial management as relevant strategy to manage risk. However, the effect of location on farmers' financial management may not determine *a priori.* The location factor is already included to consider whether site specific factors influence farmers' financial management or not. Zero grazing practice in the study area emanate from shortage of grazing land and labour involved in farming. Thus, households that adopting zero grazing may demand credit for livestock feed and other inputs, thereby they may consider credit use and proper loan allocation as important strategy compared to their counterparts. The variable *zero grazing* hypothesizes to influence farmers' perceived *financial management* positively as relevant risk management strategy.

Distance to infrastructure services (such as roads and transport) may influence farmers' perceived financial management (credit access and loan allocation and debt management) as risk management tool. *Walking time to main road* is proxy to towns and market and farmers near distance to road may have a better information and experience to manage financial activities. It is hypothesized that *distance to the main road* is inversely related to farmers' perceived financial management as relevant risk management tool. Higher income farmers who are more experienced in mobilizing large sum of money may have a better experience to manage their debt compared to lower income farmers. Household *income* is expected to influence the perceived financial management positively as relevant management strategies.

The effect of the variable *gender* on farmers' *financial management* is ambiguous; it may be positive or negative relation in the context of the study region. Male headed households may be more aware about financial management through training opportunity and peer interaction and may better manage his finance than female. On the other hand, female headed households are more careful on cash management and less extravagant compared to male thereby better manage their finance. Education, membership of livestock package program and social network is believed to increase farmers' knowledge and awareness thereby improves farm management and risk management. Therefore, these three variables are hypothesized to influence farmers' financial management positively as relevant risk management strategy.

Safety net

Risk attitude index behaviour can influence farmers' perceived safety net program as relevant risk management tool. According to Yakob (2011) the Ethiopian Productive Safety Net Program (PSNP) was designed to assist chronically food insecure households either cash or food in exchange for labour on rural infrastructure projects, or direct cash and food transfers for households that unable to participate in physical labour (labour poor, older or incapacitated individuals). Households who engage in safety net program are either very poor farmers or farmers that unable to contribute labour (such as older people) for public work activities. Members of the safety net program are very vulnerable to socio-economic shocks that presume to be more risk averse compared to counterpart. More risk averse farmers may consider the safety net more relevant strategy to manage risk compared to less risk averse farmers. The variable *risk attitude index* negatively influences farmers' perceived participation in *safety net* program as relevant risk management strategies.

Most older people are members of the safety net program that they can get direct cash or food freely and they may consider safety net program as relevant risk management strategies. Hence, *age* of household expected to influence the perceived *safety net* program positively as relevant risk mitigation tool. Household with more labour power can be benefitted more from the safety net program since more labour involve in the public works. It is expected that *family size* is positively related to the perceived *safety net* program as relevant risk management strategies. Farmers that own larger size of livestock holding (TLU) is considered wealthier and less likely to be engaged in safety net program as risk management strategies. Size of livestock holding (*TLU)*

influences the perceived *safety net* program negatively as relevant risk mitigation strategies. Differences in location (*highland and lowland*) can influence the perceived *safety net* program positively or negatively as relevant management strategy.

Adopting *zero grazing* may have more labour that can be engaged in public works for better return from the safety net program as risk management tool. The variable *zero grazing* influence the perceived *safety net* positively as relevant risk management. *Walking time to main* road as proxy to towns can influence *safety net* program as relevant management strategies. Farmers with shorter distance to the main road may be engaged in non-farm activities instead of safety net as risk management. It is hypothesized that *distance to the road* influence the perceived *safety net* positively as relevant strategy to manage risk.

Very lower income farmers are likely to join safety net as relevant strategy to manage risks. Thus, income (*log income)* is expected to influence the perceived *safety net* program negatively as relevant management tool. Male headed households are less vulnerable and less likely to join safety net program as risk management tool. Instead of safety net program for lower benefit, male farmers may be engaged in other off-farm activities for better risk management. *Gender* of the household head is inversely related to *safety net* program as relevant risk mitigation tool. *Education* is expected to influence *safety net* program as relevant risk mitigation tool. More level of schooling households may prefer farm and non-farm income instead of the subsistence income/food that they generate from the safety net. *Education* level is expected to influence the perceived *safety net* program negatively as relevant strategy to manage risk.

Farmers that participate in livestock package more likely to be engaged in activities such as dairy farm, fattening, poultry or beehive and less likely to join safety net program that has a high opportunity cost for them. Hence, the variable *livestock package* is expected to influence the perceived *safety net* program negatively as relevant strategy to manage risk.

Social network index in this study is related to farmers' social link in terms of local associations, development agents and local leaders. Thus, social networked farmers are more likely to be selected for safety net program. *Social network index* is expected to influence the perceived *safety net* positively as relevant strategy to manage risk.

Feed management

Risk attitude index can influence farmers' perceived *feed management* as relevant strategy to manage risk. However, in the context of the study area the effect of *risk attitude index* on farmers' livestock *feed management* may be positively or negatively related. Risk averse farmers may be sensitive for feed shortage and manage their livestock feed (stalk, rotational grazing and purchase enough hay) well ahead of time as relevant strategy to manage risk. On the other hand, less risk averse farmers are keen for technology adoption such as rotational grazing and other feed management practices compared to risk averse farmers and they may perceived relevant strategy to manage risk.

The influence of *age* on farmers' feed management strategies can be positive or negative. It is presumed that *age* is associated with experience and elder farmers expected to influence feed management positively as relevant strategy to manage risk. On the contrary, we also expect that younger farmers adopt agricultural technology such as feed collection and management practices as relevant tool to manage risks compared to older farmers. *Family size* is expected to influence farmers' feed management as relevant strategy to manage risk. Larger family size households have more labour to be engaged in collecting and managing livestock feed better than small family labour. We hypothesized that *family size* influence the perceived *feed management* positively as relevant risk management strategy.

According to Tolera (2007) poor quality and feed shortages are the root causes for the poor performance of the livestock sector in Ethiopia. Farmers having larger size of livestock holding (TLU) seem to be more worried to supply enough feed to their animals and feed management can be relevant strategy to mitigate the risk. Thus, *TLU* expected to influence the perceived *feed management* positively as relevant management strategy.

Location (*highland and midland*) is less moisture stress compared to lowland areas in Northern Ethiopia. Thus, livestock feed is more scarce in the moisture stress areas of lowland thereby feed management can be relevant strategy to manage risks. Both variables (*highland and lowland*) are expected to influence the perceived *feed management* negatively are relevant management tool. Farmers adopting *zero grazing* practice is worried about their livestock feed since cattle are not moving in search of feeding and feed management may be perceived relevant strategy compared to their counterparts. We expect that *zero grazing* practice influence the perceived *feed management* positively as relevant management strategy. In the study area shorter distance to the

main road facilitate farmers' feed management due to lower transport cost at a time of feed collection and purchase. Hence, *walking time to main road* influence the perceived *feed management* negatively as relevant management tool.

Higher income farmers can easily afford costs of feed management such as timely feed collection and buying feed compared to lower income farmers. It is therefore hypothesized that *income* influence the perceived *feed management* positively as relevant tool to manage risk. *Gender* of household head can affect farmers' livestock feed management practice differently. Female farmers in Ethiopia like other African countries are engaged in dual activities; that is, agricultural and domestic activities (raise children, food preparation, fetch water). Besides female farmers are labour scarce compared to male farmers and they mostly lease out their land. Thus it is hypothesized that male headed households having better labour and more time can easily manage livestock feeding than female headed households. A positive relationship is expected between *gender* (male) and the perceived *feed management* as relevant management strategy.

Awareness, information and knowledge arising out of school (education), livestock package program (such as extension services) and social network interaction (such as associations, development agents and public meeting) can improve and influence farmers' livestock feed management. Hence, these three variables may increase farmers' knowledge and information about feed management practice thereby perceived to be relevant strategy to manage risk. The three variables (*education, livestock package and social network index)* are expected to influence *feed management* positively as relevant strategy to manage risk.

Cooperatives

Risk attitude index is expected to influence farmers' joining *cooperative* as relevant risk management strategy. In the context of the study area, *less risk averse* is more motivated to join cooperatives such as associations and credit and saving cooperatives as relevant strategy to manage risk. *Risk attitude index* influence *cooperatives* positively related as relevant strategy to manage risk. *Age* is expected to influence joining cooperatives as relevant risk management strategy. *Age* of household can influence the decision to join cooperative. Mensah et al. (2012) in his study of 'agricultural cooperatives in Benin' hypothesized that older farmers are expected to be less positive to the cooperatives than younger farmers who would likely not retire soon.

Similarly, older people who are more risk averse and physically weaker may be less willing toward joining cooperatives such as associations and credit and saving cooperatives. *Age* influence the perceived joining *cooperatives* negatively as relevant risk management tool.

Joining *cooperatives* can be influenced by *family size* positively as relevant risk mitigation tool. Larger family size has excess labour force that can be allocated and participated in associations to achieve information and training and they may likely participate in credit and saving cooperatives for further investment in agriculture in order to achieve stable income for covering substantial food and non-food expenditures. Hence, *family size* is expected to influence the perceived joining *cooperatives* positively as relevant risk mitigation tool.

Size of livestock holding (*TLU)* is expected to influence farmers joining cooperative as relevant risk management tool. Increased size of livestock holding (*TLU)* as a proxy for wealth may lead farmers to be less willing to join associations and credit and saving cooperatives since wealthy farmers may have a high opportunity cost for joining associations and credit and saving cooperatives. That is, size of livestock holding (*TLU)* influence the perceived joining *cooperatives* negatively as relevant strategy to manage risk. Location (highland and midland) are more densely populated that facilitate forming associations compared to the sparsely populated and more risk averse farmers of the lowland areas. Thus, both location variables (*highland and midland*) expected to influence the perceived joining *cooperatives* positively as relevant tool to manage risk.

Farmers adopting *zero grazing* practice may likely adopt better breeding animals that demands agricultural information and credit service. Hence, farmers adopting zero grazing may consider associations and credit and saving cooperatives as relevant strategy to manage risks. Adopting *zero grazing* practice hypothesized to influence the perceived joining *cooperatives* positively as relevant strategy to manage risk.

Walking time to the main road can affect farmers' interest on joining associations and saving and credit cooperatives. Shorter distance to the main road is proxy to nearest market, towns and transport services. According to Mensah et al. (2012) transaction costs determine the commitment to cooperative business. Hence, longer distance to the main road increases farmers' transaction costs (cost of information, communication and transpiration) thereby less likely to join associations and saving and credit cooperatives. However, distance to the main road may or

may not be proxy to FTC (farmers training centre) where most associations and saving and credit cooperatives located. Hence, *walking time to the main road* may influence the perceived joining cooperatives *positively or negatively*. The shorter the distance to the main road as a proxy to FTC may encourage farmers' participation on association and credit and saving cooperatives due to lower transaction costs. Longer distance to the main road (longer to FTC) implies the lower farmers' participation on associations and saving and credit cooperatives due to higher transaction costs.

Higher income farmers are in a position of better financial resources that seem less likely to be involved in joining cooperatives (associations and saving and credit cooperatives). *Income* is expected to influence the perceived joining *cooperatives* negatively as relevant risk management tools. Gender of household head can influence farmers' interest on joining cooperative as risk management tool. Male headed households are less vulnerable to various risks and less relevant to join cooperatives compared to female headed households. On the contrary, male headed households are less risk averse and own more labour power that they may perceive cooperatives (associations and credit and saving cooperatives) as relevant tool to manage risk. Thus, *gender* of the household head may influence the perceived joining *cooperatives* positively or negatively as relevant tool to manage risk.

Education is expected to influence farmers' joining *cooperatives* as relevant risk management strategy. Tesfamariam (2012) in his study of 'Determinants of saving behaviour of cooperative members in Tigrai region, Ethiopia.' indicated that more level of schooling enable farmers to get more information and easily understand the benefits of saving in cooperatives. We hypothesized that *education* influences farmers' perceived joining *cooperatives* positively as relevant risk management tool. In the study region, livestock package program is supported with extension program and credit service and members of livestock package can consider it as a relevant risk management tool. It is expected that *livestock package* influences farmers' perceived joining *cooperatives* positively as a relevant risk management tool. More social networked farmers may learn more about the benefits of cooperatives and they may consider joining cooperatives as relevant tool to manage risk. *Social network index* is directly related to farmers' perceived joining cooperatives as relevant management strategy.

Diversification

Risk attitude index can affect farmers' decision to join farm and non-farm diversification such as spatial diversification and leasing cultivated land. Bezabih and Sarr (2012) in their study of 'Risk preferences and environmental uncertainty in Ethiopia' reported that farmers crop diversity declines as farmers become less risk averse. Hence, *risk attitude* can influence the perceived *diversification* (spatial diversification, crop-livestock farming and leasing cultivated land) negatively as relevant strategy to manage risk. *Age* of household head is the other variable interest that influences farmers' perceived *diversification* as relevant risk management tool. Younger household heads are more energetic to participate in off-farm and non-farm activities compared to weaker labour power of older heads (Zerai and Gebregziabher, 2011; Haile, 2007). Older household heads are less likely to diversify due to the fact they have reduced family labour sources (Valdivia, 1996). Hence, we hypothesized that *age* is negatively related to the perceived *diversification* as relevant strategy to manage risk.

Family size influence diversification practice as risk management strategy. According to Haile (2007) large family size results in a low on-farm marginal productivity of labour. Thus, large family size due to low on-farm marginal productivity of labour may be forced toward diversification in the form of mixed farming or leasing in or lease out cultivated land. If farmers lease in cultivated land, they invest agricultural input (labour, fertilizer and seeds) and in return they generate straw and half of the crop produce. Farmers who lease out their cultivated land may be engaged in off-farm and non-farm activities or migrate to urban areas for non-farm activities. We hypothesized that *family size* influence the perceived *diversification* positively as relevant risk management strategy.

Size of livestock holding (*TLU)* can influence farmers' decision on diversification positively or negatively as relevant risk mitigation tool. Haile (2007) reported that large number of livestock as a proxy of wealth negatively related to off-farm participation. On the other hand, increase in *TLU* (probably increases the number of oxen) may encourage farmers to be engaged in *diversification* such as mixed farming, cultivate different plots (spatial diversification) and lease in to cultivate extra land. Location (*highland and midland*) can have a positive or negative influence on farmers' decision on *diversification* as relevant risk management strategies.

Zero grazing practice is the other variable interest that influences farmers' participation on *diversification*. Famers adopting zero grazing have relatively less number of cattle but own better breed cattle (mostly for dairy and fattening) and they do focus on livestock specialization instead of diversification (mixed farming and cultivating different plots) as relevant risk mitigation tool. Hence, we expect that *zero grazing* influence *diversification* negatively as relevant strategy to manage risk. Distance to the main road is proxy to towns and market where cultivated land is limited for shorter distance to the main road. The surrounding areas of town and market have limited land to cultivate but it may be favourable for livestock production due to market opportunity for livestock productivity such as milk, butter and live animals. Hence, we hypothesized that *distance to the main road* is inversely related to the perceived *diversification* (mixed farming and cultivating different plots) as relevant risk mitigation tool.

Income of household is expected to influence diversification. Higher income farmers are more likely own oxen that may encourage them to be engaged in diversification such as mixed farming and cultivating different plots. According to Bezabih and Sarr (2012) household wealth in terms of ownership of oxen are significant determinants of greater crop diversity. Hence, it is hypothesized that *income* is positively influencing *diversification* as relevant risk management strategy. Male headed households are more likely to be involved in diversification such as mixed farming and cultivating different plots compared to female headed households since male headed households may own labour resources compared to counterparts. *Gender* of the household head is expected to influence *diversification* positively as relevant risk management strategy.

According to Bezabih and Sarr (2012) education measured as the ability of the household head to write are significant determinants of greater crop diversity compared to their counterparts. Households with more level of schooling are more aware about the benefit of diversification and perceive diversification (mixed farming, cultivating different plots and lease cultivated land) as relevant tool to manage risks compared to counterparts.

Livestock package is expected to influence households' decision towards *diversification* positively or negatively. Households that are member of the livestock package program are more aware of the extension program thereby motivate towards diversification as relevant risk management strategy. On the other hand, households that are members of livestock package program may be focussed towards livestock specialization as relevant risk management strategy. Thus, we hypothesized that the variable *livestock package* influence the perceived *diversification*

(mixed farming, cultivating different plots and lease cultivated land) positively or negatively as relevant strategy to manage risk. More social networked farmers having more information are expected to influence the perceived diversification (mixed farming, cultivating different plots and lease cultivated land) positively compared to counter groups. Hence, the variable *social network index* is influencing positively the perceived *diversification* as relevant risk management strategy.

It is hypothesized that risk taker farmers perceive disease control, finance management and joining a cooperative as more important and safety net program and diversification less important risk management strategies compared to risk averse farmers. It is expected that older households perceive disease control, finance management and safety net program as more important while they perceive cooperatives and diversification as less important management strategies compared to their counterparts. Farmers with larger family size perceive disease control, finance management, safety net, feed management, cooperatives and diversification more important risk management strategies. It is hypothesized that larger TLU farmers perceive disease control, finance management, safety net and joining cooperatives less important but feed management more important risk management strategies compared to their counterparts. It is hypothesized that farmers in highland and midland locations perceive disease control and feed management as less important and joining cooperatives as more important risk management strategies compared to farmers in lowland location. It is hypothesized that farmers who practice zero grazing perceive disease control, finance management, safety net, feed management and cooperatives as more relevant and diversification as less relevant risk management strategies compared to their counterparts. It is hypothesized that farmers with long walking time to the main road perceive disease control, finance management, feed management and diversification as less relevant and safety net program as more relevant risk management strategies compared to their counterparts. .

It is hypothesized that higher income households perceive disease control, finance management, feed management and diversification as more important while they perceive safety net and cooperatives as less important strategies to manage risks compared to their counterparts. It is expected that male head households perceive disease control, feed management and diversification as more important and they perceive safety net program as less important risk management strategies compared to their counterparts.

It is hypothesised that more educated farmers perceive disease control, finance management, feed management, cooperatives and diversification as more important and perceive safety net program as less important strategy to manage risk compared to their counterparts. Members of the livestock package program perceive disease control, finance management, feed management and cooperatives as more important while safety net program as less important strategy to manage risk compared to their counter groups. It is expected that more socially networked farmers perceive disease control, finance management, safety net, feed management, cooperatives and diversification as more relevant strategies to manage risk compared to their counterparts.

4.2.4 Determinants of cattle insurance participation and intensity

Based on related empirical study and local context, we identify factors that influence farmers' interest in hypothetical livestock insurance and the number of cattle to insure (Table 4.5). Socio-economic and demographic variables such as age, gender, education, dependent ratio, share of livestock income, household annual income, geographical location (highland and midland), size of less productive cattle and zero grazing expected to influence farmers interest in cattle insurance and the intensity of cattle to insure.

Table 4.5: Hypothesized relationship of variables used in cattle insurance

Independent variables	Dependent variables		Supporting literature	Remark
	1	2		
Age	_	_	Xiu et al. 2012	Age is predicted negative sign on cow insurance participation (Xiu et al. 2012)
Gender	n	+		Based on local context information.
Education	+	+	Smith and Baquet,1996; Patt et al. 2010; Teweldemedhin and Kafidii 2009	Education is predicted positive sign on crop insurance (Smith and Baquet, 1996; Patt et al. 2010) and livestock insurance participation (Teweldemedhin and Kafidii, 2009)
Dependent ratio	+	n.i		Based on context. Whereas n.i is not included since it was chosen as selection variable. Selection variable affects insurance participation but not the number of cattle to insure.
Share income	+	+		local context
Log income	+	+	Vandeveer, 2001; Hill et al. 2011; Xiu et al. 2012	Log income is positively related to insurance participation. Income has positive effect on crop insurance (Vandeveer 2001; Hill et al. 2011.) and livestock insurance participation (Xiu et al. 2012)
Family size				
Highland	n	n		Based on local knowledge the relation is not predicted *a priori.*
Midland	n	n		Based on local knowledge the relation is not predicted *a priori.*
Number of less productive cattle	+	+	Tadesse , 2012	Number of less productive cattle is expected positive sign. Livestock ease liquidation constraint (Tadesse , 2012) and expected positive effect in cattle insurance participation and intensity.
Zero grazing	_	_	BoARD, 2009	Zero grazing is expected negative sign. Zero grazing practice minimize livestock disease prevalence (BoARD, 2009) and farmers may be reluctant to participate in cattle insurance

Note: '+' and '-' denotes to hypothesized positive and negative relationship, respectively ; 'n' hypothesized not determined *a priori; 'n.i'* denotes for not included. variables 1 and 2 denote interest of cattle insurance and the number of cattle to be insured respectively

Age of household is a variable interest that influences farmers' interest on hypothetical cattle insurance and the intensity of cattle to insure. Older household heads are a bit conservative for new agricultural practices and technology adoption that may be reluctant to participate on hypothetical cattle insurance. A recent study Xiu et al. (2012) in China reported that age of household is negatively related to cow insurance participation. Therefore it is hypothesized that *age* of household heads is negatively related to farmers' potential *participation* on hypothetical *cattle insurance and the intensity of cattle* to insure.

Gender of household heads is expected to influence farmers' potential participation in cattle insurance and the intensity of cattle to insure. However, the effect of gender in cattle insurance participation and the intensity of cattle to insure cannot be determined *a priori*. Female headed households which are more vulnerable to socio-economic risks may be more interested in cattle insurance participation as a mitigation strategy compared to male headed households. On the other hand, male headed households are more likely to invest in new agricultural practices and may be more likely to be involved in cattle insurance scheme. In rural Ethiopia, male headed households may likely have more cattle compared to female headed households and male headed households may insure more number of cattle. Hence, we hypothesized that *gender* (male headed household) is negatively or positively related to potential cattle insurance participation but positively related to the *intensity of cattle to insure.*

Education of household head is expected to influence farmers' participation on hypothetical cattle insurance and the intensity of cattle to insure. Smith and Baquet (1996) reported that the level of education is positively associated with the participation of Multiple Peril Crop Insurance (MPCI) and the coverage level. Similarly, Patt et al. (2010) studied on 'how farmers understand insurance and their interest in case of Africa' and they reported that farmers with less understanding of insurance are less likely to use it. According to Teweldemedhin and Kafidii (2009) the low level of education of many farmers in Omaheke and Otjozondjupa regions of Namibia negatively influenced the decision to purchase livestock insurance. Thus, we presume more level of schooling creates more awareness and understanding on how to be benefitted from cattle insurance. We hypothesized that *education* of household head is expected to influence positively to farmers potential *participation in cattle insurance and the intensity of cattle* to insure.

Dependent ratio includes old age and children of economically inactive part of the household members that expected to influence farmers' *interest in cattle insurance participation*. Evidences from Ethiopia indicated that households with large dependency ratio are more vulnerable to risks and shocks. Household members that are more vulnerable to risks and shocks may incline towards livestock insurance so as to minimize livestock losses. Hence, *dependent ratio* is expected to relate positively to farmers *interest in cattle insurance participation* but this variable is not expected to influence the number of cattle to insure.

Farmers' share of income from livestock is expected to influence their interest in cattle insurance participation and the number of cattle to insure. Farmers who getting more income share from livestock may provide more attention to improve their livestock productively and minimize possible losses and such farmers may be attracted to cattle insurance and insure more number of their cattle. It is therefore hypothesized that households' *share income* from livestock is directly related to farmers' *participation in cattle insurance* and the *number* of cattle to insure.

Income of households is presumed to influence farmers' interest in cattle insurance participation and the number of cattle to insure. Vandeveer (2001) studied 'Demand for area crop insurance among litchi producers in northern Vietnam' and reported income is positively related to participation on hypothetical crop insurance. Similarly, Hill et al.(2011) reported that rich farmers in rural Ethiopia were more likely to purchase weather index crop insurance. Xiu et al. (2012) revealed that household income per capita is positively related to cattle insurance participation and willingness to pay. Households having more income are easily afforded to cattle insurance thereby increase their likely participation and the intensity of cattle to insure. A positive relationship is expected between households' *income* and their interest on *insurance participation* and the *number of cattle* to insure.

Location (*highland and midland*) is expected to influence farmers' interest in cattle insurance participation and the intensity of cattle to insure. However, location factor is not determine *a priori* whether it affects positively or negatively to farmers interest in cattle insurance and the number of cattle to insure. Gebrehiwot (2012) reported that distance to all weather roads is among the crucial factors that shapes a households' activity choice. Tadesse (2012) reported that nearer distance to roads has a significant positive effect on enabling and encouraging fertilized adoption and the intensity of its use. Along with this, shorter distance to the main road is hypothesized to encourage farmers' technology adoption such as cattle insurance participation

and intensification. That is, *walking time to the main road* is inversely related to farmers' cattle *insurance participation* and the *intensity* of cattle to insure.

Number of less productive cattle is expected to influence farmers' cattle insurance participation and the intensity of cattle to insure. Tadesse (2012) reported that increase in size of livestock is expected to ease liquidity constraints. Thus, increase in number of less productive cattle may be useful source of cash for covering cost of cattle insurance and it is hypothesized *that number of less productive cattle* is positively related to farmers' interest on *insurance participation* and *intensity* of cattle to insure. It is evidenced that *zero grazing* practice in the study region is useful management strategy to minimize cattle disease prevalence and maximize cattle productivity (BoARD, 2009). As a result, it is hypothesized that farmer' adopting *zero grazing* practice is negatively related to their interest in cattle *insurance participation* and *intensity* of use.

It is hypothesized that older household heads are negatively related to cattle insurance participation and to intensity of participation. Male farmers are expected to influence the intensity of cattle insurance participation positively. Education, share of livestock income, household income and number of less productive cattle are expected to influence cattle insurance participation and the intensity of participation positively. The variable dependent ratio is expected to influence cattle insurance participation positively. Farmers practicing zero grazing are negatively influencing cattle insurance participation and the intensity of participation.

4.3 Conclusions

Hypotheses have been set forth to examine the interrelationship of risk and management strategies in the livestock farming. The purpose of the hypothesis is to identify major sources of risk and risk management strategies; factors influencing risk attitude, risk sources and management strategies and cattle insurance participation in order to draw conclusions about those relationships. This study hypothesized that there are various sources of risk such as production, market, financial, institutional, technological and human risks and risk management strategies include ex-ante and ex-post strategies. It is also hypothesized that risk attitude, risk sources and management strategies; and cattle insurance participation are expected to be influenced by socio-economic variables, agro-ecology and institutional factors.

CHAPTER FIVE

5. RESEARCH METHODOLOGY

5.1 Introduction

The study is based on a household survey conducted in Tigray region, northern Ethiopia. The survey was conducted in three zones out of five zones and six woredas (districts). A cross sectional survey was used to gather information from the households. Sample households were selected through multistage sampling procedure based on spatial distribution for selecting zones, agro-ecology for selecting woredas, accessibility for selecting tabias[1] and finally a simple random sampling of sample households. In addition to the main household survey, focus group discussion (FGD) was considered in three zones (North Western, Eastern and Southern) and three woredas (Tahtay Koraro, Saesie Tsaeda-Emba and Ofla). Finally, the FGD collected from three tabias (Lemlem, Hadush Hiwot and Hashenge), one tabia from each woreda. That is, Lemlem tabia selected from Tahtay Koraro woreda, Hadush Hiwot tabia from Saesie Tsaeda-Emba and Hashenge tabia from Ofla woreda.

Factor analysis is used to describe variability among the observed, correlated risk sources and risk management strategies in terms of small number of latent variables (factors). In addition, OLS (Ordinary Least Square) used to examine the relationship between the latent variables (factors of risk sources and risk management) and the socioeconomic variables. Furthermore, we used Heckman model to identify the determinants of farmers' interest in hypothetical cattle insurance participation and the number of cattle to insure.

5.2 Study area and sampling design

Tigray is located in the Northern highlands of Ethiopia (see Figure 5.1), stretching from 12° 15' to 14° 57'N and 36° 27' to 39° 59'E (Abegaz, 2005). The region is bordered in the north by Eritrea, in the west by the Sudan, in the south by Amhara region, and in the east by Afar region. The eastern part of Tigray includes the escarpment facing the Great East African Rift Valley (Edwards et al., 2011).

[1] *Tabia* is the lowest administrative unit in Tigray Region. Many *tabias* make up a *woreda* (district) and many of the later make up a *zone.*

In Tigray region 53% of the land is lowland (less than 1,500 meter above sea level), 39% is mid-highland (1,500-2,300 meter above sea level), and 8% is highland (greater than 2,300 meter above sea level) (Hagos et al. 1999; Hurni, 1998). The wide range of altitude governs the temperature and climatic conditions in the region. Tigray covers an area of approximately 80,000 square kilometres (Frankenberger et al., 2007) and the region is divided into five administrative zones (Western, North Western, Central, Eastern and Southern), which in turn are subdivided in to 34 rural woredas (districts), 12 urban woredas and 660 tabias (sub-districts). The regional capital is Mekelle city.

Tigray region has diversified agro-ecological zones and niches each with distinct soil, geology, vegetation cover and other natural resources. The climate is generally sub-tropical with an extended dry period of nine to ten months and a maximum effective rainy season of 50 to 60 days. The rainfall pattern is predominantly uni-modal (June to early September) (Taffere, 2003). According to Teffere (2003) considering rainfall, atmospheric temperature and evapo-transpiration, more than 90% of the region is categorized as semi-arid and the remaining areas in the region can be categorized as dry sub-humid and arid (Teffere, 2003). Average annual rainfall in Tigray is 800-1000 mm in the west and the highlands of the south dropping to 400 mm in the extreme east. In most parts, it averages between 400 and 600 mm/year (EMA, 1988).

According to the report of the 2007 housing and population census, the total size of the Tigray population was 4.3 million (5.8% of the Ethiopian population). The average population growth in Tigray region was 2.5% per year for the year 1994-2007. When we see the sex composition of the population, 49.2% of the population in the region are male and the remaining 50.8% are female. In terms of settlement, 19.5 % of the population is living in urban areas whereas 80.5% is living in the rural areas (CSA, 2008a).

The study areas for the main household survey were from three zones of Tigray out of five zones. In these three zones, it was considered 6 woredas (districts) out of 34 woredas and 12 tabias (Kebeles) out of 121 tabias. The three zones of Tigray are North Western, Eastern and Southern zone. The woredas of North western zone included in the survey were Asgede Tsimbela (tabias of Lemlem and Kesad-Gaba) and Tahtay Koraro (tabias of Lemlem and May-Demu). In eastern zone, Saesie Tsaeda-Emba (tabias of Hadush Hiwot and Senkata) and Kelete Awlaelo (tabias of Adi-Kesandid and Mesanu) weredas were included. In southern zone, Ofla

(tabias of Hashenge and Hayalo) and Raya Azebo (tabias of Begae-Delebo and Hawelti) weredas were incorporated in the survey (see Figure 5.1).

The study woredas' population showed Rayaazebo, Ofla, Kelete-Awlalo, Saesie Tsaeda-Emba, Tahtay Koraro and Asgede Tsimbela had a total population of 136,039 (49.8% male and 51.2% female); 126,953 (49% male and 51% female); 99,688 (48.8% male and 51.2% female); 138,043 (47.3% male and 52.7% female); 68,549 (49.9% male and 51.1% female) and 135,561 (50.9% male and 49.1% female) respectively (CSA, 2008a).

Figure 5.1: Map of the study woredas

Source: www.google.ie/search?q=tigray+region+map

A multistage random sampling used to account for spatial distribution, agro-ecology and accessibility. The objective of multistage sampling procedure is to get a more representative sample of the population. In the first stage, three zones were selected based on spatial distribution (natural distance) of the region in order to consider the socioeconomic and farm variability of the households. The distance of the three zones of the study areas are far apart each other. Namely, the distance from Southern zone (Mehoni town) to Eastern zone (Adigrat) is 240 km and the distance from Eastern zone (Adigrat town) to North Western zone (Shire town) is 190 km taking the town as an approximate centre of the study woredas.

Considering the limitation of time and budget involved in the field survey, we limited the size of the study to 356 sample households from the three zones of Tigray. Along with this, a proportional sample of households was considered from each of the three zones based on the proportion of cattle population at zone level. That is, the proportion of cattle population is used as a proxy for the proportion of sample household determination. Hence, we compute the proportion of sample household at zone level from the total of 356 sample households based on the proportion of cattle population. The proportional sample household allocation is used to determine sample size that is representative in terms of cattle population. This implies that zones having more cattle population are given more weight while determining the sample size compared to small cattle population. In the second stage, a purposive sampling of six woredas (two woredas from each zone) was considered based on agro-ecology. The woredas are representative of their respective zones based on agro-ecology. To this end, from Ofla woreda from highland, Rayaazebo woreda from lowland, Asgede Tsimbela woreda represents both lowland and midland. Saesie Tsaeda-Emba represents both midland and highland. The remaining woredas of Tahtay Koraro, and Kelete-Awlaelo are representing midlands.

For each woreda in a zone, a proportional sample of households was considered based on the proportion of cattle population in the woredas that in turn depends on the preceding pre-determined sample size at zonal level. More sample households were considered from woredas that had more cattle population compared to lower cattle population in each zone.

In the third stage, 12 tabias were drawn from six woredas based on accessibility, then two tabias were drawn from each woreda that were accessible in terms of infrastructure (like roads). For each tabia in a woreda, a proportional sample of households is considered based on the proportion of cattle population that in turn depends on the preceding pre-determined sample size at woreda level. Likewise, more sample households was considered in each tabia that had more cattle population compared to lower cattle population, given the preceding pre-determined sample size at woreda level.

In the fourth stage, the proportional sample of households was drawn at random from the preceding pre-determined sample size at tabia level by taking list of names of respondents from tabia leaders in collaboration with Development Agents. To this end, a total of 356 households were drawn from the three zones, six woredas and 12 tabias (see Figure 5.2).

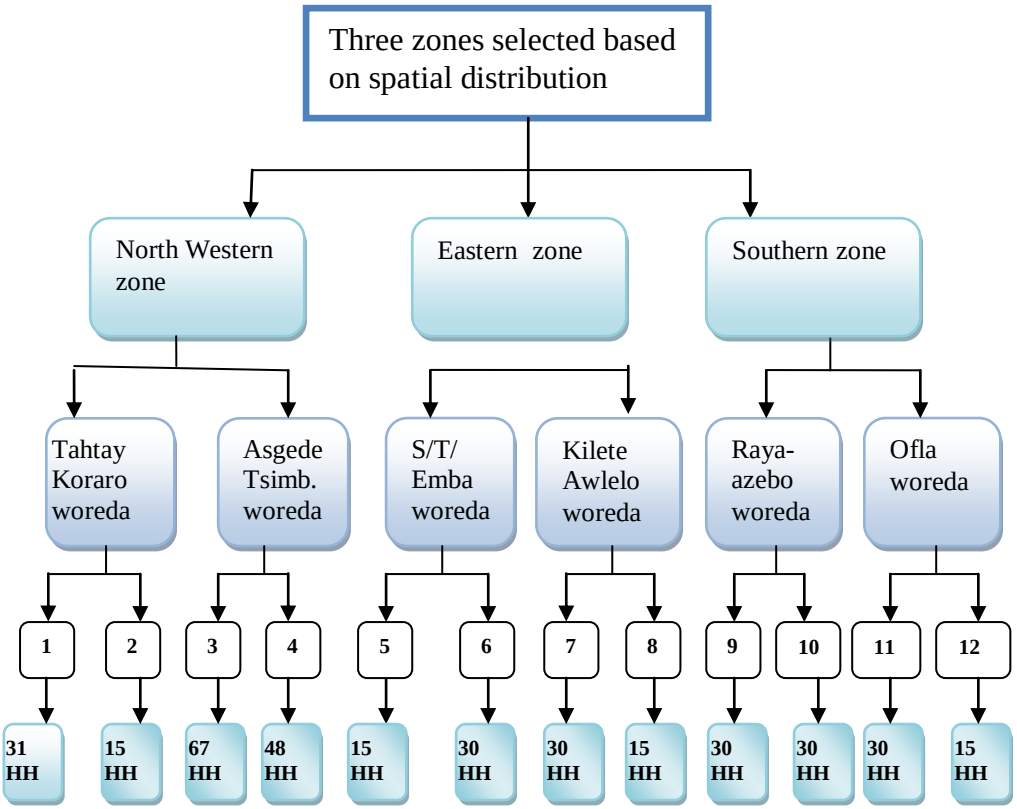

Figure 5.2: Sampling procedure of main survey

Note: Numbers 1-12 stands for the tabias from which sample households (HH) were drawn. [1] stands for lemlem, [2] May-Demu, [3] Lemlem, [4] Kesad-Gaba, [5] Senkata, [6] Hadush-Hiwot, [7] Adi-Kesandid, [8] Mesanu, [9] Hawelti, [10] Begie-Delebo, [11] Hashenge, [12] Hayalo.
[1,2,3,5,7,8] represents midland agroecology, [4,9,10] lowland agroecology, [6,11,12] highland agroecology.

A structured type of questionnaire was prepared for the main household survey. The questionnaire has 14 sections (See Appendix 2) incorporated household and village characteristics, household risk, livestock facility and market condition, perception of risk source and management strategies, livestock insurance, livestock loss and livelihood asset. A Likert scale is employed to measure households' opinion about perceived risk and risk management. A Likert scale is a psychometric scale commonly involved in social research that employs questionnaire like perception questions. It is a widely used approach to scaling responses to allow statistical analysis. However, the scales can be interpreted in different ways by respondents, for example a score of 5 might be regarded as 'good' by one person and 'very good' by someone else.

The structured questionnaire uses Likert type statements for objective 1 and 2. Likert scale questions of perceived risk sources (such as production risk, market risk, financial risk, human risk, technological risk and institutional risk), risk attitude, perception of risk management

strategies (financial management, diversification, sale or transfer asset, disease prevention, market information, emergency assistance, feed management and community asset building) were included. Likert scale is a multi-item tool composed of risk source and risk management items that help to ask respondents' opinions on the level of agreements about attitude to risk and the relevance of risk source and management strategies. For objective 3, livestock insurance questions of structured questionnaire were incorporated. Information such as social services, households' monthly expenditure, livelihood asset and social capital were also part of cross sectional data.

For the main household survey, we selected three enumerators based on their education background (1 was diploma and 2 were degree graduate) and work experience. Enumerators were given three days training from September 29-October 1, 2011. Following training, we asked each enumerator to present each item of the questionnaire to check whether all items in the questionnaire are clear or not. Before the main household survey, pilot survey was carried out in Enderta district (known as Romanat) 8 km far from Mekelle city. Following the pilot survey enumerators were given feedback. The pilot survey was found very useful experience for the enumerators to practice what is written on the paper. Besides, important information from enumerators' comments and suggestions of the pilot survey were considered for the main household survey. The main household survey was conducted between October 17, 2011-November 3, 2011 and December 26, 2011-January 2, 2012.

The focus group discussions (FGD) was undertaken in three zones of Tigray, that is, North western, Eastern and Southern zone. From each zone, it was considered one woredas and totally three woredas were included in the FGD. These woredas were Tahtay Koraro, Saesie Tsaeda-Emba and Ofla. Finally, we considered one tabia from each woreda, that is, Lemlem tabia from Tahtay koraro, Hadush Hiwot tabia from Saesie Tsaeda-Emba and Hashenge tabia from Ofla.

The FGD was collected from the tibias where main household survey was undertaken in order to collect further information that was not addressed by the main survey. The focus group discussion was collected from six groups. That is, two FGD were collected based on gender (one for male and one for female headed households) and four FGD were undertaken based on local wealth status (very poor, poor, medium and better off). In addition, a preliminary of one FGD was undertaken with key informants in order to measure the local wealth status of farmers before undertaken FGD. The preliminary FGD help to identify the local wealth ranking status of

farmers. Finally, based on the wealth ranking status FGD was undertaken. FGD collected based on gender difference and local wealth help to examine whether farmers' perception of risk and risk management strategies vary on gender and wealth. The objective of the FGD is to collect qualitative information in order to support the quantitative analysis obtained from the main household survey. In addition, the FGD was help in depth understanding about farmers' risk perception and management strategies using the open ended type of questions.

5.3 Model specification and statistical analysis

The quantitative study was focussed on the analysis and estimation of the parameters of risk and risk management strategies in the livestock farming which are key inputs for policy analysis. Factor analysis was used in objectives one (understand farmers' perception of cattle risk) and two (examine farmers' perception of existing risk management strategies) to find optimal ways of combining relevant sources of risk (objective 1) and risk management strategies (objective 2) into a small number of subsets. Factor analysis is helpful to identify the structure underlying such sources of risk and risk management and to estimate scores to measure latent factors themselves. Factor analysis was used to derive factor scores as a measure of the variables to be used to test the hypothesis. To this end, factor scores were used for subsequent multiple regression to examine the association between socio-economic variables and factors

In the main household survey there were missing data by design since the perceptions of risk sources and risk management questions included 'Not Applicable' and 'Not in Place' options (see Appendix 2, No: 6 and 9) for the five point Likert scale of risk sources (perceived likelihood and severity) and risk management strategy. Some households responded NA (not applicable) for some Likert scale items of risk sources and risk management strategies that were not relevant to the respondent. The risk sources and risk management strategies of NA response became missing values. To this end, the missing value items of likelihood of risk sources and risk management strategies were treated by converting the Likert scale from five points to six points. Whereas the missing values of items of the severity of risk sources were deleted and used a complete case analysis.

In addition to factor analysis, econometric models were used for objective one and two. For objective 1 and 2, we developed an index from the factor analysis for risk attitude, sources of risk and risk management strategies as a dependent variable. To identify the determinant factors

for those dependent variables (risk attitude, risk sources and risk management strategies) we used OLS (ordinary least square) multiple regression. Other comparable studies such as Meuwissen et al. (2001), Flaten et al. (2005) and Ahsan (2011) used a similar approach.

The determinants of risk source and risk management in the regression model help us to examine the association of socioeconomic variables and the perceived risk. According to Legesse and Drake (2005, p.413), 'studying the fundamental causes for presence of multiple perceptions and judgements is important, as it is a premise on which any strategy to improve the rural livelihoods has to be founded'. Once the determinant factors are identified, policy makers can address farmers' specific risk handling mechanism, rather than 'one size fits all' approach.

For objective 3, a Heckman model is used for estimation and for analyzing farmers' decision on cattle insurance and adoption intensity. The first stage helps to identify and analyse the determinant factors that affect farmers' interest to participate in a hypothetical cattle insurance program. In the second stage, the determinant factors that affect the intensity of adoption (the number of cattle to insure) was estimated and analyzed. The rationale to employ a Heckman model emanates from the sample selection due to the correlation of error term between the two equations. Heckman (1979) revealed that sample selection bias may arise due to self selection by the individuals or the decision by analysts (data processors). Briggs (2004) has shown how Heckman model can be used to correct for the problem of selection bias.

The aim in using the Heckman model is to identify the determinants of farmers' interest in hypothetical cattle insurance and the number of cattle to insure given a benchmark premium. Understanding determinants of preferences for hypothetical insurance offered through Heckman model can help inform us about the drivers of demand. The results of the hypothetical cattle insurance demand will inform policy makers about the possibilities to introduce real cattle insurance as a risk management tool in the rural areas of Ethiopia.

There are some agricultural insurance studies, namely Hill et al. (2011), Otieno et al., (2006), Khan et al. (2013) that used a hypothetical insurance in order to evaluate farmers' demand for insurance and to assess the feasibility of insurance implementation. According to Hill et al., (2011), the hypothetical crop insurance in Ethiopia to assess the determinants of willingness to pay for weather-index insurance demand. Hill et al., (2011) reported that even if the hypothetical insurance does not represent actual behaviour, helps to identify what kind of households may be interested to purchase a similar product. Other study (Khan et al., 2013) used a hypothetical

willingness to pay on cattle and buffalo insurance in India to examine how many people and to what extent farmers are willing to pay for dairy farm insurance and the determinants of participation. The results of the study by (Khan et al., 2013) suggested that most of the farmers were willing to participate in cattle and buffalo insurance.

Otieno et al. (2006) in their study used hypothetical cattle insurance in Western Kenya to assess farmers' willingness to pay for formal cattle insurance to manage future risks associated with cattle mortality and morbidity. From the study finding, Otieno et al. (2006) in Kenya recommended the establishment of formal cattle insurance. Contingent scenario places respondents in a hypothetical market situation that would be used as an approximation of real behaviour and it can guide practical implementation (Khan et al. 2013; Hill et al., 2011; Gebreegziabher and Tadesse, 2011; Otieno et al. 2006).

Heckman selection model was used to address sample selection bias in different applications. For example households' decision to plant tree (Gebreegziabher, 2007), water supply service (Gebreegziabher and Tadesse, 2011), farm productive activities (Tadesse, 2012), cow insurance (Xiu et al., 2012), Multiple Peril crop Insurance (MPCI) (Smith and Baquet, 1996) and Wage labour function (Verbeek, 2008; Woldridge 2002).

5.4 Conclusions

The study is based on households' cross sectional data and focus group discussion from Tigray region, northern Ethiopia. The cross sectional data was conducted in three zones, six woredas and 12 tiabias on a multistage sampling procedure. Statistical analyses include factor analysis, Ordinary Least Square (OLS) and Heckman model. Factor analysis is used to identify the major sources of risk and management strategies in terms of smaller number of latent variables factors) and OLS used to investigate the relationship of the latent variables and socio-economic variables.

CHAPTER SIX

6. HYPOTHESIS RESULTS

6.1 Determinants of households' risk aversion, likelihood and severity of risk

6.1.1 Introduction

While it is clear that risk and uncertainty play an important role in agriculture in developing countries, very little is known about the empirical basis of farmers' perception of risk in livestock farming. This study contributes towards the goal of establishing an empirical basis for risk analyses in the context of livestock farming in developing countries. A strong empirical basis is necessary to understand (and predict) how livestock farmers react to production, market, finance, institutional and human risks. In this regard, analysis of farmers' perceptions of risk and its association with farm and farmer characteristics is a necessary step towards understanding risk management.

Livestock farmers in Ethiopia operate in a very risky environment due to production risks (weather, pests, diseases) and the variability of prices. Changes in technology, institutional and social concerns and the human factor also contribute to the risky environment smallholder farmers live and operate in. Even in the arid and semi-arid lands of Kenya and southern Ethiopia, where covariate risks such as drought, infectious disease, and armed violence feature prominently, individual household member may perceive the risks they face quite differently. As a consequence, the welfare and behavioural effects of risk may differ across individuals, households and communities (Doss et al., 2008). It has been argued by Doss et al. (2008, p.1454) that 'interventions and policies intended to help vulnerable peoples manage risk either through ex-ante mitigation strategies or through ex-post coping mechanisms may need to account for such variation in order to prove effective.'

However, in many developing countries every development effort is focusing on poverty reduction but little attention is given to mitigate risk and shocks and the risk and shocks reinforces poverty. To alleviate poverty in developing countries, therefore, it would be useful to have effective national disaster management programs in the country. In this regard, Legesse and Drake (2005, p.383) argued that 'If risk is excluded from the livelihoods analysis, then findings would be misleading and policy recommendations and ultimate decisions on identification of

relevant improvements and intervention measures might be inappropriate'. Doss et al. (2008, p.1454) also stated that 'understanding of the variation in subjective perceptions of risk can inform the design and targeting of policies, research and interventions to address objective sources of risk'.

Thus, knowledge of farmers' perceptions of risk would be important precondition for devising sound risk management strategies. The main objective of this study is to assess farmers' risk attitude, identifying relevant sources of risks and their association to farm and farmers' characteristics. The results presented offer insight into the variety of farmers' risk attitudes, risks that are most relevant for livestock farming, and differences in perceptions of risk among farmers' across farm and farmers' characteristics.

6.1.2 Method of estimation

This chapter presents descriptive statistics on farmers and farm characteristics such as demographic characteristic, feed management, risk attitude and perceptions of risk sources. Factor analysis, from an exploratory perspective, was employed to reduce the large number of risk source variables in a reduced number of factors and to derive risk indices (Torress-Reyna, 2007). To reduce the risk source variables, it was considered fifteen risk sources in terms of likelihood and eleven risk sources in terms of severity. Principal component factoring (sometimes principal axis rotation) extraction method was used in order to analyse common factor variability while removing the unexplained variability from the model (Habing, 2003). Orthogonal (varimax) rotation used to ensure inter-alia that the factors were as independent as possible for subsequent use as part of ordinary least squares (OLS) regressions.

Standardised factor scores (as dependent variables) were used for subsequent multiple regression analyses (Ahsan 2011; Flaten et al., 2005; Meuwissen et al., 2001). Factors have been retained with latent root criterion (eigenvalues greater than 1). The total variance explained was found to be 62.25% for the likelihood and 73.53% for the severity of risk sources. Factor loadings with absolute values of greater than 0.45 were analysed, which are generally considered to be above the minimal level for interpretation of the structure (Hair et al., 2010). The Kaiser–Meyer–Olkin measure of sampling adequacy (KMO) was used to check the factorability of the correlation matrices. KMO values were found to be 72.58% for likelihood and 71.90% for severity of risk

sources; this indicated that patterns of correlations were relatively compact and factor analysis was appropriate (Ahsan, 2011). This KMO value indicates that overall the likelihood of occurrence and severity of risk sources have nearly 72 % in common, and therefore warrant a factor analysis. Individual KMO values for risk sources less than 50 % were excluded from the analysis (see Hair et al., 2010). KMO values and communalities for likelihood of occurrences and severity of risk sources are given in Appendix 1 (Table 1.1). The Cronbach's alpha value for likelihood of risk sources occurring was found to be 0.68, which is deemed acceptable in social science research (Pennings et al., 2006) while the Cronbach's alpha value for severity of risk sources was found to be 0.83.

Variance inflation factors for all variables used in regression were found to be less than 2.1, indicating no multicollinearity problems (Gujarati, 2004). Heteroskedasticity problems were detected using the Breusch-Pagan/Cook-Weisberg test of post regression models (Torress-Reyna, 2007; Baum, 2006). When the usual assumptions of homoscedastic disturbance is not met, the loss in efficiency in using ordinary least square (OLS) may be substantial and more importantly, the biases in estimated standard errors may lead to invalid inferences (White, 1980; Breusch and Pagan, 1979). The Breusch-Pagan test was carried out using fitted values and we found evidence for heteroskedasticity (variance of error term was not constant) in variables such as risk attitude index, likelihood of institutional and human risk as well as the severity of human risk. To avoid possible biased standard errors we use heteroskedasticity-robust standard errors to deal with heteroskedasticity (Torress-Reyna, 2007).

To examine the relationship of risk attitude index, the likelihood of occurrences and severity of risk sources with the socio-economic and demographic variables, Ordinary Least Square (OLS) multiple regression was used. Increasing the index of *risk attitude* variable is considered to be associated with low risk averse (more risk taker) and vice versa. The regression coefficients, robust standard errors and the goodness-of-fit measures (adjusted R^2) are presented. All models presented were statistically significant at the 1% level.

Variables such as age, family size, education, cattle size, location (highland, midland), zero grazing practice, walking time to main road, income, gender, participation in livestock package and risk attitude index were found to affect farmers' risk perception (likelihood of occurrences and severity of risks). Except for two variables, that is, grazing practice and participation in livestock package, the above mentioned variables are also used in other similar studies (Ahsan,

2011; Doss et al., 2008; Flaten et al., 2005; Legesse and Drake, 2005; Meuwissen et al., 2001; Gebreegziabher and Tadesse, 2014).

The goodness-of-fit measures for some of the regression models were found to be low. The low levels of goodness-of-fit may indicate that farmers' perceptions are very personal. That is, farmers' perception varies from farmer to farmer. As a result, a low proportion of the sample variation in the dependent variable can be explained by the model. Or it may be caused if the necessary variables explaining a farmer's risk perceptions have been excluded (see similar studies Ahsan, 2011; Flaten et al., 2005; Meuwissen et al., 2001). However, in this study the low level of goodness-of-fit in the regression may be related to risk perception variation among farmers since the relevant socio-economic variables were already included in the regression. Socio-economic variables such as age, gender, family size, education, cattle size and income of households were included to explore their variability and effect on farmers' risk perception. The independent variables employed were found statistically significant in one or more of the regression models (Table 6.6, 6.8 and 6.10).

6.1.3 Data description

The data that used in this analysis come from the survey of 356 sample households collected from three zones (Eastern, North Western and Southern) of Tigray, northern Ethiopia during the year 2011. The primary data was collected mainly through the use of cross sectional design and focus group discussion (FGD). The cross-sectional design was composed of a structured type of questionnaire. The cross-sectional data included information such as household characteristics (gender, age, family size, marital status, education), village characteristics, cultivated and grazing lands (agro-ecology, vegetation type, cattle feeding practice) and market condition (cattle sold, reason for selling cattle and problems of livestock market). In addition, information on the perception of risk sources was gathered using Likert scale questions regarding risk attitude, production risk, market risk, financial risk, human risk, technological risk and institutional risk. Along with the cross sectional data, FGD information was used to support the quantitative analysis.

Each farmer (respondent) was asked to score each source of risk in terms of likelihood of occurrences on a Likert scale from 1 (very low) to 5 (very high). But some respondents indicated that they did not at all experience some of the risk sources and responded 'Not Applicable' (NA).

This NA response is a type of missing data by design. Therefore, we follow Hair et al. (2010) for accommodating the missing value. Variables where more than 50% of the values (NA response) are missing were removed from further analysis.

As long as the likelihood of occurrences of risk sources is zero, we included the NA responses (missing values) under the lowest value of the Likert Scale. That is, we upgrade the Likert scale from five points to six points in order to incorporate the zero likelihood of occurrence for the risk sources response. To this end, the NA response is given 1 and the remaining value of the Likert scale is increased by 1. That is, NA is changed to 1 (very low); 1 is changed to 2 (low); 2 is changed to 3 (moderately low); 3 is changed to 4 (moderately high); 4 is changed to 5 (high), and 5 is changed to 6 (very high). The intensity of Likert scale indicated how respondents' perceive the likelihood of occurrences for each sources of risk.

For the likelihood of occurrences of risk sources, we considered 15 out of 37 items in the factor analysis. Following Hair et al. (2010), 13 (35%) of the variables were removed from factor analysis when missing values exceeded 50%. A further of 9 variables were also removed from factor analysis due to low KMO values (KMO values less than 50%). To this end, a total of 356 sample households were used for the factor analysis and for regression analysis of the likelihood of risk sources occurring.

Unlike the likelihood of occurrence, the consequences (severity) of risk sources are not likely to be zero. Even if the likelihood of a particular risk source is very low, the severity of that risk can be either low or high. Since this was conveyed to respondents, we can assume that the severity of risk sources is unlikely to be zero and safely delete the NA responses from the analysis.

Variables that contained missing values were excluded from analysis. The sample size for the severity of risk sources is therefore 160 for both the factor analysis and regression.

From the total 37 severity of risk sources only 11 variables were considered for factor analysis. Furthermore, 13 variables were excluded from the analysis due to missing values more than 50% and the remaining 13 variables were excluded due to low KMO values (KMO values less than 50%). STATA 11 was employed for all analysis.

6.1.4 Demographic Characteristics

The average family size per household for the survey sample was 6.1 (6.5, 6.3 and 5.4, from Eastern, North Western and Southern zones of Tigray), that is, above the average family size per household of 4.7 at national level (CSA, 2008a). The total dependency ratio in the study area was found to be 96.6%, of which 92.1% was accounted for by people of less than 15 years and 4.5% by people of more than 64 years. Thus, the total dependency ratio in the study area was a bit higher than the national level of 92.3% (CSA, 2008a). This implies that around 97 dependent (young children and old age) people depend on every 100 of economically active working age group (15-64 years). That is, more than half of the working age group would be important to undertake different farm activities. The education status of the household heads indicated that 174 (48.9%) were illiterate (cannot read or write). The remaining 182 household heads (51.1%) were found to be literate. The average levels of education for head of households were found to be school grade 2.3 (grade 2.3 for Eastern, grade 1.9 for North western and grade 1.8 for Southern zones). This implies that the average level of farmers' education is very low, education is important to enhance farm productivity directly by improving the quality of labour.

Marital status of the head of households was found to be 6 (1.69%) single and 261 (73.31%) married. The remaining heads of households were 38 (10.67%) widowed, 13 (3.65%) separated and 38 (10.67%) divorced. The study also indicated that 26 (24.16%) of the heads of households were female and 270 (75.84%) were male.

6.1.4.1 Livestock Feeding Management

The major source of feed for cattle in the study area was free grazing (Figure 6.1). The free grazing practice leads to overgrazing that would contributes towards environmental degradation and desertification. The remaining farmers are practicing either zero grazing or both zero grazing and free grazing.

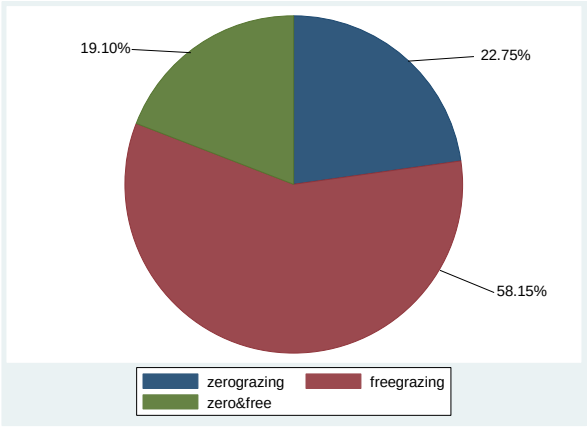

Figure 6.1: Feeding practice

There are different types of crops grown in the study area. The major crops grown in the study area are sorghum, wheat, barley, maize and teff (Figure 6.2). These major crops are staple food in the study area. Teff (*Eragrostis Tef*) is very expensive crop and most farmers sell it in the market.

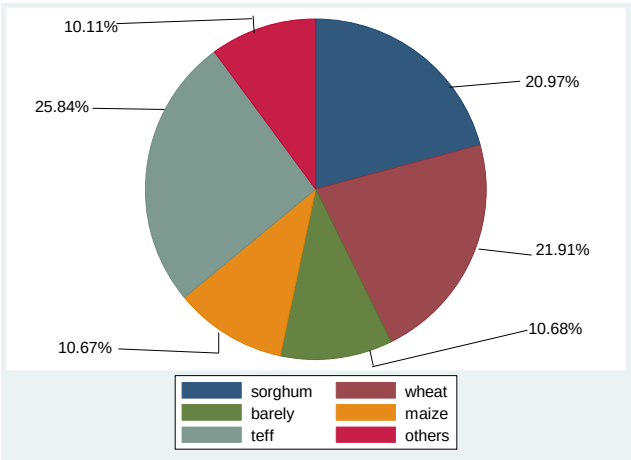

Figure 6.2: Major crops grown in normal season

The major feed resources used during the dry season were found to be straw (mostly from teff, barley and wheat), piling of stalk (from maize and sorghum) and hay (Table 6.1). On the other hand, two-third of the feeding in the study area was composed of green fodder during wet season. Around a quarter of the feeding resource in wet season was found from other resources (such as farm weed).

Table 6.1: Feed resources used in dry and wet season

Major feed dry season	% of total respondent	Major feed wet season	% of total respondent
Straw	51.95	Green fodder	69.10
Aftermath	0.84	Straw	4.49
Cactus	2.25	Hay	1.12
Stalk	20.51	Others	25.28
Hay	24.44	Total	100.00
Total	100.00		
n= 356		n=356	

Source: own survey, 2011.

With regard to grazing land in the study area, 333(93.54%) of the households had access to communal grazing land while 23 (6.46%) did not have any access to communal grazing. Respondents were also asked whether or not the grazing land was adequate during wet and dry season. The results revealed that 250 (77.22%) of the respondents found grazing land to be inadequate during the wet season while 106 (29.78%) of the respondents found it adequate. The reasons for inadequate grazing land during wet season has been indicated by 87 (34.80%) of respondents as due to extensive cultivation, 134 (53.60%) of respondents due to area closure, 17 (6.80%) of respondents due to too many cattle in the community and 12 (4.80%) of the respondents gave other reasons.

Similarly, 303 (85.11%) of the respondents found grazing land to be inadequate during the dry season while 53 (14.89%) found it to be adequate. The reason given for inadequate grazing land during dry season was: 43(14.19%) of respondents was due to extensive cultivation, 130 (42.90%) due to area closure, 57 (18.81%) due to too many cattle, 71 (43.23%) due to small grazing land and 2 (0.66%) of households due to other reasons.

Generally, feed shortage occurs both in the dry and in the wet season; however, the shortage was more severe during the dry season. Out of the total respondents, 85.11% encountered seasonal feed shortage in dry season. To overcome the shortage of feed, the farmers have developed their own coping mechanisms. In this regard, 156 (43.82%) of the farmers were buying forage from the market to alleviate the problem of grazing and feed shortage. The remaining 22 (6.18%) of

farmers used farm weed, 70 (19.66%) used cactus, 80 (22.47%) used the cut and carry system, 8 (2.25%) seasonally reduced their livestock and 20 (5.62%) used other coping mechanisms.

6.1.4.2 Livestock drinking water

More than half of the farmers in the study area were using rivers as their main source of livestock drinking water (Figure 6.3). The remaining farmers use stream, dam and other sources for their livestock drinking. In many rural areas of Ethiopia, people and livestock commonly use unprotected water as a source of drinking. This has negative effect in rural farm in that both human and animals die from diseases related to poor water quality. In relation to this, out of total respondents 34.25% indicated that there was shortage of water during the dry season for livestock drinking. The reason for shortage of livestock drinking water in dry season has been indicated as drought, high turbidity of dam water or river, large livestock population and others.

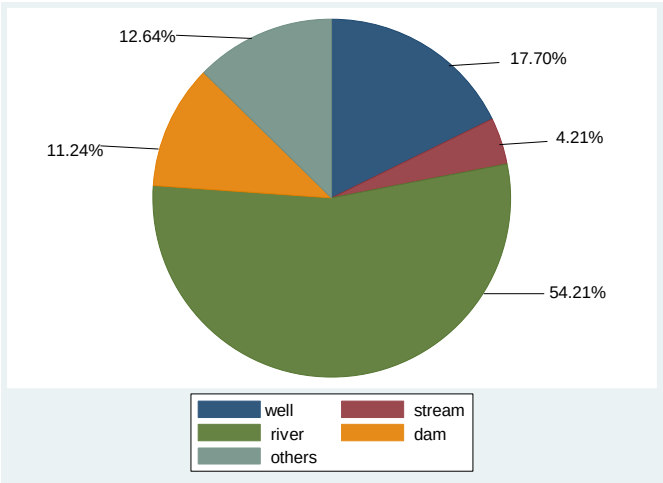

Figure 6.3: Main sources of livestock drinking water

6.1.4.3 Farm problems

Farmers were asked to rank the major problems related to their livestock farming (Table 6.2). The result indicated that shortage of feeding, livestock diseases and quality and quantity of drinking water were the major problems related to livestock farming. This result is in line with other study in Tigray region (Tesfaye 2010; Abegaz et al., 2007; Gebremedhin et al., 2004; Hagos et al., 1999).

Table 6.2: Farmers' major problems of livestock farming

Problem	% of total respondent (%)
Shortage of feeding	38.76
Diseases	36.24
Drinking water	15.17
Poor productivity (infertility, low milk)	7.87
Poor or inadequate shelter	1.12
Others	0.84
Total	100.00
n= 356	

Source: own survey, 2011.

6.1.4.4 Cultivated land

The average land holding per household in the study area was 1.02 ha (0.58 ha for Eastern, 1.25 ha for North western and 1.05 ha for Southern zones). The average land holding of farmers in eastern zone is much lower than the overall average result; perhaps this is due to the densely populated nature of the zone compared to other zones. Around 5.62% of the households that engaged in farming did not have any cultivated land while 58.14% of the households had a cultivated land in the range 0.10-1.0 ha which is less than the average of the study area (Table 6.3). Our finding support the empirical evidence presented by Haile (2008) in his study in northern Ethiopia found the average land holding of farmers in the area to be 0.96 ha.

Table 6.3: Size of cultivated land per household

Cultivated land (in ha)	% of total respondent (%)
0	5.62
0.1-0.5	26.68
0.51-1.0	31.46
1.01-1.5	21.91
1.51-2.0	9.83
greater than 2	4.49
Total	100.00
n=356	

Source: own survey, 2011.

6.1.5 Determinants of households' risk aversion

Using Likert scales, farmers' risk aversion was recorded. Farmer's risk aversion was compared with other farmers in the same locality (see Meuwissen et al., 2001 for similar treatment). The following statement we used in our questionnaire: "I am willing to take more risks than others with respect to: production, marketing, finance and investment; and technology risks". Each respondent was asked to agree or disagree for each risk. The level of agreement under the Likert scale has 5 points (1= fully disagree; 2= disagree; 3= neutral; 4= agree; 5= fully agree). The response of households on 1 and 2 are categorized under more risk averse, 3 risk neutral, 4 and 5 less risk averse (or risk taker) (Table 6.4).

The frequency of farmers who responded 'fully disagree' was zero, 'disagree' was 14.6%, neutral was 52.8%, 'agree' was 24.7% and 'fully agree' was 7.9% on production risk (Table 6.4). For production risk, 14.6% of the respondents were 'more risk averse', 52.8% were 'risk neutral' and the remaining 32.6% were 'less risk averse'. Above half of the respondents were thus classified as risk neutral with regard to production risk. Around one-third of the respondents were classified less risk averse (risk taker) towards production risk.

Table 6.4: Relative risk aversion by farmers.

	Relative risk aversion based on Likert scale (in %)				
Items	1	2	3	4	5
Production risk	0	14.6	52.8	24.7	7.9
Marketing risk	0.50	20.5	52.3	21.1	5.6
Finance and investment risk	4.5	24.4	28.1	33.4	9.6
Technological risk	7	43.5	33.4	8.4	7.7
n=356					

Source: own survey, 2011.

For marketing risk, around 21% of the respondents were identified as risk averse, whereas 52.3% of respondent were risk neutral and 26.7% were less risk averse. That is, most farmers were neutral in their decision about buying and selling of agricultural input (such as fodder) and output. For finance and investment, 28.9%, 28.1% and 43% of the respondents were risk averse, risk neutral and less risk averse (risk taker), respectively. For finance and investment, the 43%

of farmers were taking risk, perhaps this could be due to credit access provided to most farmers through the microfinance in the region.

For technological risks, 50.5% of respondents were found to be more risk averse, 33.4% of respondents found risk neutral and 16.1% of the respondents found less risk averse (risk taker) (see table 6.4). Thus, a bit more than half of the respondents were found more risk averse and thus considered relatively reluctant to take decisions like employ improved breed, Artificial Insemination (AI), and vaccination. Only 16.1% of the respondents decided to adopt new technology (modern breed and use of AI) to improve their livestock productivity. The remaining farmers were found neutral for their decision of technological risks in livestock farming.

In sum, farmers perceived them-selves as generally risk neutral for production and marketing in their livestock farming. On the other hand, farmers perceived them-selves relatively risk takers for finance and investment risks and risk averse for technological risks.

The eigenvalue of the four statements of risk aversion was found to be 3.05 in a single factor model with a Cronbach's alpha of 0.85. The factor loadings of the four statements of farmers' risk aversion range from 0.70 to 0.85. It is possible to conclude that the four statements of risk aversion items measure the same construct. Hence, the four statements of respondents' risk aversion items were aggregated to a single variable index (risk attitude index) for further regression analysis (see Flaten et al., 2005; Meuwissen et al., 2001).

OLS multiple regressions have been used to assess the relationship between risk attitude and socio-economic and geographical location variables. The summary of the description of the variables used in the regression analysis is presented in Table 6.5. The regression coefficients, robust standard errors and the goodness-of-fit measures of the models are reported in Table 6.6. Significant variable at 1%, 5% and 10% are discussed from Table 6.6.

Table 6.5: Summary statistics of variables used in regression

Variables	Mean	Std.dev	Min	Max
Age of household head (years)	45.2	12.08	22	84
Family size (number of members in the household)	6.09	2.17	1	13
Education of head of household (years of schooling)	2.31	2.94	0	12
Cattle size (number of household's cattle)	6.65	5.29	1	49
Highland dummy (1=highland area; 0= otherwise)	0.22	0.41	0	1
Midland dummy (1=midland area; 0= otherwise)	0.47	0.50	0	1
Zero grazing dummy (1= zero grazing practice; 0 otherwise)	0.23	0.42	0	1
Walking time to main road (walking distance from homestead to nearest highway, in minutes)	79.49	76.13	0	360
Log income (log of household's annual income in Birr[a])	8.98	0.76	6.41	11.44
Gender of the household head (1= male; 0 otherwise)	0.76	0.43	0	1
Livestock package dummy (1= if the household is member of the livestock package program; 0 otherwise)	0.83	0.37	0	1
Risk attitude index (index from factor analysis)	0	1	-2.47	2.77

[a] At a time of survey, 1 USD was equivalent to 17.2 Ethiopian Birr (as of October 17, 2011).

The results suggest that the family head's level of *education* was positively and significantly related to perceived *risk attitude index* at 5% level of significance (Table 6.6). Thus, famers with a higher level of education were found to be less risk averse. A higher level of farmers' education relatively was associated with lower risk aversion in the case of the Netherlands (Meuwissen et al., 2001). An increase in the number of *cattle* ownership was associated with a higher *risk attitude index* (at 5% level of significance). *Zero grazing* farmers were positively and significantly associated with *risk attitude index* at 1% level of significance.

Table 6.6: Multiple regression for risk attitude

Independent Variables	Risk attitude [a]
Age	-0.0056 (0.0042)
Family size	0.0001 (0.0246)
Education	0.0449** (0.0189)
Cattle size	0.0199** (0.0095)
Highland	0.1509 (0.1285)
Midland	0.0731 (0.1261)
Zero grazing	0.4262*** (0.1261)
Walking time to main road	0.0001 (0.0007)
Log income	0.4099*** (0.0696)
Gender	0.1953 (0.1341)
Livestock package	0.6392*** (0.1151)
Risk attitude index	n.i[b]
Constant	-4.532*** (0.6239)
Adjusted R^2	0.2854***
n=356	

***, **, * indicate statistically significant at 1%, 5% and 10%, respectively. Values in parentheses are robust standard errors. [a]Risk attitude extracted from the corresponding factor analysis, [b] stands for not included.

Income *(log income)* is positively and significantly related to risk attitude index at 1% level of significance. Higher income households were found to be less risk averse compared to lower income households. A previous study on farmers' risk aversion and poverty in Ethiopia also found that farm households who are wealthier were more willing to take risk (less risk averse) in exchange for higher returns than poorer households (Yesuf and Bluffstone, 2009). Evidence from the Netherlands also suggests that higher income farmers were less risk averse than lower income farmers (Meuwissen et al., 2001). Households who were a member of the *livestock package* program were found positively and significantly related to *risk attitude* at 1% level of significance. That is, households who were a member of livestock package program found to be less risk averse compared to non-member of the package program. This could be because the extension program is integrated with the livestock package program and that may help farmers to be aware about agricultural practices and technology adoption, and thereby be less risk averse.

6.1.6 Determinants of likelihood and severity of risk sources

6.1.6.1 Factors affecting the likelihood of risk

The analysis of the perceptions of likelihood of occurrence was based on a six point Likert scale, accommodation of the missing values. The Likert scale is extended from very low (LS=1) to very high (LS=6). To this end, for the likelihood occurrences of risk sources, a six point Likert scale was used for further analysis (descriptive statistics, factor analysis and regression analysis).

The mean values in decreasing order and the standard deviations for the Likert scale regarding households' likelihood of risk sources is presented in Table 6.7. High price of forage was perceived to be the most likely risk source occurring. The second major sources of risk for respondents were small farm income, followed by shortage of family labour in the livestock farming. Livestock price variability, cash shortage, lack of savings, forage shortage, shortage of herders, non-epidemic diseases and epidemic diseases were also perceived to be relevant sources of risks occurring in descending order.

Table 6.7: Varimax rotated factor loadings for likelihood of risk

Likelihood of risk sources	Mean[a]	SD[b]	Most important factors[c]				
	(n=356)		1	2	3	4	5
High price of forage	4.74	1.12	-0.04	**0.82**	-0.17	0.06	0.06
Small farm income	4.50	1.0	-0.38	0.30	-0.05	**0.49**	0.17
Shortage of family labour	4.35	1.64	0.00	0.13	0.10	0.14	**0.82**
Livestock price variability	4.21	1.10	0.16	**0.69**	0.14	-0.01	-0.13
Cash shortage	4.10	1.50	0.04	0.14	-0.08	**0.82**	-0.06
Lack of saving	3.95	1.71	0.12	-0.04	0.06	**0.81**	0.05
Forage shortage	3.94	1.44	-0.03	**0.73**	-0.04	0.16	0.01
Shortage of herders	3.82	1.75	0.22	-0.15	0.12	0.13	**0.80**
Non- epidemic livestock diseases	3.79	1.27	**0.73**	0.00	0.20	0.06	0.17
Epidemic livestock diseases	3.75	1.30	**0.85**	0.05	-0.06	-0.06	0.07
Cattle death	3.29	1.66	**0.74**	0.06	0.24	0.25	-0.01
Property rights conflict (water, land)	2.56	1.72	0.31	0.21	**0.58**	-0.11	0.21
Inadequate government support	2.54	1.22	0.10	0.04	**0.72**	0.02	0.12
Cattle accident	2.43	1.59	**0.57**	-0.24	0.43	0.10	0.14
Lack of road and communication	2.25	1.36	0.18	-0.25	**0.76**	-0.03	0.09
%age of total variance explained	-	-	21.75	15.65	9.56	8.51	6.78
Cumulative %age of total variance explained	-	-	21.75	37.40	46.96	55.47	62.25

[a,b]Mean score and standard deviation (1 = very low, 6 = very high). [c]Factors 1 to 5 are production, market, institutional, financial and human respectively. Factor loadings greater than 0.45 are in bold.

A factor analysis on 15 risk sources and the likelihood of their occurrence was conducted; five factors and their respective factor loadings are presented in Table 6.7. Factor loadings are the weights and correlations between each source of risk and the factors. Higher loadings are more relevant in defining the factor's dimensionality. Based on the loadings, factors 1 to 5 can best be represented as *production, market, institutional, financial* and *human* risks, respectively. Production risk comes from the unpredictable nature of weather and uncertainty about the performance of livestock, including the incidence of diseases, feed shortage and other factors. Marketing risks arise from unpredictable competitive markets for input and output, market risk is often significant and may increase over time. Market risk includes risks of unpredictable currency exchange (Hardaker et al., 2004). Livestock producers may be badly affected by new restrictions on the use of pesticides and by introduction of restrictions on the use of drugs for disease prevention and treatment; this is a type of institutional risk. Institutional risk embodies political risk, meaning the risk of unfavourable policy changes. Financial risk results from the method of farm financing and use of risks credit. The most significant financial risks include unexpected rises in interest rates on borrowed funds, lack of credit available and changes in interest rates (Hardaker et al., 2004). Human risk arises from conflict, divorce, death and disability is often the result of adverse health effects in humans.

Factor 1, *production risks* loads significantly on morbidity and mortality of livestock. Specifically, production risk had high loadings on *epidemic and non-epidemic livestock diseases, death* and *accident of cattle.* In similar studies, livestock farmers in other countries (Norway and Netherlands) also perceived the same sources of risk to be important (Flaten et al., 2005; Meuwissen et al., 2001). Factor 2, *market risks*, had high loading variables such as *high price of forage, livestock price variability* and *forage shortage.* Similar studies in Ethiopia and Turkey, dairy farmers perceived market risks as the most relevant sources of risks (Gebreegziabher and Tadesse, 2014; Akcaoz et al., 2009). *Institutional risk* in Factor 3 had high loading variables of *property rights conflict, inadequate government support* and *lack of road and communication.* Factor 4, *financial risks*, had high loadings of *small farm income, cash shortage and lack of saving.* Heavy loadings of *human risk* variables included *shortage of family labour* and *shortage of herders* in factor 5.

OLS multiple regression used to assess the relationship between the likelihood and severity of risk sources and socio-economic and geographical location variables. The summary of the description of the variables used in the regression analysis is presented in Table 6.6. The regression coefficients, robust standard errors and the goodness-of-fit measures of the models

are reported in Table 6.8. All models were highly significant at 1% level of significance. Significant variable at 1%, 5% and 10% are discussed from Table 6.8.

The regression model indicates the influence of different socioeconomic and geographical location variables on farmers' perception of the likelihood risk. *Age* of household head is positively and significantly related to the likelihood of *production* risks at 1% level of significance. That is, older household heads perceived cattle *production* risks as more likely than their counter younger household heads. *Production* risks in this study are associated with cattle morbidity and mortality. This may be because older household heads are relatively physically weaker to prevent cattle diseases, death and accidental damage as compared to the younger household heads. *Cattle size* was positively and significantly associated with *production risk* at 10% level of significance. Households with larger *cattle size* perceived the likelihood of *production* risks more compared to those with small cattle owner. This may be due to poor livestock management practices for large cattle size as compared to small cattle that may not be easy to control cattle morbidity and mortality.

Highland and *lowland* geography were negatively and significantly related to the likelihood of *production* risks at 1% level of significance. Households in *highland* and *midland* location perceived the likelihood of *production* risks less as compared to lowland areas. In Ethiopia, the lowland areas are relatively poor in terms of infrastructure and social services like roads and veterinary services, which may exacerbate cattle morbidity and mortality. In addition, the livestock diseases are more prevalent in the moisture stress areas of lowland compared to *highland and midland* areas.

Zero grazing was negatively and significantly associated with the likelihood of production risks at 1% level of significance. The likelihood of production risk was perceived less for households adopting zero grazing compared to their counterparts. This may be because zero grazing practice minimizes the likelihood of cattle diseases, death and accidental damage. That is, zero grazing practice is a better cattle management systems compared to the opposite groups. Income (log income) was negatively and significantly related to the likelihood of production risks at 1% level of significance.

Table 6.8: Multiple regression for risk attitude and risk source occurring

Independent Variables	Risk attitude	Sources of risk [a]				
		Production	Market	Human	Institutional	Financial
Age	-0.0056 (0.0042)	0.0128*** (0.0045)	0.0064 (0.0049)	0.0075 (0.0049)	0.0052 (0.0044)	0.0075 (0.0051)
Family size	0.0001 (0.0246)	0.0390 (0.0244)	0.0073 (0.0298)	-0.1113*** (0.0296)	0.0104 (0.0282)	0.0343 (0.0310)
Education	0.0449** (0.0189)	-0.0109 (0.0174)	0.0152 (0.0184)	0.0369** (0.0186)	0.0074 (0.0202)	-0.0338 (0.0210)
Cattle size	0.0199** (0.0095)	0.0175* (0.0093)	-0.0141 (0.0122)	0.0114 (0.0115)	0.0045 (0.0089)	-0.0426*** (0.0110)
Highland	0.1509 (0.1285)	-0.4669*** (0.1530)	-0.3296** (0.1559)	-0.2076 (0.1716)	-0.4597*** (0.1376)	-0.0106 (0.1514)
Midland	0.0731 (0.1261)	-0.3587*** (0.1193)	-0.2272* (0.1245)	-0.2771** (0.1254)	-0.0814 (0.1162)	0.1128 (0.1178)
Zero grazing	0.4262*** (0.1261)	-0.4927*** (0.1166)	0.4019*** (0.1390)	-0.2597** (0.1258)	-0.0798 (0.1260)	0.1774 (0.1368)
Walking time to main road	0.0001 (0.0007)	-.0001 (0.0007)	0.0019*** (0.0007)	-0.0002 (0.0007)	4.02e-06 (0.0007)	0.0020*** (0.0007)
Log income	0.4099*** (0.0696)	-0.2761*** (0.0798)	0.2237*** (0.0761)	-0.2846*** (0.0912)	-0.5822*** (0.0876)	-0.0155 (0.0750)
Gender	0.1953 (0.1341)	0.3245*** (0.1257)	0.1837 (0.1504)	-0.0613 (0.1290)	0.4879*** (0.1274)	-0.0822 (0.1444)
Livestock package	0.6392*** (0.1151)	0.2388* (0.1451)	-0.0118 (0.1545)	-0.0261 (0.1451)	0.0507 (0.1395)	-0.1248 (0.1608)
Risk attitude index	n.i[c]	-0.0949* (0.0528)	0.1202* (0.0708)	-0.0073 (0.0644)	0.0036 (0.0596)	-0.1170** (0.0654)
Constant	-4.532*** (0.6239)	1.524** (0.7631)	-2.481*** (0.7118)	3.055*** (0.8319)	4.630*** (0.8133)	-0.1365 (0.7267)
Adjusted R^2	0.2854***	0.2469***	0.1028***	0.1182***	0.2176***	0.1177***
n=356						

***, **, * indicate statistically significant at 1%, 5% and 10%, respectively. Values in parentheses are robust standard errors. [c] stands for not included. [a]Risk attitude and risk source indices extracted from the corresponding factor analysis.

Higher income (log income) households perceived the likelihood of production risks less as compared to lower income households. For higher income farmers it may be affordable to use cattle vaccination and medication that reduces the likelihood of cattle disease and death compared to the lower income farmers. This finding is also consistent with previous study (Meuwissen et al., 2001) that indicated the inverse relationship of gross farm income of farmers and perceived production risks. Unexpectedly, *gender* was positively and significantly

associated with the likelihood of *production* risks at 1% level of significance. That is, male headed households perceived the likelihood occurrence of *production* risks more compared to female headed households. Male headed households may be less careful on cattle management, leading them to perceive more likelihood of production risks compared to female headed households.

Unexpectedly, farmers who were members of livestock *package program* (such as selected breed) perceived the likelihood occurrence of *production* risks higher than non-members (significant at 10% level). This may be due to the fact that members of *livestock package* program adopt better cattle breeds (cross breed, exotic breed or better local breed) that are more susceptible to diseases, deaths and accidental damage compared to local breed cattle owners. In a study from Oromia region of Ethiopia about the financial cost of clinical Lumpy Skin Disease (LSD) and the financial benefit of its control through vaccination, production loss impacts for local zebu cattle were compared with those of Holstein Friesian (HF) and crossbred cattle. Annual cumulative incidence of LSD infection in HF/crossbred and local zebu cattle were 33.93% and 13.41% respectively and statistically significant. Annual mortality was also significantly higher in HF and crossbred than in local zebu cattle (Gari et al., 2011). A study in Kenya also reported that zebu cattle breed had the lowest vulnerability to disease risks in terms of the average sickness frequency, veterinary costs and output loss (Otieno et al., 2006). *Risk attitude index* was negatively and significantly associated with the likelihood of *production* risks at 10% level of significance. Less risk averse farmers perceived the likelihood of *production* risks less compared to risk averse farmers.

Households in *highland and midland* geographic areas perceived the likelihood of *market* risks less compared to those in *lowland* areas (both significant at 10% level of significance). *Highland and midland* farmers worried less about the likelihood occurrence of *market* risks compared to *lowland* farmers. The reason could be highland and midland locations have better infrastructure in terms of roads and transport facilities that ease market constraints compared to lowland location. The likelihood occurrence of *market* risks are associated with *high price of forage*, *livestock price variability* and *forage shortage*.

The likelihood of *market* risk was perceived more for households adopting *zero grazing* as compared to counter groups (significant at 1% level of significance). This could be because households who adopting *zero grazing* worried more about *high price of forage* and *forage*

shortage compared to their counterparts. In the study area most households adopting free grazing used communal grazing lands for their livestock, which may lead them to be less worried about forage.

Longer *walking time to main road* was also found positively and significantly related with the likelihood of *market* risks at 1% level of significance. Since longer *waking time to main road* may be the main constraint to many farmers due to increase in forage and livestock transaction costs (transport and market information costs).

Contrary to expectation, higher *income* households perceived the likelihood of *market risks more* compared to lower *income* households (significant at 1% level). Higher income farmers may demand more forage and concerned more about forage market compared to lower income farmers. *Risk attitude* was positively and significantly associated with the likelihood of *market* risks (significant at 10%), that is, *less risk averse* farmers were concerned more about the likelihood occurrences of *market* risks than risk *averse* farmers.

Respondents with larger *family size* perceived the likelihood occurrence of *human* risks lower compared to those with lower *family size* (significant at 1%). This is due to the fact that larger households have more labour that can be engaged in livestock farming compared to lower family size households. The *human* risk in this study is related to *shortage of family labour* and *shortage of herders* in the household.

Education level of heads of households was found to influence positively and significantly to the likelihood of *human* risks at 5% level. The result showed that with higher level of heads' schooling, the likelihood of shortage of family labour and herders increases. Possibly heads of households with more schooling may be engaged more in off-farm and non-farm wage compared to those with lower schooling, which could lead to the scarcity of labour availability for livestock farming. A similar study in Thailand indicated that the higher education level of farmers was positively related to diversification and off-farm income risk strategies (Aditto et al., 2012). In addition, head of households with more level of schooling are able to send their children to school compared to others; this may exacerbate the scarcity of family labour and herders in the livestock farming. Farmers in *midland* geography were less concerned about the likelihood occurrence of *human* risks compared to farmers in lowland areas (significant at 5%

level). This may be because the supply of labour market is relatively more in the densely populated *midland* areas compared to low land areas.

Farmers that practiced *zero grazing* tend to perceive lower likelihood of *human* risks (statistically significant at 5% level), due to the fact that households adopting *zero grazing* demand lower number of labour to manage the livestock farm activities. Higher *income* farmers are less concerned about the likelihood occurrence of *human* risks (significant at 1% level), perhaps because the higher income households could employ enough labour from the market.

The likelihood of risks related to *institutional* factors was perceived to be relatively less by farmers in the *midland* location (significant at 1% level). The possible reason is that midland location is equipped with better infrastructure (such as roads and transport facilitates) and has less conflict for water and grazing land compared to the lowland location. The likelihood of institutional risk occurrences was also perceived less for higher *income* farmers (statistically significant at 1%). The inverse relationship between perceived institutional risks and gross farm income was also consistent in other study (Meuwissen et al., 2001). Higher *income* farmers worried less about the likelihood occurrence of risks associated with institutional risks such as *inadequate governmental support* and *lack* of infrastructure (like *roads and communication*). This is because higher *income* farmers depend less on *governmental support* such as transport and communication facilities compared to lower income farmers. The higher income farmers can afford cost of transport and communication facilities; they can have pack animals (donkey, mule and horses) and mobile phones to facilitate transport for their farm input and outputs compared to lower income farmers. Contrary to hypothesis, institutional risks were positively and significantly related to gender at 1%, that is, male headed households worried more about the likelihood occurrences of institutional risks compared to female headed households. This could be possibly male headed farmers have relatively more grazing land and cultivated land and more likely to be engaged in resource conflict as compared to female headed farmers.

Cattle size was negatively and significantly associated with financial risk at 1% level. Large *cattle size* farmers minimize the likelihood occurrence of *financial* risks such as small farm income, cash shortage and lack of saving compared to small cattle owner farmers. The reason is that farmers who own large numbers of cattle can sell their cattle to alleviate their financial constraints. In relation to this, Gebremedhin et al. (2004) indicated that livestock in Ethiopia are important sources of income to households and insurance against risk. *Walking time to main*

road is positively related to the *likelihood occurrences* of the perceived *financial risks* (statistically significant at 1%). The reason could be longer distance to the main road may discourage farmers' participation on non-farm activities, which results in financial constraints compared to those with a shorter distance to the main road. *Risk attitude* is inversely related to the perceived *likelihood occurrences* of *financial risks* (significant at 5% level), that is, less risk averse farmers worried less about their financial constraints compared to their counterparts. Perhaps less risk averse farmers are taking financial risks in their farm investment for better return and they may be in a position to obtain better financial return compared to risk averse farmers.

6.1.6.2 Factors affecting the severity of risk

The descriptive statistics on the severity of risk include mean values and standard deviations of the Likert scale entries (Table 6.9). Shortage of family labour was perceived as the most severe risk in terms of its impact. Next to this, high price of forage was perceived 2nd and small farm income perceived 3rd in terms of severity of risk for the respondents. The standard deviation for the severity of small farm income is less than 1, indicating a high level of consensus among the respondents. Following this, cash shortage and forage shortage were perceived severe sources of risk to respondents. Cattle death, lack of saving, shortage of herders, livestock price variability, epidemic and non-epidemic diseases were also perceived severe risk sources in declining order.

In relation to this, the focus group discussion (FGD) in North western and Southern zone of Tigray indicated that feed shortage is the most critical problem that increased over time in livestock farming. According to the FGD, reasons for increased trend of feed shortage over time included shortage of rainfall, large cattle size, area closure, urbanization, high human and animal population and shifting grazing land to cultivated land. Another study Doss et al. (2008) pointed out that human illness, shortage of pasture (forage), animal sickness or death, absence of livestock buyers, shortage of livestock drinking water and low livestock sales prices were the major concerns to residents of the arid and semi-arid lands of East Africa (Northern Kenya and Southern Ethiopia). Studies on beef cattle producers in Texas and Nebraska in the USA found that severe drought, cattle price variability, hay (forage) price variability, cattle diseases and labour availability were perceived major sources of risks (Hall et al., 2003). A study conducted on importance, causes and management responses to farm risk in Florida and Alabama in the USA indicated that livestock price variability and livestock diseases and pests were ranked the most perceived sources of risks in livestock farming (Boggess et al., 1985).

Table 6.9: Varimax rotated factor loadings for severity of risk

	Mean[a]	SD[b]	Most important factors[c]			
Severity risk sources	**(n=160**		**1**	**2**	**3**	**4**
Shortage of family labour	4.03	1.08	0.09	0.12	0.08	**0.88**
High price of forage	3.98	1.02	-0.05	-0.02	**0.85**	0.10
Small farm income	3.97	0.97	0.06	**0.80**	0.16	0.13
Cash shortage	3.92	1.0	0.22	**0.82**	0.01	0.03
Forage shortage	3.76	1.09	-0.20	0.27	**0.67**	0.07
Cattle death	3.75	1.45	**0.88**	0.28	0.03	0.11
Lack of saving	3.71	1.20	0.29	**0.82**	0.02	0.13
Shortage of herders	3.54	1.37	0.27	0.07	-0.04	**0.84**
Livestock price variability	3.45	1.11	0.33	0.07	**0.69**	-0.16
Epidemic livestock diseases	3.31	1.16	**0.85**	0.07	-0.05	0.10
Non-epidemic livestock diseases	3.30	1.16	**0.86**	0.15	0.02	0.22
%age of total variance explained	-	-	33.39	16.64	11.81	11.69
Cumulative %age of total variance explained	-	-	33.39	50.03	61.85	73.54

[a,b]Mean score and standard deviation (1 = very low, 5= very high). [c]Factors 1 to 4 are production, financial, market and human respectively. Factor loadings greater than 0.45 are in bold.

Except for the severity of small farm income, the standard deviation for likelihood and severity of risk sources in Table 6.7 and 6.9 shows grater or equal 1 that shows less agreement among respondents, perhaps farmers in our survey were fairly heterogeneous groups (Meuwissen et al., 2001).

Eleven variables of the severity of risk sources were incorporated for factor analysis and based on the factor loadings, four factors were extracted for analysis (Table 6.9). The four factors under the severity of risk sources can be represented as *production, financial, market and human* risks. Production risks were *cattle death, epidemic and non-epidemic livestock diseases* all load highly on factor 1. Factor 2, the severity of *financial risk*, is characterized by variables *small farm income, cash shortage and lack of saving.* Factor 3 *(*severity of *market* risk*)* had high loadings on *high price of forage, forage shortage and price of livestock variability* during buying and selling. Factor 4, *human* risk, had high loading on severity of risk sources on *shortage of family labour and shortage of herders*.

The finding of the factor analysis suggests that the likelihood of occurrence and severity of risk sources were very similar. This implies that the likelihood of occurrence and the severity of perceived risk sources are correlated with each other. This could be due to the fact that a higher likelihood of risk sources occurring increases the perceived severity of risk that in turn affects the respondent's livelihood (economy).

OLS multiple regressions have been used to assess the severity of risk sources with socio-economic and demographic variables. The summary of variables used in regression is already presented in Table 6.5. The regression coefficients, robust standard errors and the goodness-of-fit measures of the models are reported in Table 6.10. All models were highly significant at 1% level of significance. The relationship of independent variables and the perceived severity of risks are discussed under the assumption of ceteris paribus.

Age of household heads was positively related to the perceived severity (impact) of *production* risk sources (significant at 10%). Older household heads perceived the impact of livestock morbidity and mortality more compared to younger household heads. This result was consistent with Table 6.7, which indicated a positive relation between *age* and the perceived likelihood of *production* risks. This notion suggests that older farmers perceived the likelihood and impact of production risks more compared to young farmers.

Zero grazing was negatively and significantly related to the severity of *production* risk at 1%. Households adopting *zero grazing* were worried less about the severity of *production* risks compared to their counter groups. Households adopting *zero grazing*, coefficient estimates for the likelihood and impact of *production* risks (Table 6.8) have the same sign. That is, in terms of likelihood occurrences and impact of risk sources, households adopting zero grazing perceived production risks less compared to their counterparts.

Table 6.10: Multiple regression for the severity of risk sources

Independent variables	Risk sources [a]			
	Production	Market	Human	Financial
Age	0.0148* (0.0079)	0.0118* (0.0070)	0.0158** (0.0068)	0.0056 (0.0064)
Family size	0.0268 (0.0430)	-0.0314 (0.0423)	-0.0982*** (0.0396)	-0.0276 (0.0396)
Education	0.0038 (0.0376)	0.0630** (0.0285)	0.0149 (0.0300)	-0.0150 (0.0310)
Cattle size	0.0094 (0.0206)	-0.0210 (0.0234)	-0.0512** (0.0263)	-0.0620*** (0.0236)
Highland	-0.4895* (0.2873)	0.1352 (0.2438)	-0.0618 (0.2199)	-0.3062 (0.2421)
Midland	0.0023 (0.2044)	0.3296* (0.1758)	-0.2624 (0.1955)	0.2098 (0.1681)
Zero grazing	-0.7146*** (0.2572)	0.1112 (0.2761)	-0.8059*** (0.1606)	0.5381** (0.2455)
Walking time to main road	-0.0028*** (0.0010)	0.0012 (0.0009)	-0.0029*** (0.0010)	0.0006 (0.0009)
Log annual income	-0.1626 (0.1485)	0.3825*** (0.1300)	0.2305* (0.1323)	0.1097 (0.1372)
Gender	0.1461 (0.2156)	0.1273 (0.1783)	-0.5475*** (0.1724)	-0.0194 (0.1927)
Livestock package	0.3983 (0.2621)	-0.0631 (0.1926)	-0.2227 (0.2053)	-0.0916 (0.2440)
Risk attitude index	-0.2794*** (0.0910)	0.0365 (0.0807)	-0.1386 (0.0996)	-0.2254** (0.1062)
Constant	0.3271 (1.324)	-4.412*** (1.113)	-0.8357 (1.176)	-0.8434 (1.270)
Adjusted R2	0.1642***	0.0993***	0.2538***	0.1495***
n=160				

***, **, * indicate statistically significant at 1%, 5% and 10%, respectively. Values in parentheses are robust standard errors. [a]Risk source indices extracted from the corresponding factor analysis.

Contrary to expectation, *walking time to main road* was inversely and significantly related to the perceived severity of production risks (significant at 1%). Households that resided far from the *main road* perceived the impact of *production* risks less, maybe due to lower accidental damage and death of cattle caused by car accidents that are common problems in the study areas.

Risk attitude is negatively and significantly related with the severity of *production* risks at 1%, which implies that less risk averse farmers perceived the impact of *production* risks less compared to risk averse farmers. This finding was found consistent with the effect of risk

attitude on the likelihood of production risk (see Table 6.8). That is, less risk averse households perceived the likelihood and impact of *production* risks less compared to risk averse farmers.

Age of household head has a direct relation with the severity of *market* risk (significant at 10%). That is, older household heads perceived the impact of *market* risk more compared to the younger household heads. This result may imply that searching for information and walking long distance for better *market* is easier for young household heads compared to older household heads. Thus, older household heads perceived the impact of *market* risks more compared to their counterparts. The severity of market risk is associated with *forage shortage, high price of forage* and *livestock price variability* in case of buying and selling.

Education was positively and significantly associated with the severity of *market* risk at 5%. As expected, household heads with higher level of schooling perceived the severity of market risks more compared to household heads with lower level of schooling. More educated farmers may be more aware of the impact of feed shortage and livestock price variability compared to their counterparts.

Contrary to expectation, farmers in the *midland* location perceived the *severity* of *market* risks more compared to farmers in the lowland location (statistically significant at 10%). However, farmers in the *midland* location perceived the *likelihood of market* risks less compared to farmers in the *lowland* location. This indicated that market risks were perceived more severe impact but less likely in the midland location compared to the high land location. Unexpectedly, the impact of *market* risk was found to be a very relevant source of risks for higher *income* farmers compared to lower *income* farmers (statistically significant at 1%). Perhaps the higher income farmers are more frequently engaged in marketing transactions that they may perceive the impact of market risks more compared to the lower income farmers that rarely engaged in marketing activities.

Age of household heads is positively related to the perceived consequences of *human* risks at 5%. This implies that older household heads perceived the impact of shortage of labour and herders more compared to younger household heads. Older household heads are less likely to be engaged in herding and livestock activities compared to younger household heads, probably because the older household heads are physically weaker to be engaged in farm activities and are busy in other social affairs than young heads.

Family size was negatively and significantly related to *human* risk at 1%. Larger *family size* households perceived the impact of *human* risks less compared to lower family size households. Larger *family size* has more labour that can contribute towards livestock farming. This finding is consistent with Table 6.8, in that larger *family size* households perceived the likelihood and the impact of *human* risks less relevant compared to small *family size* households. Contrary to hypothesis, *large cattle* owner households perceived the severity of *human* risks to be a less relevant factor compared to lower cattle owners (statistically significant at 5%). Larger cattle owner households may depend more on livestock rearing for their livelihood with relatively low participation in off-farm and non-farm activities in order to allocate enough labour to their livestock farming. On the other hand, households who owned small number of cattle may be engaged more in other income generating activities (off-farm and non-farm) to supplement household income, which could be at the expense of livestock herding and management.

The severity of *human* risk factor was perceived to be less by farmers adopting *zero grazing* (statistically significant at 1%). The reason is, farmers that adopting *zero grazing* minimizes the labour for herding since the cattle are tied in their homestead and feed their cattle using cut and carry system; which is consistent with table 6.8. In terms of likelihood occurrence and impact, farmers that are adopting *zero grazing* perceived *human risks* less compared to their counter groups. Contrary to hypothesis, farmers with longer *distance to the main road* perceived the impact of human risks less relevant (significant at 1%). *Walking time to main road* is a proxy for distance to market; longer *walking time to main road* means longer distance to market and other non-farm opportunities. Therefore, households may be discouraged to make frequent visit towards distant market or to be engaged in non-farm activities; such farmers may be focussed in their livestock farming that possibly minimize the human risk.

Contrary to expectation, higher income farmers perceived the impact of human risks more compared to lower income farmers (significant at 10%). Possibly, the higher income farmers may demand more labour for various farming activities; thereby the scarcity of labour may be more severe impact for them. This result was not consistent with Table 6.8 since higher income farmers perceived the likelihood of human risks less. That is, higher income farmers perceived the impact of human risk more but the likelihood of human risk less compared to lower income farmers. *Gender* was negatively and significantly related to *human* risk at 1%. Male headed farmer's perceived the impact of human risk less compared to female headed farmers. The reason is male headed farmers who are in a position to arrange more labour power could perceive the severity of human risks less compared to female headed farmers.

The severity of *financial* risks was perceived to be less for farmers having large number of *cattle* and for less risk averse farmers (statistically significant at 1% and 5%, respectively); which was found consistent result with table 6.8. This showed that the likelihood occurrence and impact of financial risk were found less for farmers having larger cattle and for less risk averse farmers. The reason could be farmers having large number of cattle can sell relatively more milk, butter and live animals so as to minimize financial constraints compared to their counterparts. Similarly, less risk averse farmers are taking more risks in farm and non-farm investment for more financial return in order to minimize financial constraints. However, farmers adopting *zero grazing* perceived the impact of financial risks more as compared to their counterparts (significant at 5%). Farmers who adopted zero grazing may invest more on inputs like better breeds of cattle, feeding and animal health that lead to financial constraints.

6.1.7 Conclusions

This study on farmers' perceptions with regard to the likelihood and impact of sources of risk provides insights on the various factors that are driving farmers' perceptions. With a *priori* hypotheses there are various types of risks (such as production, market, financial, technological etc) facing smallholder farmers and the study assessed specifically the risk perception of farmers and their determinants from Tigray, Northern Ethiopia.

The results suggest that farmers perceived them-selves relatively as risk neutral for production and marketing in their livestock farming. Farmers perceived them-selves less risk averse for financial risk and more risk averse for technological risk. This implies that farmers in the study area would be reluctant (risk averse) to adopt better agricultural technology. These risk averse farmers may not be keen to use artificial insemination (AI) and better breeds of cattle since they may consider these activities would involve higher production cost. However, the use of these services may stabilize farm income and even increase farm output and profitability. The risk averse farmers may use lower agricultural inputs (in terms of quality and quantity) that lead them to low agricultural productivity and result in poverty.

In the study, risk sources in terms of likelihood of occurrence and severity were gathered under main factors by applying factor analysis. The likelihood of production, market, financial, human and institutional risks were perceived the major sources of risk by farmers in the study area. In terms of severity: production, market, financial and human risk were the most severe.

Production risks are constraints to livestock production in the smallholder farmers. Production risks results of livestock morbidity and mortality and farmers unable to cultivate their farm land, lose income from livestock productivity (milk, butter, meat, hides etc), low fertility, loss of manure and dung fuel, high medication and treatment cost and taking long time to rehabilitate their livelihood.

Market risks were related to cost of forage, forage shortage and variability in livestock price. The shortage of forage leads to high forage demand in the market. The cost of forage also varies with season and with the location of the market. Farmers are selling their cattle mainly during drought season at low prices due to feed constraints and they are buying cattle for breeding and ploughing at relatively higher prices during wet season.

Financial constraints in the form of meagre farm income, cash shortage and lack of saving found to be relevant risk source. Farmers need financial resource to buy improved agricultural inputs, farm implements and cover operating costs in order to increase their farm output and farm income and break the cycle of poverty. However, financial constrained farmers are more likely to be involved in low farm investment and low agricultural productivity and that unable to break the cycle of poverty.

Human risks associated with shortage of family labour and herders were found relevant in the study area. The shortage of family labour can be partly due to human illness, injury and death of family members that constrain labour involved in livestock farming. Human risk causes a serious damage to the agricultural sector of smallholder farming that rely heavily on man power for production. A reduction in labour supply could results in poor livestock production intensification and affecting households' food production. In the study area, the majority of farmers used both crop and livestock production system. Reduction in labour may lead to the reduction of the cultivated land and results in lower animal feed (straw and stalk) and lower agricultural yield.

The likelihood of *institutional* risks was also found worry for farmers due to *property rights conflict, inadequate government support and lack of road and communication*. Property rights conflict in the study area may be related mainly with the land certificate that was undertaken in Tigray region. In Tigray region, land certification was implemented in a broad scale in the late

1990s (Holden, 2009). However, land certification results in a dispute on ownership of cultivated land and grazing land in Tigray and Amhara region of Ethiopia (Tesfay, 2011; Adnew and Abdi, 2005). Governmental interventions (conflict management, advocacy, infrastructure etc) are key to farmers in order to minimize risks in the rural area. Probably, the perceived importance of *institutional* risks needs future research since little is known about *institutional* risks compared to production and marketing risks in the context of livestock farming in Ethiopia.

The other main contribution of this chapter is the examination of specific factors that affect risk perceptions in the livestock farming. That is, the relationship of socioeconomic and location variables with perceptions of risk (attitude to risk and risk sources). Interestingly, the likelihood and impact of production and human risks were perceived less by farmers that adopted zero grazing (cut and carry system). This finding shows that zero grazing practice reduces cattle contact which reduced livestock diseases (epidemic and non-epidemic). In addition, adopting zero grazing practice reduces the need for labour involved in livestock farming such as herding. The likelihood and impact of production risks were found to be less in the highland area compared to the lowland area. Lowland areas are mostly moisture stressed and have poor public services such as human clinic, veterinary service, transport, road and communication. The moisture stressed lowland areas are associated with livestock diseases due to poor feed resources and intense temperature and the diseases are not easily controlled due to shortage of veterinary services and poor infrastructure.

Risk in agriculture is inevitable and complex. Farmers perceived various risk sources, many of which are specific to the industry. The presence of risks in agriculture influences farmers' decision making, including choices farmers make in production and input used for this production and strategies to manage and cope with risks. The results of this empirical investigation will be helpful for targeting further research and resources towards specific sources of livestock risks and to understand the linkage of risk and household and farm characteristics. Understanding perceived risk sources and its association with socio-economic and agro-ecology helps to put in place viable strategies to manage risk at farm level. Policy measures by means of rules and regulatory approaches in agriculture will have impact on risk reduction for farmers in the livestock farming. Given the lack of relevant information on farmers' risk perception and behaviour, this is a challenging area for policy makers, thus these findings should help inform sound risk management strategies and associated policy support. Although the findings of this

study are based on samples of households from rural Ethiopia, they can have wider practical implication for livestock farming in East African countries.

6.2 Determinants of the perceived risk management strategies

6.2.1 Introduction

The agricultural sector in developing economies is perceived to be a very risky sector. Previous evidence suggests that smallholder farmers in the Eastern highlands of Ethiopia perceived the main risk sources as drought, flooding, hail, frost, heavy wind, pests and diseases, health risk and price risks (Legesse and Drake, 2005).

The same study (Legesse and Drake, 2005) suggests that smallholder farmers in the Eastern Highlands of Ethiopia do not face identical constraints and opportunities. The main determinants of variations in perceptions of risks were: asset endowments, differential infrastructural access, differences in agro-ecological zones, gender, human capital (represented by family size, education level and experience), diversification (income, spatial and enterprise), retained output from previous harvest, access to information, health situation of household members, religion and ethnic origin. The sources of risks are different for different smallholder. Hence, smallholders do not have a single dominant model in judgements of the probabilities and consequences of various sources of risks.

Most poor people in developing countries reside in rural areas. The rural poor are exposed to many risks while often lacking instruments to manage them adequately, and so are highly vulnerable (Hardaker et al., 2004). Households living in these risky environments have developed a range of mechanisms to shield consumption from these risks, including income smoothing, self-insurance, and social insurance arrangements (Kazianga and Udry, 2006). Providing appropriate risk-management instruments and supporting the critically vulnerable is thus one key pillar in an effective and sustainable rural poverty-reduction strategy. Such provision better allows the able-bodied to engage in high risk/high return activities and thus with good fortune to move out of poverty (Anderson, 2003). Framework must be adequate, involve multiple strategies (prevention, mitigation, coping) and arrangements of risk management strategies such as informal, market-based and public for dealing with risk, and instruments that take account of the sources and characteristics of rural risk (Anderson, 2003).

Risk management is a systematic application of policies, procedures and practices to the tasks of identifying, analysing, assessing, treating and monitoring risks (Hardaker et al., 2004). For any organization or family farms, risk management is, or should be, an integral part of the good management. It is a way for a farm to avoid losses and maximize opportunities (Hardaker et al., 2004). Risk strategies can also be defined as the methods applied to remove or reduce partly the effects of factors creating risk in agriculture (Akcaoz and Ozka, 2005). To reduce effects of risk for farm activities, it is necessary to use risk strategies. The selection of good risk strategies depends on the farm operator, the financial situation and risk attitudes of the farmer (Akcaoz and Ozka, 2005).

According to Hardaker et al. (2004, pp.14) 'Risk management is not a set of procedures to be followed, once and for all, to 'inoculate' the organization against risk, since that is impossible in a world that is changing all the time so that the nature and consequences of risks are constantly evolving. Rather it is a continuous, adaptive process that needs to be integrated in to all relevant aspects of the decision-making procedures of the organization.' Beal (1996) reported that risk management strategies adopted by farmers reflect their personal perceptions of risk. In this regard, Legesse and Drake (2005) revealed that knowledge on risk perception is an important precondition for devising risk management strategies.

The economy of developing countries like Ethiopia still depends on the agricultural sector as a means of livelihood for the majority of farmers. In this line, the livestock sub-sector in Ethiopia contributes to the overall economy in terms of employment and income generation to the majority of farmers. High population pressure, economic crisis and environmental damage as a result of human and natural induced factors are a great challenge to the agricultural sector.

In this regard, a study conducted on risk management provides a better understanding of how to improve farmers' livestock farming. The objective of this chapter, therefore, is to provide empirical insight into the following questions: What are the relevant risk management strategies in livestock farming in Tigray? What are the determinants of the relevant risk management strategies?

6.2.2 Method of estimation

Descriptive statistics used to identify the major risk management strategies in livestock farming. In addition, factor analysis was conducted to describe the variability among observed correlated large variables of risk management strategies in terms of potentially lower number of unobserved variables (factors). The number of factors has been retained with latent root criterion (eigenvalues greater than 1). For the factor analysis we assumed that standard parametric statistical procedures are appropriate for ordinal variables in the form of Likert-type scales (Ahsan, 2011; Flaten et al., 2005; Meuwissen et al., 2001). Orthogonal (varimax) rotation was used, to ensure inter-alia that the factors were as independent as possible for subsequent use in multiple regressions (Flaten et al., 2005). Total variance accounted was found to be 69.83% for risk management strategies. Factor loadings with absolute values of greater than 0.45 were analysed for interpretation of the structure (Hair et al., 2010). Kaiser–Meyer–Olkin measure of sampling adequacy (KMO) values was found to be around 76.68% for risk management strategies. This KMO value indicates that overall the risk management strategy items have 76.68% in common to warrant a factor analysis. Individual KMO value for variables of risk management strategies of less than 50% were excluded from the analysis (see Hair et al., 2010). KMO values and communalities for risk management variables are given in Appendix 1 (Table 1.2). The Cronbach's alpha value was found to be 0.70 for risk management strategies that indicated an acceptable internal consistency.

Furthermore, to assess the relations of socio-economic variables and risk management strategies we used OLS (Ordinary Least Square) multiple regression. Variance inflation factors for all independent variables were found to be less than 1.7, indicating no multicollinearity problems (Gujarati, 2004). A heteroskedasticity problem was detected using the Breusch-Pagan/Cook-Weisberg test of post regression models (Torress-Reyna, 2007; Baum, 2006). The Breusch-Pagan test was carried out using the fitted values and we found the heteroskedasticity problem in four of the six regression models (diversification, cooperatives, financial and diseases control) at less than 5% level of significance. Thus, a heteroskedasticity-robust standard errors was reported to avoid biased estimated standard errors and inferences (Torress-Reyna, 2007). The goodness-of-fit measures (adjusted R^2) are presented and all models presented were significant at 1% level of significance. Socio-economic and demographic variables were included in the regression to assess the association with perceptions of the risk management strategies of the livestock farmers.

6.2.3 Data description

For this chapter the cross sectional data of 356 sample households was considered for analysis. The data were collected from three zones of Tigray, Northern Ethiopia. The primary data was collected through cross sectional design and focus group discussion (FGD). The cross sectional data was the main household survey used to provide the quantitative analysis while the FGD used to support the quantitative analysis. The cross sectional design was a structured type of questionnaire. The survey collected information on perceptions of risk management using Likert scale questions. The Likert scale questions regarding risk management strategies were focusing on financial management, diversification, selling or transferring asset, disease prevention, market information, relief and assistance, livestock feed management and community asset building.

A Likert scale (LS) from 1 (very low) to 5 (very high) was used to elicit farmers' perceived risk management strategies. But some of the questions were responded 'Not Applicable' (NA) by the farmers if the risk management strategies were not relevant for them. Then, the 5 point Likert scale was increased towards 6 point in order to include the missing value items in the analysis. Accordingly, the NA response is given the lowest value of the Likert scale, that is, LS = 1 (least relevant). The remaining farmers' Likert scale responses were increased by one unit. That is, LS = 1 changed to 2 (less relevant), LS = 2 changed to 3 (moderately less relevant), LS = 3 changed to 4 (moderately more relevant), LS = 4 changed to 5 (more relevant), LS = 5 changed to 6 (most relevant).

From the total of 54 variables, 19 variables were included for risk management in the factor analysis. Eighteen (33.3%) of the variables were removed from the factor analysis for having missing value more than 50% while the remaining 19 (35.1%) of the variables were removed due to low KMO values (KMO values less than 50%).

6.2.4 Factors affecting perceived risk management strategies

The descriptive statistics revealed that the use of veterinary service was the most important risk management strategy (Table 6.11). Crop-livestock farming was found the second relevant risk management strategy. Control parasites and prevent disease the third and fourth risk management strategy, respectively. The standard deviation for risk management strategies such as use of veterinary service, crop-livestock farming, control parasites and prevent disease found to be less than 1, indicating consensus among respondents. Use of veterinary services and

controlling parasites are important management tool. Internal and external parasites reduce livestock productivity; at worst it leads to livestock mortality. To minimize the economic loss, controlling parasites and diseases prevention in livestock farm would be an important activity.

Table 6.11: Varimax rotated factor loadings for perceived risk management

Risk management strategies	Mean[a]	SD[b]	Most important factors[c]					
	(n=356)		1	2	3	4	5	6
Use of veterinary services	5.45	0.73	**0.87**	0.09	0.00	0.01	0.05	0.10
Own crop-livestock	5.39	0.95	0.45	0.14	0.02	0.12	-0.24	**0.47**
Control parasites	5.35	0.78	**0.87**	0.09	0.02	0.01	0.16	0.06
Prevent disease	5.26	0.83	**0.89**	0.14	0.07	0.20	-0.02	0.01
Borrow from formal institution	5.24	1.43	-0.03	**0.94**	0.06	0.01	0.07	0.02
Separate cattle home	4.90	1.18	**0.60**	0.07	0.09	0.41	-0.15	-0.06
Stalk	4.86	1.37	0.24	-0.07	-0.27	**0.67**	-0.15	0.05
Loan allocation	4.74	1.66	0.13	**0.95**	-0.03	0.02	0.00	0.01
Clean cattle shelter	4.70	1.53	**0.54**	0.25	0.19	0.31	-0.27	-0.05
Minimize debt	4.58	1.61	0.20	**0.92**	-0.06	-0.05	-0.04	0.4
Join association	4.42	1.00	0.20	0.02	-0.01	0.14	**0.80**	-0.04
Spatial diversification	4.11	1.74	0.08	0.21	-0.12	0.13	-0.17	**0.64**
Buy enough hay	3.84	1.67	0.20	0.08	0.25	**0.53**	0.37	0.16
Lease land (in or out)	3.50	2.00	0.05	-0.09	-0.07	-0.07	0.21	**0.72**
Rotational grazing	3.44	2.00	0.11	-0.03	0.11	**0.81**	0.10	-0.01
Food or cash for work	3.21	1.80	0.06	-0.01	**0.93**	0.09	-0.06	-0.01
Enterprise diversification	3.00	2.14	0.42	0.15	-0.43	-0.34	-0.29	-0.02
Productive safety net program (PSNP)	2.97	2.06	0.08	-0.02	**0.87**	-0.11	0.01	-0.08
Credit and saving cooperative	2.78	1.80	-0.37	0.12	-0.25	-0.15	**0.57**	0.16
%age of total variance explained	-	-	19.61	15.07	10.51	10.31	7.84	6.50
Cumulative %age of total variance explained	-	-	19.61	34.67	45.18	55.49	63.33	69.83

[a,b]Mean score and standard deviation (1 = least relevant, 6 = most relevant). [c]Factors 1 to 6 are disease control, finance management, safety net, feed management, cooperatives and diversification. Factor loadings greater than 0.45 are in bold.

The factor analysis of risk management strategies found 6 interpretable factors. The factors 1-6 are interpreted as *disease control, finance management, safety net, feed management, cooperatives* and *diversification* (Table 6.11). The first factor *disease control*, had high loadings of *clean cattle shelter, prevent disease, control parasites, use of veterinary services and separate cattle home.* At household level, disease control measures such as sanitation, preventive

measures (such as use of cattle shed during hot weather, avoiding cattle mixing with other cattle) and vaccination are important to minimize risks associated with livestock mortality and morbidity. The second factor, *finance management* included high loadings of *loan allocation, minimize debt and borrow from formal institution.* Loans are important to farmers for buying agricultural input, farm investment and non-farm investments. Farmers borrow mainly from the formal micro finance institution known as DECSI (Dedebit Credit and Saving Institution) in Tigray region. The lending of the micro-finance institution is based on groups of farmers. Members of the group are responsible for any loan default by any one of the members. If any farmer has not settled their initial loan it is not possible to extend an extra loan. This might be the reason farmers have given due attention to financial management such as proper loan allocation and repayment of the loan as an important tool to manage risks in their farming.

The factor *safety net* (factor three) had high loadings of *Productive Safety Net Program and food or cash for work.* The PSNP provides food and cash to the poorest food insecure farmers through participation of the public work (soil and water conservation, roads construction, school construction). On the other hand direct support in the form of food or cash is provided to households with no able-bodied members (elders, ill-health). At the time of natural disasters, farmers can smooth their consumption through food or cash for work that helps them to avoid selling productive assets. High loadings of *stalk, rotational grazing* and *buy enough hay* were included on factor four (feed management). Feed is one of the most important factors that determine the productivity of livestock. This productivity of livestock leads to production and price risks. Therefore, collecting feed and improving the quality of feed would be important strategies to mitigate risks.

Factor five, identified as *cooperatives* included high loadings of *join association* and *credit and saving cooperatives.* Cooperatives are useful to provide access to credit and agricultural inputs supply. In addition, joining cooperatives may help farmers to take advantage of prices in input and output markets. Furthermore, institutional risks may be easier for farmers to solve through organizations in the form of cooperatives. High loadings on *spatial diversification, own crop-livestock and lease in or lease out cultivated land* were found in factor six *(diversification).* In Ethiopia, farming is particularly weather sensitive and farmers face price and production risks. Farmers can benefit through diversification to reduce yield variability by cropping in different plots (spatial diversification) and practicing both crop and livestock farming.

The following analysis explores to what extent perceived risk management strategies were influenced by various socio-economic and demographic variables as well location factors. The summary descriptions for variables used in the regression analysis are presented in Table 6.12.

Table 6.12: Summary statistics of variables used in regression

Variables	Mean	Std.dev	Min	Max
Risk attitude index (index from factor analysis)	0	1	-2.47	2.77
Age of household head (years)	45.2	12.08	22	84
Family size (number of members in the household)	6.09	2.17	1	13
TLU (Tropical Livestock Unit)[2] (in number)	5.75	5.54	0.5	53.1
Highland dummy (1= highland area; 0 = otherwise)	0.22	0.41	0	1
Midland dummy (1= midland area; 0 = otherwise)	0.47	0.50	0	1
Zero grazing dummy (1= zero grazing practice; 0 otherwise)	0.23	0.42	0	1
Walking time to main road (walking distance to nearest highway in minute)	79.49	76.13	0	360
Log income (log of household's annual income in Birr[a])	8.98	0.76	6.41	11.44
Gender of the household head (1= male; 0 otherwise)	0.76	0.43	0	1
Education of head of household (years in schooling)	2.31	2.94	0	12
Livestock package dummy (1= if the household is member of the livestock package program; 0 otherwise)	0.83	0.37	0	1
Social network index	0	1	-2.85	2.16

[a] At a time of survey 1 USD was equivalent to 17.2 Ethiopian Birr (as of October 17, 2011).

The *risk attitude index* was positively and significantly related to *disease control*, ceteris paribus (Table 6.13). This suggests that less risk averse farmers perceived livestock disease control as a more relevant risk management strategy compared to risk averse farmers. As expected the variable *age* of household head is directly and significantly related to *disease control*. This implies that older heads perceived livestock disease control more relevant than their counterparts. This could be due to the fact that older household heads may be more experienced in livestock disease control than the young heads. Household who reside in *highland* and *midland* perceived livestock *disease control* less relevant compared to households in the *lowland*. Livestock diseases are more prevalent in lowland parts of Ethiopia and that could lead farmers to give more attention towards livestock disease control in the lowland areas.

[2] Ox/Bull = 1TLU, Cow = 0.8TLU, Heifer = 0.5 TLU, Calf = 0.2TLU, Sheep/Goat = 0.1TLU, Horse = 0.8TLU, Donkey/Mule = 0.5TLU, Camel = 1.1TLU, Poultry = 0.01TLU (Njuki et al., 2011).

Table 6.13: Multiple regression analysis for perceived risk management strategies

	Risk management strategies [a]					
Independent variables	Disease control	Financial management	Safety net	Feed management	Cooperatives	Diversification
Risk attitude index	0.1257** (0.0541)	0.1753*** (0.0477)	-0.1985** (0.0554)	-0.0190 (0.0587)	0.2400*** (0.0627)	0.0720 (0.0715)
Age	0.0096** (0.0044)	0.0063** (0.0029)	0.0027 (0.0043)	0.0100** (0.0046)	0.0004 (0.0053)	0.0088* (0.0047)
Family size	-0.0170 (0.0260)	0.0127 (0.0162)	0.0654*** (0.0264)	-0.0589** (0.0253)	0.0419 (0.0272)	-0.0088 (0.0261)
TLU (tropical livestock unit)	-0.0015 (0.0083)	-0.0057 (0.0074)	-0.0230** (0.0095)	0.0249*** (0.0092)	0.0264* (0.0143)	0.0027 (0.0075)
Highland	-0.4195*** (0.1486)	0.0378 (0.1090)	-0.2012 (0.1435)	-0.0854 (0.1257)	0.4226*** (0.1408)	-0.1943 (0.1459)
Midland	-0.2835*** (0.1232)	-0.0915 (0.0891)	0.0407 (0.1256)	-0.3617*** (0.1172)	0.1079 (0.1295)	0.0049 (0.1140)
Zero grazing	-.1693 (0.1259)	-0.0407 (0.0729)	0.4423*** (0.1280)	-0.7603*** (0.1288)	-.1012 (0.1399)	-0.2765** (0.1385)
Walking time to main road	-0.0039*** (0.0008)	0.0002 (0.0004)	-0.0002 (0.0007)	-0.0029*** (0.0007)	0.0013* (0.0007)	-0.0015*** (0.0006)
Log income	0.3239*** (0.0772)	0.0654 (0.0558)	-0.2339*** (0.0735)	0.0734 (0.0764)	-.1832** (0.0941)	0.4539*** (0.0770)
Gender	-0.1945 (0.1361)	-0.0545 (0.0927)	-0.3975*** (0.1313)	0.2820** (0.1354)	-0.2671* (0.1402)	0.3719*** (0.1397)
Education	-0.0392** (0.0178)	0.0116 (0.0140)	0.0001 (0.0174)	-0.0284 (0.0182)	0.0329* (0.0189)	-0.0157 (0.0203)
Livestock package	0.2616 (0.1637)	1.909*** (0.1539)	0.1212 (0.1462)	0.1563 (0.1295)	0.1654 (0.1374)	0.1789 (0.1606)
Social network index	-0.0165 (0.0390)	-0.0431* (0.0244)	0.0828** (0.0395)	0.1619*** (0.0368)	0.1465*** (0.0369)	0.0632* (0.0374)
Constant	-2.632*** (0.7301)	-2.469*** (0.4752)	1.850*** (0.6976)	-0.5782 (0.7072)	0.9777 (0.8836)	-4.606*** (0.7819)
Adjusted R2	0.1400***	0.6191***	0.2099***	0.2393***	0.1594***	0.2306***
n=356						

***, **, * indicate statistically significant at 1%, 5% and 10%, respectively. Values in parentheses are robust standard errors. [a]Risk management index extracted from the corresponding factor analysis.

Walking time to main road is negatively and significantly related to *disease control*. As walking time to main road increases, veterinary service might be less accessible and that make livestock disease control difficult compared to farmers closes to the main road. The variable *income* was positively and significantly affecting the *disease control.* Higher income farmers perceived livestock disease control as more relevant risk management strategy than lower income farmers. Higher income farmers can likely afford costs incurred in animal health such as cost of medication and vaccination services. Contrary to expectation, *education* of head was negatively and significantly related to livestock *disease control*. More educated farmers perceived livestock disease control as less relevant compared to their less educated counterparts. Livestock disease prevention is massively propagated through extension program and local leaders in the rural areas and less educated farmers may give more attention towards it compared to educated farmers. Possibly, more educated farmers may manage their livestock more professionally compared to less educated farmers.

The *risk attitude index* was positively and statistically significantly related to *financial management*. Less risk averse farmers perceived financial management as relevant risk

management strategies compared to risk averse farmers. Less risk averse farmers are taking risks such as the use of credit service from local microfinance institutions in order to invest in farm and non-farm activities; therefore, financial management (such as credit use, loan allocation and debt management) is relevant strategy to manage financial risk. Risk averse farmers are reluctant to adopt credit due to fear of credit default and they may perceive financial management less relevant to manage financial risks. *Older* household heads perceived *financial management* as a relevant strategy to manage risks since older heads have longer experience on credit use, loan allocation and debt management compared to young heads. The effect of age on perceived financial management is in line with other previous study (Flaten et al., 2005).

Farmers that participated in *livestock package* also perceived *financial management* as relevant tool to manage risks. The local government provides financial support to farmers that are members of the livestock package program such as credit service through micro-finance institution. This access to credit may lead members of the livestock package program to give more attention to financial management (proper loan allocation, minimizing debt and borrowing from formal institution) as a tool to manage risks. Contrary to expectation, more *social networked* farmers (including participation in associations and public meetings, contact with the Development Agents (DA), frequent visits to church or mosque and markets) perceived *financial management* as less relevant compared to less networked counterparts. Probably more social networked farmers are actively engaged in off-farm and non-farm activities to strengthen their income and hence they may give lower attention to borrowing and debt management.

Less risk averse farmers perceived the safety net program (food or cash for work and PSNP) as less relevant strategy to manage risk compared to risk averse farmers. This could be the fact that members of the safety net program are chronically food insecure and vulnerable to socioeconomic risks and shocks. Such households are presumed to be risk averse and they may consider safety net program relevant tool to manage risk. Households with large family size found safety net programs as a relevant strategy to manage risks. This may be due to the fact that larger family size households can allocate more labor towards public work (example environmental rehabilitation) in order to get food or cash in return. This safety net may enable households to smooth consumption so that they will not need to sell productive assets in order to overcome food shortages.

Household with higher TLU (Tropical Livestock Unit) and income found safety net program less relevant than farmers with lower TLU and income. It is only the poorest farmers that are given

the opportunity to participate in the safety net program. Thus, farmers with lower TLU and income found the safety net program relevant to manage risk compared to the wealthy farmers. Farmers who practiced *zero grazing* will not allocate labour for herding and minimizes problems related to labour shortage. Thus, farmers adopted zero grazing can have relatively more labour force to be engaged in food for work or cash for work of the safety net activities and these farmers may perceived *safety net* programs as relevant strategy to manage risks compared to their counterparts. *Gender* was negatively and significantly related to *safety net* programs. That is, *safety net* program was perceived less relevant strategy to manage risk for male headed households compared to female heads since for male headed farmers safety net programmes have high opportunity costs. Female headed households are generally resource poor and more likely to invest their labour in the safety net program so as to earn minimum benefit than the labour wage market. More socially networked farmers perceived safety net programs more relevant strategies to manage risks, because more networked farmers are more likely to participate in the safety net program to manage risk compared to less networked farmers.

Age of household heads was positively and significantly related to *feed management*. That is, older household heads perceived feed management (stalk, rotational grazing and buying enough hay) relevant strategy to manage risks in livestock farming. Probably older household heads having more year of experience can consider feed collection relevant strategy to manage risk. Contrary to expectation, households with large *family size* perceived *feed management* as a less relevant strategy to manage risks in the livestock farming compared to small sized households. Probably in the mixed farming practice of the study area larger households may divert their labour towards crop cultivation activities instead of animal rearing activities. On the contrary, small sized farm households may be focussed on livestock farming and engage in livestock feed management.

Farmers with larger *TLU* perceived *feed management* as relevant strategy to manage risks compared to farmers with less TLU. Livestock feed represents the single largest cost to many livestock owners in Ethiopia. Thus, large livestock owners perceived timely feed collection and management as relevant strategy to manage risk compared to small livestock owners. Farmers in *midland* areas perceived *feed management* less relevant compared to lowland counterparts. The lowland areas are mostly moisture stressed and this could be the reason why farmers in lowland found feed management as relevant strategy to manage risks. Contrary to hypothesis, farmers practicing *zero grazing* perceived *feed management* less relevant compared to their counterparts,

perhaps, because they use other feeding systems such as cut and carry, heap straw, cactus and fodder crops (namely Alfa-Alfa) instead of feed management such as stalk, buying hay and rotational grazing.

Longer *walking time to main road* is negatively and significantly related to *feed management*. Farmers who resided far from main road perceived feed management less important compared to nearby farmers. Long walking time to main road may also imply long distance to markets that making it difficult for farmers to buy or collect feed from distant areas that would require extra labour and travel cost. *Gender* of household head is positively and significantly related to *feed management*. Male headed households perceived feed management more relevant strategy to manage risk compared to female headed households. Male headed households have more labour power and time compared to female headed households that allotted part of their time for domestic activities, thus most female farmers lease out their cultivated land. It is common that male farmers lease in land and cultivate extra land thereby obtaining half of the harvest and the whole amount of the straw based on share cropping agreement. Thus, male farmers perceived feed management relevant strategy compared to female farmers that are mostly lease out their cultivated land. Managing risk through *feed management* was also perceived relevant by farmers that had more social network.

Risk attitude is directly and significantly related to *cooperatives.* That is, less risk averse farmers are more motivated to join local associations and credit and saving cooperatives and they perceived *cooperatives* as a relevant strategy to manage risk than *risk averse* farmers. Currently, the Ethiopian government support farmers to organize them-selves in the form of cooperatives to discharge the necessary agricultural input and credit to farmers. Contrary to expectation, managing risk through *cooperatives* was perceived as relevant by farmers with larger size of *TLU* compared to farmers with smaller sized *TLU.* Probably, in the context of mixed farming those farmers with larger TLU may demand more farm input (selected seeds, fertilizer and other farm input) thereby demanding associations and credit and saving cooperatives to get access for information and financial resources. Farmers in the *highland* location perceived joining *cooperatives* as relevant strategy to manage risks compared to farmers in the *lowland* location. The *highland* location is a more densely populated area that may give farmers an advantage in forming relatively more cooperatives as a risk management tool compared to the sparsely populated lowland locations. In addition, farmers in the highland location are less risk averse and they are more likely to be engaged in saving and credit cooperatives.

Farmers with a longer *distance to the main road* perceived joining *cooperatives* as relevant strategy to manage risk compared to their counterparts. Perhaps, farmers that are far distance from the main road may likely to join local cooperatives in order to get the required information, agricultural input and credit and saving services since longer walking *distance to the main road* (as a proxy for distance to towns and markets) would lead farmers towards higher transaction costs to get relevant service from far towns and market.

Income of household is inversely and significantly related to joining *cooperatives.* Higher *income* farmers are in a position of better wealth and they can easily get the required information and agricultural input by them-selves and they may perceive joining *cooperatives* as a less relevant strategy to manage risks compared to lower income farmers. On the other hand, poor farmers may demand more institutional support from the local government in the form of cooperatives in order to get information, credit and agricultural inputs compared to the rich farmers. *Male headed* farmers perceived joining *cooperatives* as a less relevant strategy to manage risk compared to their female colleagues. In fact, female farmers are more vulnerable to socioeconomic factors and they demand institutional and governmental support through cooperatives as important strategy to manage risk.

Education of household head and *social network index* were positively and significantly associated with joining *cooperatives.* Farmers with higher level of schooling and more networked perceived cooperatives as relevant strategy to manage risk compared to farmers with lower levels of schooling and network. More educated and more networked farmers are possibly more aware of the advantage of joining cooperatives to manage risk.

Contrary to hypothesis, managing risk by *diversification* (spatial diversification, mixed farming and leasing land) was perceived to be more relevant by *older* household heads compared to young ones. The reason could be younger heads are mostly landless in the study region and the possibility of diversification (spatial diversification, crop-livestock farming and leasing cultivated land) may not be relevant strategy to manage risk. In addition, older household heads have many years of experience on farm diversification (mixed farming and leasing land arrangement) compared to young heads.

Zero grazing was negatively and significantly related to *diversification.* This showed that farmers adopting *zero grazing* perceived *diversification* less relevant strategy to manage risks. The reason could be that farmers adopting *zero grazing* are more focused on better breed cattle

and livestock production specialization instead of mixed farming. *Diversification* was perceived to be less relevant to manage risks for farmers far away from the *main roads*. This may indicate that distance to the main road as proxy to town and market area have more land to cultivate for longer distance but there seems less market opportunity for livestock products such as milk, meat, butter and live animals. Hence, instead of diversification (mixed farming, cultivate different plots and lease cultivated land) farmers far from town may focus on crop production as an important strategy to manage risk.

Higher *income* farmers perceived *diversification* (mixed farming, spatial diversification and leasing cultivated land) as an important strategy to manage risks compared to the lower *income* farmers. Perhaps higher income farmers have more productive resources (oxen and labour) compared to lower income farmers so as to deal with diversification in the form of mixed farming, cultivate plots in different areas and cultivate land through leasing as relevant strategy to manage risk. Male headed farmers' perceived *diversification* as more important to manage risks compared to female headed households. This is due to the fact that male headed households have better opportunities in terms of own labour and farm implement to facilitate farm *diversification* than female headed households. More social networked farmers perceived diversification more relevant risk management strategies than counterparts since more social networked households have more information and better opportunity for diversification.

6.2.5 Correlation of risk sources and risk management strategies

Correlation analysis was conducted between risk sources and risk management as developed from factor analysis. The correlation between the likelihood of risk sources and risk management is provided in Table 6.14. It found a negative and significant correlation between disease control and likelihood of institutional risks. That is, livestock disease control was perceived less relevant by farmers to mitigate the likelihood of institutional risks. Financial management was perceived as an important strategy to mitigate the likelihood of marketing risks but less important to mitigate the likelihood of human risks. Safety net programs were perceived as an important strategy to manage the likelihood of institutional, financial and human risks. Feed management factor was perceived relevant to manage the likelihood of production, institutional and human risks but less relevant to manage the likelihood of market and financial risks. Joining cooperatives was perceived a relevant strategy to manage the likelihood of institutional risks but less relevant to manage the likelihood of financial risks. Diversification (spatial diversification,

mixed farming and leasing cultivated land) was perceived relevant to manage the likelihood of market risks but less relevant to manage the likelihood of institutional and financial risks.

Table 6.14: Correlation between the likelihood of risk source and risk management

Risk sources (likelihood)[a]	Risk management strategies[b]					
	Disease control	Finance management	Safety net	Feed management	Cooperative	Diversification
Production	0.0363	0.0130	0.0293	0.3591***	0.0077	0.0018
Market	0.0631	0.1401***	-0.0558	-0.1714***	0.0094	0.1370***
Institutional	-0.1707***	-0.0773	0.1167**	0.2164***	0.2357***	-0.1380***
Financial	-0.0675	0.0155	0.1631***	-0.2450***	-0.2065***	-0.0926*
Human	-0.0466	-0.1636***	0.1169**	0.1948***	0.0961*	-0.0382

***, **, * indicate pairwise correlation statistically significant at 1%, 5% and 10%, respectively. [a,b]Risk source and risk management index extracted from the corresponding factor analysis, respectively.

A correlation matrix between the severity of risk sources and risk management strategies is presented in Table 6.15. Livestock disease control (cleaning cattle shelter, prevent diseases, control parasites, use of veterinary service and separate cattle home) was perceived as relevant strategy to mitigate the severity of production risks (cattle morbidity and mortality). In addition, farmers perceived livestock disease control as an important strategy to manage the severity of financial and human risks. Farmers perceived financial management as relevant risk management tool to counter the severity of market risks but less relevant to manage the severity of human risks. Farmers considered the safety net programs relevant to manage the severity of production, financial and human risks.

Table 6.15: Correlation between severity of risk sources and risk management

Risk sources (severity)[a]	Risk management strategies[b]					
	Disease control	Finance management	Safety net	Feed management	Cooperatives	Diversification
Production	0.4733***	0.0962	0.1548**	0.4955***	-0.3882***	0.0992
Financial	0.2398***	0.0238	0.2747***	0.1268	-0.4494***	-0.0944
Market	0.0540	0.2309***	-0.0911	-0.0891	-0.1310*	0.0895
Human	0.4570***	-0.1333*	0.3439***	0.5015***	-0.3575***	0.2238***

***, **, * indicate pairwise correlation statistically significant at 1%, 5% and 10%, respectively. [a,b]Risk source and risk management index extracted from the corresponding factor analysis, respectively.

Livestock feed management was found to be a relevant tool to mitigate the severity of production risks (livestock mortality and morbidity). Farmers perceived feed management as relevant tool to manage the severity of human risks, that is, on time feed collection helps farmers to minimize the scarcity of labour in livestock farming that could otherwise assigning labour in search of feed in the field. Cooperatives were perceived as less relevant strategy to mitigate the severity of

production, financial, market and human risks, probably the cooperatives may be ineffective to counter the impact of these risks. Diversification was perceived relevant strategy to manage the severity of human risks. Probably farmers who engaged in diversification activities such as mixed farming and spatial diversification allocate their labour more efficiently to mitigate human risks.

The correlation matrix indicates the association of farmers perceived risk sources and management strategies in the livestock farming. Farmers who perceived a high likelihood of production risk emphasized feed management as the most important strategy. Farmers that perceived a high severity of production risks in their livestock farming gave more importance to disease control, safety net programs and feed management. Financial management and diversification found to be an important strategy to manage the likelihood of market risk. Financial management was found relevant strategy to mitigate the severity of market risks. Disease control and safety net were found important strategies to mitigate the severity of financial risks. Safety net, feed management and cooperatives were perceived relevant strategies to mitigate the likelihood occurrence of institutional risks. Safety net was considered important strategy to manage the likelihood occurrence of financial risks. Safety net, cooperatives and diversification was perceived as relevant strategies to manage the likelihood occurrence of human risk. Disease control, safety net, feed management and diversification was found relevant to manage the severity of human risks.

The result of the correlation analysis indicated that there is no one-to-one correspondence between the risk management strategies and the sources of risks. For a particular source of risk there are two or more strategies to mitigate a risk. For example, production risks were found to be highly associated with management responses such as disease control and feed management. Market risks were linked to financial management and diversification. Institutional risks were associated with safety net, feed management and joining cooperatives. Financial risks were highly related to risk management strategies such as disease control and safety net programs. Previous studies also revealed the multiple strategies to mitigate a particular source of risk. For example, Flaten et al. (2005) revealed that production risks were associated with management strategies such as disease prevention, flexibility and financial management. Consultancy and fixed cost sharing were also found important responses to credit risks. Ahsan (2011) also found that institutional risk to be associated with management strategies such as organisational support, collaboration, diversification and disease control.

6.2.6 Conclusions

The objective of this chapter was to provide empirical insights into farmers' perceptions of risk management in livestock farming. Descriptive statistics were used to analyse farmers' risk management strategies. Factor analysis was used to summarize the information in a reduced number of factors. To assess the relations of socio-economic variables and risk management factors, we used OLS multiple regression. Finally, a correlation matrix was used to examine the association of risk source and risk management indices.

It was found six interpretable risk management factors from factor analysis: *disease control, finance management, safety net, feed management, cooperatives and diversification*. Disease control was perceived as the most important strategy to manage risk. In this line, there are various livestock diseases in the study area such as blackleg, foot-and-mouth disease (FMD), anthrax, bovine tuberculosis (BTB), lumpy skin disease, tick-borne disease and lice infestation that greatly hinder livestock product and productivity. The recent outbreaks of FMD in some parts of the study region lead to substantial economic loss. Indeed, livestock disease leads to economic losses due to death, reduced live weight and poor animal condition that greatly hampers livestock productivity and market values. Effective delivery of veterinary services in terms of coverage and quality would be useful strategies to minimize farmers' financial and economic loss.

Financial management such as proper loan allocation and loan repayment were perceived to be relevant strategies to manage risk. Loans are provided to farmers in order to invest in productive farm activities such as purchasing oxen, selected seed, fertilizer or investment in off-farm activities that have relatively better financial return. Once the loan is invested in activities that have better financial return, farmers would not be in problem to repay their loan and again to take further loan from the microfinance institution. Proper loan allocation and repayment loan are important to farmers in the study area, otherwise farmers may end up with financial loss and this loss may disrupt their livelihood.

Farmers perceived safety net participation as an important risk management strategy. The productive safety net program (PSNP) was designed as a tool to address the recurrent impact of drought. Farmers are engaged in food or cash for work in public activities such as soil and water conservation, road construction, reforestation, small scale irrigation etc. The PSNP help farmers

to protect their existing assets, maintain consumption smoothing and build their community asset and reduce household vulnerability to shocks.

Joining cooperatives was perceived to be a relevant strategy to manage risk. Joining cooperatives may help farmers in order to get credit access and agricultural input (fertilizer, seed, insecticides etc), to provide market opportunity for selling their harvest and to intensify information and communication through the social network. According to Tesfamariam (2012), however, farmers' awareness, weak institutional capacity, low capital base, limited saving culture are affecting the outreach and the sustainability of the Saving and Credit Cooperatives (SACCOs) in one of our study woreda (Ofla), Tigray region.

Farmers' perceived diversification and livestock feed management as relevant strategies to counter risks. The use of mixed crop-livestock farming was found to be most important in farm diversification. In the highlands of Northern Ethiopia, the majority of farmers use crop-livestock farming system to increase their income and maintain food security. In mixed farming, cattle use as a sources of manure and draught power to crop cultivation and in return crop cultivation help to provide crop residue as source of livestock feed. In the context of smallholder farming in the study area, mixed farming system is important as risk management strategy.

A number of socio-economic and geographic variables were found to be significantly affecting risk management strategies; namely, higher *income* farmers perceived *disease control* as relevant risk management strategy as compared to lower income farmers. That suggests that the higher income farmers can afford the costs associated with disease prevention and they found disease prevention to be an important strategy to manage risk compared to lower income farmers. Households with large family size found safety net programs as a relevant strategy to manage risks but less relevant for wealthy farmers (higher income and more TLU owned). This suggests that larger family size households can allocate more labor towards public work in order to get more food or cash in return from the safety net. However, wealthy farmers perceived safety net less relevant to manage risk since the safety net program is likely an opportunity only for the poorest farmers to reduce shocks. Higher income farmers and male headed households perceived diversification (mixed farming, spatial diversification and leasing cultivated land) an important strategy to manage risk compared to their counterparts. Possibly, higher income and male headed farmers may have relatively more oxen, labour and farm implements to facilitate diversification activities to manage farm risks.

The correlation matrix indicated the intensity of association between farmers' risk sources and management strategies in the livestock farming. The correlation findings suggest that various sources of risk could be mitigated through multiple management strategies. For example, the likelihood of market risks was linked to management responses such as financial management and diversification. The likelihood of institutional risks was associated with risk management strategies such as safety net, feed management and joining cooperatives. The severity of production risks was found to be highly associated with management responses such as disease control and feed management. The severity of financial risks was highly related to risk management strategies such as disease control and safety net programs.

Agriculture is one of the riskiest economic activities, especially for farmers in developing countries where they have imperfect information to forecast the price of farm input and output, in addition to weather conditions and other related risks that might impact the farm in the future. Agricultural risk undermines farm income, farm investment and the possibilities of farmers to accumulate assets. Obviously, risk cannot be totally eliminated. However, risk can be reduced and there are several strategies for improving one's abilities to withstand adverse farm conditions. Findings showed that increase in likelihood and impact of risk has implications for managing agricultural risks. The result of the analysis showed that disease control, finance management, safety net, feed management, cooperatives and diversification were perceived as important risk management strategies in livestock farming. In this regard, effective approaches to manage agricultural risks enable farmers to cope with risk and minimize their income and consumption fluctuations. The findings have implications for policy interventions, by comparing the current risk management performance to standards or expectations that point out the need for improvement, thereby offering ways to improve the risk management of livestock farmers. In this regard, research conducted on risk management may help farmers to make optimal decision in risky environments.

CHAPTER SEVEN

7. FACTORS INFLUENCING FARMERS' POTENTIAL CATTLE INSURANCE DECISIONS

7.1 Introduction

Agricultural producers face a series of production risks related to weather conditions, pests and diseases and market conditions. All these risks affect the income stability and welfare of farm households (Xiu et al., 2012). Uninsured risk leaves poor households vulnerable to serious or even catastrophic losses from negative shocks. It also forces them to undertake costly strategies to manage their incomes and assets in the face of risk, thus lowering mean incomes earned (Pan, 2008; Haile, 2007; Dercon, 1996). Welfare costs associated with farm risk and shocks and foregone profitable opportunities have been found to be substantial in low-income countries, contributing to persistent poverty (Elbers et al., 2007).

To minimize such risks, poor households rely on a combination of self insurance and informal risk-sharing mechanisms (McPeak, 2006). In many developing countries, however, informal risk sharing among kin and families has serious limitations due to the problem of covariate (systemic) risk within such networks (Meze-Hausken et al., 2009). Informal risk sharing does not work when an entire community is hit by covariate risks such as a drought (Meze-Hausken et al., 2009; Ellis, 1998). Moreover, these informal strategies come at high opportunity costs, such as diversification in to activities that are less productive but hedge risk (Meze-Hausken et al., 2009).

In low-income countries there are higher agricultural risks, however, the formal risk management institutions are almost unavailable (McPeak, 2006). Agricultural insurance is one method by which farmers can stabilize farm income and investment and guard against disastrous losses due to natural hazards or low market prices. Insurance not only stabilizes the farm income but also helps the farmers to initiate production activity after a bad agricultural year. Insurance spreads the crop losses over space and time and helps farmers make more investments in agriculture (Narayanan and Saravanan 2011; Singh, 2004). It forms an important component of safety-net programmes in many developed countries such as the USA and Canada as well as countries of the European Union (Narayanan and Saravanan 2011).

Agricultural insurance is one of the most useful and important risk management tools for farmers (Xiu et al., 2012). Agricultural insurance is seen as a key financial instrument to stabilize farmers' income and improve their resilience to financial hardship from poor harvests (Xiu et al., 2012). Agricultural insurance markets were initiated first in Europe and then in USA over 200 years ago in the form of privately offered protection against livestock mortality and named peril events such as crop-hail (Smith and Glauber, 2012). Yet, only in the last 50 years there has been a rapid expansion and development in the range and scope of insurance products offered to producers in the developed countries (Smith and Glauber, 2012). According to Meuwissen et al. (2013), the Common Agricultural Policy (CAP) in Europe currently allows the support of agricultural insurance (both crop and livestock), with a particular focus on mutuals. The study analyzed the experience of nine mutuals in the Netherlands over the past 20 years. Results illustrate that mutuals are well equipped to insure risks that are uninsurable in the commercial market and able to fulfil the EU conditions for receiving premium support. However, experience of mutuals showed that they are not always successful even with substantial public support mainly due to lack of members caused several mutuals to be discontinued only a few years after their foundation.

In developed countries agricultural insurance has been well developed but little is known in low income countries (Xiu et al., 2012). Xiu et al. (2012) argue that public support to agricultural insurance is necessary for its development, especially in the initial stage, encouraging farmers to take an active role in risk management. Matsaert et al. (2011) explain how researchers at the International Livestock Research Institute (ILRI) used an innovation systems perspective to look at the feasibility of index-based livestock insurance provision in Marsabit district of Kenya. This study reviewed existing pastoralists' risk-management strategies, recent trends, and drivers of change, and considered whether index-based insurance could complement and enhance these existing practices, and whether the current institutional and policy environment was favourable to its development. They concluded that individual based insurance (that is, opposite to index-based) is not feasible in pastoralist areas of Africa, because poor infrastructure and high levels of livestock mobility make it difficult to implement the required monitoring due to high administrative cost. However, index-based insurance, because it is based on area-averaged risk experience rather than individual household experience, could potentially be viable.

Raising the necessary capital to make index based crop insurance schemes financially secure is difficult for micro-insurance providers. However, it was argued that spatial pooling of micro-

insurance schemes could reduce these capital requirements. That is, diversification across uncorrelated risk can reduce the amount of capital that is necessary to make an insurance program sustainable (Meze-Hausken et al., 2009).

In developing countries empirical investigations on agricultural insurance are very limited and most of the agricultural insurance studies are focused on crop insurance (Hill et al., 2011; Liua et al., 2010; Meze-Hausken et al., 2009; Kurosaki and Fafchamps, 2002; Sakurai and Reardon, 1997) but there is limited research on livestock insurance (Chantarat et al., 2013; Khan et al., 2012; Xiu et al., 2012; Matsaertis et al., 2011; AEMFI, 2010; Mude et al., 2010; Fischer and Buchenrieder, 2009; Mahul et al., 2009; Mahul and Skees, 2007; Otieno et al., 2006).

Agricultural sector needs insurance to protect against the various risks and respond to human food insecurity. The agricultural risk factor is caused mainly due to its dependence on weather related natural conditions and some human induced factors, which necessitates protection. The climate change impact such as drought has been exacerbated from time to time. With climate change, the magnitude and frequency of stresses and shocks is lively to be increased which results in crop failure and livestock loss. The natural and human induced risk is threatening the human in the form of food production, clean water, food distribution channels, health, environment, safe shelter, livelihood assets, purchasing power, market flows and so on. To address agricultural risks, research needs to investigate a mix of appropriate risk management strategies.

Microinsurance is hypothesized to reduce the economic hardship from livestock loss and its consequences for vulnerable rural households (Fischer and Buchenrieder, 2009). Livestock insurance is important in the Ethiopian context as a complementary risk management strategy to cope with natural and human induced risks involved in livestock activities. This chapter examines farmers' perceptions towards hypothetical cattle insurance in rural Tigray, Northern Ethiopia. Specifically, it examines farmers' likely demand for cattle insurance participation and projected intensity use and their determinant factors.

7.2 Theoretical model

Following Greene, (2003) suppose y^1 and y^0 represents the household's utility of two choices, namely by investing in hypothetical cattle insurance or not. Let the utility of the two choices be denoted by $U^1$and U^0. U^1 is the utility farmers expect from investing in cattle insurance. U^0 is

the utility for the status quo in which farmers prefer not to invest in cattle insurance. According to Habb and McConnell (2002) the determinants of utility can be household income, household characteristics and attributes of choices and the component (random term) of preferences known to the individual respondent but not observed by the researcher.

The observed choice (whether to invest in cattle insurance or not) between the two reveals which one provides the greater utility but not the unobservable utilities (Greene, 2003). The observed indicator equals 1 if $U^1 > U^0$ and 0 if $U^1 \leq U^0$. The utility maximizing condition implies that the household will invest in a hypothetical cattle insurance if the expected utility is greater than the status quo, that is $U^1 > U^0$, otherwise the household will not invest in it if $U^1 \leq U^0$.
The linear random utility model (RUM) following Greene (2003) is given as:

$U^1 = X\beta_1 + u_1$ and $U^0 = X\beta_1 + u_0$

If we denote Y=1 the respondent choice of alternative (insurance) is given by:

$$\begin{aligned}
\text{Prob Y [Y=1/X]} &= \text{Prob } [U^1 > U^0] \\
&= \text{Prob } [X\beta_1 + u_1 - X\beta_0 - u_0 > 0|X] \\
&= \text{Prob } [X(\beta_1 - \beta_0) + u_1 - u_0 > 0|X] \\
&= \text{Prob } [X\beta + e > 0|X]
\end{aligned}$$

where X represents a vector of households' socioeconomic variables, agro-ecology and other relevant variables.

7.3 Method of estimation

The farmer decision model explored here relates to a hypothetical scenario of insurance selection (stated preference), not to an observed and deliberate choice in the market place by farmers. In light of this focus on potential insurance adoption as well as the intensity of adopting insurance, a Heckman selection model (1979) is employed instead of a double-hurdle specification (Greene 2003). The rationale for employing the Heckman (1979) approach is that it is anticipated a fundamental selection problem with our survey data: it can be expected that farmers who choose to participate in insurance in our survey sample differ in unmeasured ways from farmers that do not choose to participate in insurance.

The Heckman two-stage model (Heckman, 1979) makes assumptions about the relationship between two equations in an underlying behavioural model: a selection equation and an outcome (intensity) function. Consider a behavioural model for farmers' participation in livestock insurance. That is, the decision of whether or not to participate in livestock insurance and the number (intensity) of cattle to insure. In the Heckman two-step model, the focus is on controlling for sample selection bias. The sample selection bias arises here from using non- random selected samples to estimate behavioural relationships. That is, farmers who participated in a hypothetical insurance market are self selected non-randomly from the total sample. More specifically, factors that are unmeasured affecting insurance participation of sampled farmers may be correlated with unmeasured factors that impact the intensity of insurance decision, leading to selection bias, which is equivalent to omitted variable bias (Heckman 1979). Therefore, we use the Heckman model (1979) to counter such bias.

Further, what is the rationale for choosing the Heckman approach instead of standard Tobit and thus double-hurdle models? The standard Tobit model (Amemiya 1984) imposes a structure that is often too restrictive: it assumes that exactly the same set of variables is affecting the probability of participation and the intensity, with the same sign (Verbeek, 2008). The Tobit model has therefore been modified by Cragg (1971) to overcome this restrictive assumption and to allow participation and intensity to be generated by separate processes, such that the Tobit emerges when the participation hurdle ceases to be relevant. The Cragg (1971) model assumes two hurdles, yet the errors between participation and intensity decision are also assumed independent.

Faced with the above sample-selection problem, Heckman's (1979) selection model, also known as 'Heckit' is estimated in two steps, employs a probit model for participation and OLS with inverse Mills ratio term for modelling intensity. Birru (2009) emphasises that 'Heckit' and double-hurdle models are similar in identifying the rules governing the discrete (zero or positive) outcomes[3]. Both models recognize that these outcomes are determined by the selection and level of use decisions. They also permit the possibility of estimating the first and second stage equations using different sets of explanatory variables. However, the Heckman two-step model, as opposed to the double-hurdle, assumes that there will be no zero observations in the second stage once the first stage selection is passed.

[3]The Heckman two-step estimation procedure has come to be known as the "Heckit" estimator (Green, 2003; Cameron and Trivedi, 2005; Hill et al., 2003).

Applying the Heckman model (1979) to our survey data, we have a probit model for the probability of having a positive outcome of farmers' interest on livestock insurance participation (selection equation), and an OLS estimation (intensity; outcome equation) of the number of cattle to insure, conditional on those farmers who decided to participate in livestock insurance. From equation (7.1), we estimate the outcome equation by adding to it a variable (called inverse mills ratio or the hazard rate) that is derived from the probit model equation (7.2). As emphasised above, the number of cattle to insure in the outcome equation is always assumed to take on positive values. Following Heckman (1979) the two equations are as follows:

$$Y_i^* = X_{1i}B_1 + u_i \tag{7.1}$$

$$Z_i^* = X_{2i}B_2 + \varepsilon_i \qquad (i = 1, 2 \ldots\ldots\ldots\ldots\ldots\ldots I) \tag{7.2}$$

Equation 8.1 is outcome equation and 7.2 is the selection equation.

Where X_{ji} is a 1x K_j vector of exogenous regressors:

B_j is a K_j x1 vector of parameters.$u_i$and ε_i are the error terms of outcome and selection equations, respectively. The Heckman model (1979) assumes that the error terms u_i and ε_i are independently and jointly normally distributed. That is:

$$(u_i, \varepsilon_i) \sim \text{NID}\left(0, \begin{bmatrix} \sigma^2{}_{\varepsilon_i} & \rho\sigma_{ui} \\ \rho\sigma_{ui} & 1 \end{bmatrix}\right)$$

That is, u_i and ε_i~N (0, 0, $\sigma^2 u_i$, $\sigma^2 \varepsilon_i$, $\rho\sigma_{ui}$), bivariate normal distribution with expectation zero, variances $\sigma^2 u_i$ *and* $\sigma^2 \varepsilon_i$ respectively and a covariance $\rho\sigma_{ui}$.The term σ_{ui} is the standard deviation of u_i and ρ is the correlation between u_i and ε_i. Model (8.2) is the standard probit model with normalization $\sigma_2^2 = 1$ or $\sigma^2 \varepsilon_i = 1$ (Verbeek, 2008; Greene, 2003).

Suppose that survey data observed on the outcome equation of Y_i^* if $Z_i^* > 0$ while if $Z_i^* < 0$, there are no observations on Y_i^*

We have the following observation rule

$$Y_i = Y_i^*,\ Z_i = 1\ if\ Z_i^* > 0 \tag{8.3}$$

$$Y_i \text{ is not observed},\ Z_i = 0\ if\ Z_i^* \leq 0 \tag{8.4}$$

Where Y_i denotes farmers i's potential number of cattle to insure. The binary variable Z_i indicates whether the farmers are interested to participate in a hypothetical livestock insurance

scheme or not. Following Verbeek (2008), the conditional expected number of cattle to insure, given the farmer is interested to participate in cattle insurance is given by:

$$E(Y_i/Z_i = 1) = X_{1i}B_1 + E(u_i/Z_i = 1) \quad (7.5)$$

$$= X_{1i}B_1 + E(u_i/\varepsilon_i > -X_{2i}B_2) \quad (7.6)$$

$$= X_{1i}B_1 + \frac{\sigma 12}{\sigma_2^2} E(\varepsilon_i/\varepsilon_i > -X_{2i}B_2 \quad (7.7)$$

$$= X_{1i}B_1 + \sigma_{12}\frac{\emptyset(X_{2i}B_2)}{\phi(X_{2i}B_2)}, \quad (7.8)$$

Where equation (6.8) uses $\sigma_2^2 = 1$ and equation (7.7) uses the fact that for two normal random variables $E(u_i/\varepsilon_i) = (\frac{\sigma 12}{\sigma_2^2})\,\varepsilon_i$. We can write $\sigma_{12} = \rho_{12}\sigma_1$, where ρ_{12} indicate the correlation coefficient between the two error terms. Where Ø and ϕ are the standard normal probability distribution function (pdf) and the standard normal cumulative distribution function (cdf), respectively.

Thus, equation (7.1) can be rewritten as:

$$Y_i^* = X_{1i}B_1 + \sigma_{12}\frac{\emptyset(X_{2i}B_2)}{\phi(X_{2i}B_2)} + u_i \quad (7.9)$$

Where:

$\boldsymbol{Y_i^*}$ is farmers i's potential number of cattle to be insured; $\boldsymbol{\sigma_{12}}$ denotes covariance; $\boldsymbol{X_{1i}}$ is the vector of exogenous regressors; $\boldsymbol{B_1}$ is parameter and $\frac{\boldsymbol{\emptyset(X_{2i}B_2)}}{\boldsymbol{\phi(X_{2i}B_2)}}$ is Inverse Mill's Ratio (IMR).

Following equation (7.8) the conditional expected number of cattle to insure equals $X_{1i}B_1$ only if $\sigma_{12} = \rho_{12} = 0$. If the error terms from the two equations are uncorrelated, the outcome equation (the number of cattle to insure) can be estimated consistently by ordinary least squares (OLS). A sample selection bias in the OLS estimator arises if $\sigma_{12} \neq 0$. The term $\frac{\emptyset(X_{2i}B_2)}{\phi(X_{2i}B_2)}$ in equation (7.9) is known as inverse Mill's ratio (IMR) which is the ratio of the probability distribution function (pdf) to cumulative distribution function (cdf) (Verbeek, 2008).

Thus, the crucial parameter that makes the sample selection model different from a regression model and probit is the correlation coefficient (or covariance) between the two equations' error terms (Verbeek, 2008). The IMR captures the correlation between the selection and outcome equations. To generate the IMR, we first estimate the probit model from equation (7.2) using all observations. Then we include the IMR as an additional regressor in equation (7.1), as shown in equation (7.9). If the errors were uncorrelated, we could estimate the regression equation for the

number (extent) of cattle to insure by OLS and ignore the selection equation. If the errors of the two equations were correlated or, in other words, if the inverse Mill's ratio (IMR) coefficient was found to be significant, the use of Heckman model yields consistent estimates, as opposed to OLS (Wooldridge, 2002).

There are two ways of estimating the Heckman (1979) model. When estimating it as a two-step procedure, it is known as 'Heckit', as emphasized above. When estimating via maximum likelihood estimation (MLE), issues of convergence may occur, yet the advantage is that MLE estimation is more efficient, if the two error terms are jointly normally distributed (Wooldridge, 2002).

When estimating the Heckman model, we need at least one variable that affects selection equation without affecting the outcome equation. If we allow all variables in the selection equation to also appear in the outcome equation, the Heeckman model estimates would become imprecise due to collinearity of the IMR with the explanatory variables of the outcome equation. Such multicollinearity leads to very high standard errors for the parameter estimate of outcome equations. Finally, if not proceeding as above, it would be difficult to distinguish sample selection from a mis-specified functional form in the outcome equation (Wooldridge, 2002).

In the following estimation approach, it is considered the selection variable *'dependent ratio'* that is expected to influence farmers' interest in cattle insurance participation but not the decision for the number of cattle to insure. Households having larger number of dependents (old age and children) are more vulnerable to risks and shocks thereby this is anticipated to influence the decision for cattle insurance participation. However, increasing the proportion of the dependents in the household is not expected to influence the number of cattle to be insured. Rather, the economically active household members that are engaged in household income earning activities are expected to influence the number of cattle to be insured. In this regard, a study by Tadesse (2012) suggests that the selection variable (the number of dependents in the household) can influence decision making related to the employment of adults in their household; but given employment, the number of dependent household members is not expected to influence income from employment in productive activities.

To sum up, the Heckman model both two-step and maximum likelihood procedures was used to estimate households' cattle insurance participation and the intensity of use in order to address sample selection bias. Estimating the Heckman model with both procedures (two-step and

maximum likelihood) helps to compare parameter estimates in both models. In this regard, we need at least one variable that affects the participation equation without affecting the outcome equation. If we allow all variables in the selection equation to also appear in the outcome equation, the Heckman estimates become very imprecise. According to Wooldridge (2002), the reason for the imprecision of the estimates is due to the severe collinearity of the IMR with the explanatory variables of the outcome equation. Such multicollinearity leads to very high standard errors for the parameter estimate of outcome equations. Finally, it would be extremely difficult to distinguish sample selection from a mis-specified functional form in the outcome equation.

7.4 Data description

The data used in this chapter are cross sectional data obtained from a sample of 356 farmers collected from three zones of Tigray, Northern Ethiopia. Data was collected in 2011 on farmers' potential decision to cattle insurance and the extent of cattle to insure; how farmers might pay premiums, potential benefits of livestock insurance, attractive features of livestock insurance, type of cattle most likely to insure, willingness to pay for insurance premiums and the size (number) of cattle to insure. In addition, data were collected on current livestock ownership, access to social services and institutions, cattle mortality and cattle sales.

Farmers interest to participate in a hypothetical insurance and the number of cattle to insure is expected to influence by variables such as age of household, gender of household head, education level of head, dependent ratio of the household, share of livestock income out of annual income, household annual income (log income), geographical location (highland and midland), number of less productive cattle aged less than 2 or greater than 8 years and zero grazing dummy. For Heckman estimation procedure, we considered the selection variable *'dependent ratio'* that was expected to influence farmers interest on cattle insurance participation but not the decision on the number of cattle to insure. The hypothesized relationship of variables for cattle insurance participation and the number of cattle to insure is given in Table 4.5 (for detail see section 4.5).

7.5 Results and discussions

7.5.1 Descriptive results

7.5.1.1 Households' interest and willingness to pay for cattle insurance

Out of a total of 356 farmers, 336 (94.38%) were interested in cattle insurance while 20 (5.56%) were not interested (Figure 8.1). Out of the 20 farmers that were not interested in cattle insurance scheme, nine (45%) stated that they did not trust insurance, six (30%) reported that they did not understand about insurance and five (25 %) gave other reasons.

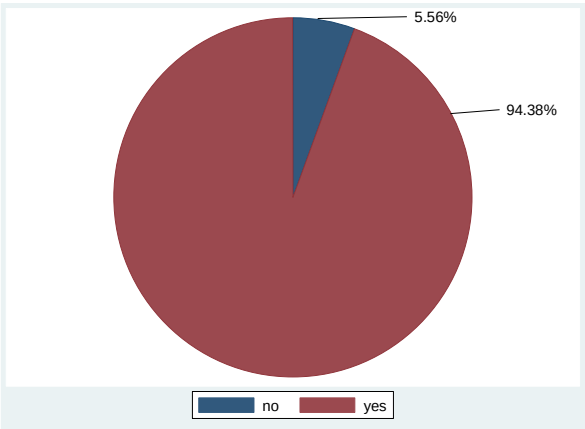

Figure 7.1: Farmers interest in cattle insurance participation

Data was collected about farmer's willingness to pay (WTP) for hypothetical cattle insurance using Contingent Valuation Method (CVM) questions. The WTP showed whether or not farmers' were able to afford the pre-specified 4% premium. This 4% premium was the benchmark taken from live cattle insurance adopted by Nyala Insurance S.C that was at the pilot stage in Ethiopia. The bid elicitation approach used in the hypothetical scenario was dichotomous choice (yes/no) for the initial bid (4% of the animal value) followed by open ended questions. The open ended questions helps to elicit households' maximum willingness to pay (MWT) per animal. The theoretical insurance scheme limited the age of insured cattle in the range of 2 to 8 years old. Using the hypothetical example of one head of cattle valued at Birr 2,000, we asked farmers whether they would be willing to pay or not for an annual premium of Birr 80 (4% of value). From 336 farmers, 260 (77.38%) stated that they would be willing to purchase the cattle insurance at the given rate while 76 (22.62%) were not willing as they perceived it too costly (Figure 7.2).

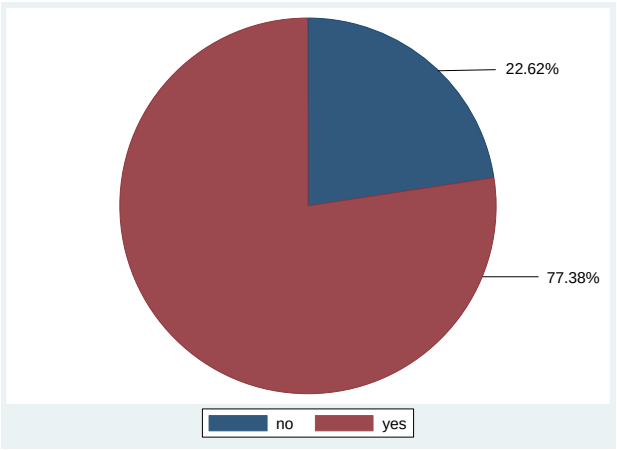

Figure 7.2: Farmers decision on buying premium insurance

Using the hypothetical example of one head of cattle valued at Birr 2,000, we also asked farmers how much maximum they are willing to pay. 7.44% of the farmers were willing to pay less than Birr 30 and 16.08% of farmers were willing to pay a premium in the range Birr 31-60. It was found that 49.40% of the farmers were willing to pay a premium in the range Birr 61-90 per head of cattle insured per year (Table 7.1). 22.91 % were willing to pay in the range Birr 91-120 while 4.17% were willing to pay more than Birr 120 per cattle per year. The average willingness to pay was found to be (Birr 79.7).

Table 7.1: Farmers' maximum willingness to pay per cattle

Willingness to pay per cattle (in Birr)	% of total respondent
less than 30	7.44
31-60	16.08
61-90	49.40
91-120	22.91
greater than120	4.17
Total	100.00
n=336	

Source: own survey, 2011.

With regard to the sources of finance, around half (50.60%) of farmers indicated that they would pay the cattle insurance premium from the proceeds of crop or livestock sales (Table 7.2); 22.02% of farmers would pay from personal saving, while 22.62% of farmers would pay from other sources such as off-farm earnings. A small number of farmers indicated that they would access credit to pay their insurance premium, which may be due to the high cost of credit (interest).

Table 7.2: Farmers' financial sources for paying livestock insurance

Financial sources	% of total respondent
Personal saving	22.02
Credit from informal institution such as friend, relatives and money lenders	1.49
Credit from informal institution (such as Equb, Iddir and Mahber)[4]	1.49
Credit from formal institution such as DECSI and bank	1.79
Selling crop and livestock	50.60
Other sources	22.62
Total	100.00
n=336	

Source: own survey, 2011.

Respondents were asked how many of their cattle in the age range of 2 to 8 years old they would insure given the 4% cost of cattle premium; 23.81% of farmers indicated that they would insure one head of cattle; 31.85% would insure two heads of cattle (see Table 7.3). On average farmers would insure 2.71 cattle for all farmers that are interested to insure their cattle.

Table 7.3: Respondents' interest to insure size of cattle

Cattle size insured	% of respondent
1	23.81
2	31.85
3	22.92
4	10.12
5	4.46
6	3.57
greater than6	3.28
Total	100.00
n=336	

Source: own survey, 2011.

7.5.1.2 Expected benefit of cattle insurance

We asked farmers what benefit they expected from buying cattle insurance and nearly half (48.51%) of them reported that they expected to gain cash compensation following cattle loss (Table 7.4); 27.98% of farmers would feel more secure; 22.02% expected that it would allow them to access credit using a cattle insurance certificate (the option of credit access from

[4] *Equb* is associations for credit and *mahber is* religion-based socialization in Ethiopia (Berhane-Selassie, 2009).

financial institutions was included as part of the hypothetical livestock insurance scheme presented to the respondents) (Table 7.4).

Table 7.4: Farmers' expectation on the benefits of cattle insurance

Benefits of cattle insurance	% of total respondent
Feel more secure	27.98
For credit access	22.02
Getting cash during cattle loss	48.51
Others	1.49
Total	100.00
n=336	

Source: own survey, 2011.

We asked farmers what features would make cattle insurance attractive to them. In this regard, 20.83% of farmers indicated that minimizing disasters would make cattle insurance attractive to them; 31.25% indicated the ability to earn a stable income; 32.14% indicated that it would help them to recover from shocks; and 15.77% of farmers were attracted in cattle insurance in order access credit from financial institutions (Table 7.5).

Table 7.5: Farmers' expectation of cattle insurance attractiveness

Attractiveness of cattle insurance	% of total respondent
Minimize disaster	20.83
Earning stable income	31.25
Recover from shock	32.14
Credit access	15.77
Total	100.00
n=336	

Source: own survey, 2011.

7.5.1.3 Preferred type of cattle insurance

In terms of type of cattle to insure, more than half of the respondents (55.65%) reported that their first preference would be to insure cows; 29.76 % of farmers ranked ox insurance as their priority; 5.65% of farmers ranked bulls as their priority while 8.93% of farmers ranked insurance of heifers as their priority (see Table 7.6). In the mixed farming system of Northern highlands of Ethiopia, the principal use of oxen is to provide draft power for crop production, and farmers keep cows mainly for breeding and milking. Cows are an important source of income for many farmers through the sale of milk, butter, cheese and calves. Bulls and heifers are farmers' potential assets for draft power and breeding, respectively. The preference of farmers for cow

insurance may be due to cows' multiple roles in income generation or perhaps losses of cow (mortality and morbidity) might be more frequent than other type of cattle.

Table 7.6: Farmers' priority the type of cattle to insure

Type of cattle prioritized to insure	1st rank (%)	2nd rank (%)	3rd rank (%)	4th rank (%)
Ox	29.76	46.43	14.58	9.23
Cow	55.65	26.19	14.29	4.17
Bull	5.65	11.61	26.19	56.25
Heifer	8.93	15.77	44.94	30.36
Total	100.00	100.00	100.00	100.00
n=336				

Source: own survey, 2011.

7.5.1.4 Cattle size

Table 7.7 shows total, average and share of cattle type owned by the survey sample as a whole. On average farmers owned 1.39 oxen, 1.77 cows, 0.83 bulls, 1.10 heifers. The average calf ownership per household found was 1.55. Cows constituted above a quarter of cattle while bulls made up the smallest share. It was found that farmers with at least one head of cattle were included in the sample and a maximum of 49 cattle per household.

Table 7.7: Types and size of cattle owned by farmers

Cattle type	Total	Mean	Share (%)
Ox	497	1.39	21.0
Cow	631	1.77	26.7
Bull	295	0.83	12.4
Heifer	395	1.10	16.6
Calf (less than 2years)	551	1.55	23.3
Total	2368	6.65	100.00
n=356			

Source: own survey, 2011.

Looking at livestock ownership more broadly, farmers in the sample owned an average of 6.65 cattle, 0.94 donkeys, 0.04 mules, 0.05 horse, 0.26 camel, 1.80 goat, 2.16 sheep and 5.15 poultry (Table 7.8). Farmers own relatively greater number of cattle compared to other livestock. This is due to the fact that cattle are used for multiple purpose in Northern Ethiopia. Farmers used cattle as a source of milk production, food, cash, draft power, prestige and means of storing wealth. Cattle are rarely sold, kept as an income safety net to reduce the risks associated with bad years.

The small ruminant animals (sheep and goats) are relatively drought tolerant, small in size, easily manageable and easily saleable so that the family can use them for ready cash. Most farmers in Tigray use sheep and goats as a source of income by selling during holidays and festivals at relatively better price. However, many better-off farmers slaughter sheep and goats for them-selves particularly during the festival seasons. Most poor farmers kept poultry since it requires minimal input and poultry production is considered by most farmers as a supplement to their main livelihood strategies. Usually farmers sell poultry at a time of cash shortage or use them for personal consumption during holidays. In Tigray donkeys are most common pack animals, used for various transport activities such as grain from field, grain to local market, agricultural input to farm land or from market, fuel wood to market and animal feed from field.

Table 7.8: Farmers' size of livestock ownership

Livestock type	Total	Mean
Cattle	2368	6.65
Donkey	335	0.94
Mule	15	0.04
Horse	17	0.05
Camel	94	0.26
Goat	642	1.80
Sheep	766	2.16
Poultry	1833	5.15
Total	6060	17.04
n=356		

Source: own survey, 2011.

7.5.1.5 Distance to social and institutional services

Table 7.9 indicates walking distance from farmers' homesteads to various social services or institutions. The survey found that, on average, walking time to reach the nearest drinking water for cattle was 15.40 minutes in the wet season and 27.62 minutes in the dry season. On average households took around 25 minute in search of feed in the wet season and 19 minute in the dry season. Surprisingly, households' search for feed was longer in wet season compared to dry season. This may be due to the fact that in dry season most farmers feed their cattle crop residue (straw, hay and stalk) collected in their homestead. On the other hand, in wet season most farmers move their cattle in search of grazing that is available farther away from homestead.

Household members took more than one hour to reach the nearest livestock market and around 44 minutes to reach the veterinary clinic. Household members' average walking time to reach the

nearest all weather road (asphalt) was 79.49 minutes and to the nearest all weather road (gravel) was 19.20 minutes.

Excessive time to reach the social services or institutions results in high transaction costs for farmers associated with resource mobility, transport and communication cost and opportunity costs. In particular, longer walking distance to livestock veterinary services increases risks associated with livestock mortality and morbidity.

Table 7.9: Walking time to social services or institutions

Nearest distance from homestead	Average walking time (in minute)
Cattle drinking water (wet season)	15.40
Cattle drinking water (dry season)	27.62
In search of feed (wet season)	25.73
In search of feed (dry season)	19.08
Livestock market	63.08
Veterinary clinic	44.36
All weather road (asphalt)	79.49
All weather road (gravel)	19.20
n=356	

Source: own survey, 2011.

7.5.1.6 Cattle mortality

Respondents were asked whether they lost any cattle in the past three years. Among households that lost cattle, the average loss of cattle per farmer was found to be 1.76 head: 1.18 head due to diseases, 0.48 due to accidents and 0.09 due to other reasons. The greatest proportion (more than 66%) of cattle deaths were caused by diseases. The cause of deaths for more than a quarter (27.7%) of cattle was accidental damage and 5% of the cattle loss was caused by any other reasons (Table 7.10). According to BoARD (2009) the major infectious cattle diseases are viral disease such as foot-and-mouth disease (FMD), lumpy skin disease and rabies; vector-born diseases such as trypanosomosis, heart water, babesiosis and anaplasmosis; and bacterial diseases such as anthrax, blackleg, bovine pasteurellosis, streptotrichosis (dermatophilosis), tuberculosis, brucellosis, mastitis and contagious bovine pleura pneumonia. In addition, there are various internal and external parasites that impact negatively on animal health and livestock productivity.

Table 7.10: Cattle mortality in the past three years

Cause of death	Total cattle deaths	Mean per farmer	Share of deaths (in %)
Diseases	420	1.18	66.87
Accident	174	0.48	27.70
Others	34	0.09	5.41
Total	628	1.76	100.00
n=356			

Source: own survey, 2011.

7.5.1.7 Households' cattle sold and reason

Respondents were asked if they sold cattle in the past three years and the reasons for sale. 318 of the farmers (89.33%) reported that they sold cattle but the remaining 38 respondents (10.67%) did not sell any. More than half of the respondents (59.12%) reported that they sold cattle only during the dry season while 5.03 % of respondents sold their cattle only during the wet season. The remaining 35.85 % of respondents sold cattle during both the wet and dry seasons. This may imply that farmers sold their cattle because of seasonal feed shortage and high cost of feeding during the dry season.

Respondents were asked the principal reasons why they sold their cattle in the past three years: 31.45% reported that they sold their cattle to obtain cash for personal consumption such as food, clothes, medical and other expenses; 28.93% sold cattle in order to buy agricultural inputs such as fodder, fertilizer, seed, veterinary drugs and other inputs (Table 7.11).

Table 7.11: Farmers' reasons for cattle sold in the past three years

Reason for sale	% of respondent
Personal needs	31.45
Repay loan	16.67
Buying inputs	28.93
Ceremonial expenses	1.26
Others	21.70
Total	100.00
n=318	

Source: own survey, 2011.

7.5.2 Estimation results

Important variables influencing households' decision to insure cattle and the number of cattle to insure are analyzed here. Variables such as age, gender, education, share income, income (log income) and number of less productive cattle have a significant effect on farmers' interest in hypothetical cattle insurance participation and/or the number of cattle to be insured. Heckman model used to address sample selection bias. This model used to identify the determinants of households' participation in cattle insurance and the number of cattle to be insured. To this end, one variable, that is, 'dependent ratio' was chosen that affects selection equation but not outcome equation.

7.5.2.1 Farmers' interest in cattle insurance participation and intensity

A summary description of the data used in the household regression is presented in Table 7.12. The Heckman model estimates of the determinants of farmers' interest in cattle insurance participation and the number of cattle to insure are presented in Table 7.13.

In the outcome equation, the test for sample selection bias indicates that the null hypothesis of no selection bias (λ =0) is rejected at 10% level of significance (see Table 8.13). The null hypothesis is rejected in favor of the alternative hypothesis. Thus, the sample selection problem has to be accounted for. In this case, the selection correction term (λ) is an indication of sample selectivity bias and the Heckman sample selection model should be used to get consistent estimates. In the presence of selection bias, OLS estimates would be inconsistent (Green, 2003). In other words, due to the presence of sample selection problem the use of Heckman model is appropriate to address selection problem thereby provide correct inferences.

Table 7.12: Summary statistics of variables used in regression

Variables	Mean	Std.dev	Min	Max
Independent variables				
Age of household head (years)	45.2	12.08	22	84
Gender of the household head (1= male; 0 otherwise)	0.76	0.43	0	1
Education of head of household (years of schooling)	2.31	2.94	0	12
Dependent ratio (proportion of dependents in a household whose age less than 15 years and greater than 64 years)	0.97	0.77	0	5
Share income (livestock share of annual income in ratio)	0.31	0.19	0	1
Log income (log of household's annual income in Birr)	8.98	0.76	6.41	11.44
Highland dummy (1=highland area; 0= otherwise)	0.22	0.41	0	1
Midland dummy (1=midland area; 0= otherwise)	0.47	0.50	0	1
Number of less productive cattle (number of cattle aged less than 2 & greater than 8 years)	4.09	4.24	0	34
Zero grazing dummy (1= zero grazing practice; 0 otherwise)	0.23	0.42	0	1
Dependent variable				
Interest on cattle insurance participation (yes=1; 0 otherwise)	0.94	0.23	0	1
log number of cattle to insure (number of cattle aged between 2 and 8) (in log)	0.82	0.58	0	2.99

Table 7.13 includes the results of Heckman model (two-step) and Heckman model (maximum likelihood). Heckman two-step estimator is more robust and appears to be the better choice for almost all practical applications (Chiburis and Lokshin, 2007, Wynes, 2013). Because of this reason, only the results of the Heckman two-step are discussed.

The finding of the selection equation revealed that *age* of head negatively and significantly influenced the household's interest in hypothetical cattle insurance participation; perhaps older farmers are more conservative when it comes to adopting new agricultural practices as compared to the younger heads. *Gender* was found to have no significant effect on farmer's interest in cattle insurance, that is, there is no difference between male and female headed households in cattle insurance participation.

Table 7.13: Heckman model

Variables	Heckman model (two-step)		Heckman model (ML)	
	Selection equation	outcome equation	selection equation	outcome equation
Age	-0.0245* (0.0130)	-0.0051* (0.0028)	-0.0209 (0.0132)	-0.004* (0.0025)
Gender	-0.1305 (0.3705)	0.3320*** (0.0708)	0.3313*** (0.0673)	-0.0774 (0.3577)
Education	0.3794** (0.1480)	0.0269** 0.0106	0.4118*** (0.1233)	0.0257*** (0.0096)
Dependent ratio	0.4159* (0.2446)		0.3458 (0.2214)	
Share income	-0.3745 (0.7233)	0.8936*** (0.1499)	-0.2601 (0.7362)	0.8987*** (0.1595)
Log income	0.6546*** (0.2294)	0.1293*** (0.0478)	0.7669*** (0.2093)	0.1209*** (0.0480)
Highland dummy	0.1771 (0.4607)	0.0016 (0.0798)	0.3196 (0.3934)	0.0006 (0.0772)
Midland dummy	0.0335 (0.3155)	-0.1097* (0.0666)	0.0357 (0.3230)	-0.1091* (0.0668)
log number of less productive cattle	-0.0695** (0.0304)	0.0242*** (0.0081)	-0.0818*** (0.0273)	0.0254*** (0.0097)
Zero grazing	0.0171 (0.4485)	-0.1274* (0.0694)	-0.0810 (0.3850)	-0.1286** (0.0618)
Constant	-3.029 (2.182)	-.7576* (0.4309)	-4.199** (1.991)	-0.6937 (0.4350)
λ (IMR)		0.4107* (0.2441)		
Wald χ^2 ($\rho = 0$)				4.19**
n=356				

***, **, * indicate statistically significant at 1%, 5% and 10%, respectively. Values in parentheses are robust standard errors.

Education was found to have a significant positive influence on cattle insurance participation. That is, households in which the head has a higher level of schooling are more likely to be interested in cattle insurance compared to household heads with lower level of schooling. The implication is that skill and knowledge obtained from higher level of schooling can lead farmers to better understand the benefit of cattle insurance as compared to their counterparts. Probably more educated farmers may realize the consequence of risk and the way insurance mitigates risk better than low educated farmers. The result was consistent with another study (Khan et al., 2012; Hosseini and Zadeh, 2011).

The *dependent ratio* positively and significantly influenced farmer's interest in cattle insurance participation. This implies that households with relatively large number of dependents (children and old people) are more likely to be involved in cattle insurance compared to those with smaller number of dependents. Households with a high dependency ratio are more vulnerable to socio-

economic risks and shocks, with the result that they may consider participation in cattle insurance as an important protection to minimize farm disaster.

Unexpectedly, *share of income* from livestock negatively influenced households' cattle insurance decision even if it was insignificant effect. Probably, households that earn a greater share of income from livestock may have good livestock management systems and therefore be less willing to participate in insurance. *Income* of households (log income), however, positively and significantly influenced household's interest to participate in cattle insurance. This may be because the higher income households can better afford to pay the cost of cattle insurance compared to lower income households.

Location (*highland and midland*) were found to have no significant effect on the households' interest in cattle insurance participation. Contrary to hypothesis, *number of less productive cattle* (cattle age less than 2 and greater than 8 years) was found to influence household's interest for cattle insurance participation in a significantly negative relation. Households that have large number of less productive cattle might be unhappy with the policy of excluding less productive cattle from the hypothetical insurance scheme (as outlined to the survey respondents) which may cause them to be reluctant in the hypothetical cattle insurance participation for productive cattle (age of 2-8 years).

Households that adopted zero grazing were found with the expected sign but insignificant, which suggests that whether households adopt zero grazing or not does not give rise to a difference in their interest in cattle insurance scheme.

The outcome equation indicated that *age* of head of household negatively and significantly influences log number (extent) of cattle to insure. Older household heads are conservative about new agricultural practices; thus they may be interested to insure a low number of their cattle in order to evaluate the advantage of cattle insurance compared to their counter groups. *Gender* was found to have insignificant effect on farmers' interest in cattle insurance participation, however, positively and significantly influences log number of cattle to insure. This is due to the fact that male headed households may own larger number of cattle compared to female headed household that may lead larger number of cattle to insure for male heads compared to female heads.

Education of head positively and significantly influenced log number of cattle to insure. The result suggests that household heads with more schooling are interested to insure more cattle

than household heads with less schooling. That is, increase in households' level of schooling is one important factor to increase log number of cattle to insure.

Share income, was found to have no significant effect on farmers' interest in cattle insurance participation, but had positively and significantly influenced log number of cattle to insure. This suggests that households' that generate a greater share of income from livestock many be expected to insure more cattle compared to households that generate less share of their income from livestock. The fact that households that generate relatively more income from livestock may want to insure more cattle in order to maintain their income compared to their counter groups. As expected, household *income* was found positively and significantly influences not only households' interest in cattle insurance scheme but also log number of cattle to insure. The result showed that higher income households expected more number of cattle to insure compared to lower income households. Highland location was found to have no significant effect on log number of cattle to insure. Whereas midland location was found negatively and significantly influences log number of cattle to insure.

As expected, the *number of less productive cattle* significantly and positively influence log number of cattle to insure. The result showed that households with larger *number of less productive cattle* expected to insure more cattle compared to those farmers that had small number of less productive cattle. The reason is that, farmers that have larger number of less productive cattle can sell these cattle in order to get cash for paying premium for larger number of cattle to insure.

Adopting *zero grazing* was found negatively and significant effect on log number of cattle to insure. The reason is, *zero grazing* practice minimizes cattle contamination and disease prevalence thereby famers that practice zero grazing may insure less number of cattle compared to their counterparts.

7.6 Conclusions

Livestock plays a pivotal role in smallholder production systems in developing countries. However, economic risks, especially the loss of livestock, are major reasons for slipping into poverty (Fischer and Buchenrieder, 2009). Livestock farmers in developing countries face many risks and uncertainties due to diseases, adverse weather, market, institutional and other risks. The livestock risks are much higher for smallholder farmers in countries such as Ethiopia.

To mitigate livestock risks, livestock insurance could bring advantages for developing countries (Fischer and Buchenrieder, 2009). Livestock insurance scheme is a relevant strategy in managing different risks related to livestock farming (Khan et al., 2012). In developing countries, however, insurance markets are still underdeveloped (Fischer and Buchenrieder, 2009). For this study, field research on the potential role of livestock insurance was carried out. Recently in Ethiopia there was an attempt to introduce a cattle insurance scheme by two private companies (Nyala Insurance S.C and Oromia Insurance S.C). So far, it is not possible to evaluate its success or challenge since it is currently underway in some areas as a pilot study.

The purpose of this chapter is to present the results of an empirical study on hypothetical cattle insurance, a subject that has not been received much attention in developing countries. In this chapter we analyse farmers' interest in cattle insurance participation, the number (extent) of cattle to insure and its determinants in rural areas of Tigray. The farmers' interest in cattle insurance participation was based on the 4% of value of the cattle as a premium, a figure that was adopted by Nyale Insurance S.C. Heckman model was implemented to model farmers' interest in cattle insurance participation and the extent of cattle to insure and analyse survey data from three zones of Tigray (north western, eastern and southern Tigray).

Around 94.38% of the households were found to be interested to participate in cattle insurance, out of which three-quarters of them willing to pay the 4% of premium; for the remaining households (one-fourth) it was not affordable. On average, farmers were willing to pay Birr 79.7 per cattle per year that was equivalent to 4% of cattle premium. The most important factors affecting households' decision in cattle insurance scheme and log number of cattle to insure were education and household income (log income).

Several implications come out of this finding. The majority of farmers were interested in participating in the hypothetical cattle insurance and most of them were willing to pay the benchmark premium. Our results suggest that improving education and income of households in rural areas can improve not only farmers' participation in cattle insurance but also the extent of cattle to insure in order to transform the hypothetical cattle insurance scheme into an actual insurance scheme. Increasing education will change how people view the importance of livestock insurance while also expanding the insurance market. Expanding adult education program and extension service could be an important strategy to increase farmers' awareness and thereby increase farmers' interest in livestock insurance participation.

In addition, nearly a quarter of the farmers were interested to participate in livestock insurance but they could not afford to pay the 4% cattle insurance premium and they are willing to pay less than 4% of premium. The differences between households' interest to participate in livestock insurance scheme and ability to pay the 4% value of cattle premium suggest that there is a problem in affordability. This evidence may support the need for governmental intervention in terms of insurance subsidy in poor income countries. One interesting innovation by Horn of Africa Risk Transfer for Adaptation (HARITA) project in Tigray enable poor farmers to pay for crop insurance with their own labour through participation in soil and water conservation strategies rather than cash (WFP and Oxfam, 2012). According to Bennett (2012), an intervention to control livestock diseases is due to a significant economic impact on livestock production and incurs substantial costs for societies. Impacts affect not only livestock farms and the livestock industries but also sectors outside of farming. Important negative externalities of livestock disease include impacts on the health of other producers' livestock, on human health, and on animal welfare. Good disease risk management and good animal welfare are thus public goods.

To this end, the development of livestock insurance needs to be one of the risk management tools available to smallholder farmers. Livestock insurance can facilitate efforts to protect farmers from loss of their livestock caused by livestock mortality and morbidity. In particular, the outbreak of epidemic animal diseases like foot-and-mouth disease has a devastating economic impact for farmers. Such impact affects households' farm income and livelihood strategies. It also affects the export market and results in low domestic prices. Farmers' concern about livestock loss that they can no longer bear has increased. Hence, more attention needs to be given to provide viable risk management strategies to minimize shocks in the smallholder farmers. In this regard, livestock insurance helps farmers to enhance livelihoods, and reduces the vulnerability of farmers after a shock arising from livestock mortality, and thereby helps them more effectively manage the resulting shocks.

CHAPTER EIGHT

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

The purpose of this chapter is to summarize the main conclusions, identify the contribution to academic literature and implications for policy and practice. In addition, some limitations of the current study and possible directions for further research are presented.

Risk is part of life in developing economies. Climatic risks, economic fluctuations and a large number of individual-specific shocks leave farmers vulnerable to severe hardship (Dercon, 2002). Farmers in mixed crop-livestock systems produce about half of the world's food. In small holdings around the world, livestock are reared mostly on grass, browse, and non-food biomass from maize, millet, rice and sorghum crops and in their turn supply manure and traction for future crops. Animals act as insurance against hard times and supply farmers with a source of regular income from sales of milk, eggs, and other products (Herrero et al., 2010).

Livestock farmers in developing countries face risk and uncertainties in the pursuit of reproductive and growth operations. Diseases, adverse weather, theft, predation, fire and other perils can cause sickness, loss of stock or of performance, or death (Roberts, 2007). In Ethiopia rural households are exposed to a variety of risks, including harvest failure as a result of drought, floods, frost, and other climatic events; policy shocks, such as changes in taxation and the death and illness of livestock (Dercon, 2002). Thus, faced with human and natural risk factors, it is crucial to investigate small-holder farmers' major sources of risk and management strategies in livestock farming.

This thesis aims, therefore, to examine risk perception and management as well as the potential role of insurance in livestock farming in Tigray, Northern Ethiopia. The preceding chapters focussed on farmers' perception of risk in livestock farming (Chapter 6); perceptions of risk management strategies (Chapter 7); and factors potentially influencing farmers' cattle insurance decision (Chapter 8). In order to answer the research questions (as set out in Chapter 1, section 1.3) cross-sectional data were collected from the farmers in the study districts of Tigray. Factor

analysis and multiple regression were applied in the analysis of risk perception and risk management strategies, while the Heckman model was used to analyse the potential of cattle insurance decisions. The purpose of this chapter is to summarize the main conclusions, present contribution to academic literature and the implication for policy and practice; as well as the limitations of the current study and possible directions for further research.

8.2 Summary of main conclusions

This thesis set three major research questions and then answered each research questions using empirical analysis. The research questions are: how do farmers' perceive risk related to cattle farming? What do farmers perceive as relevant risk management strategies? What might be determinants of farmers' decision to participate in a hypothetical cattle insurance and its intensity of use? The aim of this section is to summarize the major findings relevant to each research questions.

8.2.1 Farmers' perception of risk

Ethiopian agriculture is characterized by low productivity, low farm income, low technological adoption and inefficient production techniques. Poor agricultural output in part is related to farmers' attitude towards risk in the adoption of modern agricultural inputs. In addition, the low farm productivity of farmers is linked to the various sources of risks associated with the agricultural sector and poor management strategies. In chapter 5 (for the first research question) farmers' perception related to livestock risk is examined. Results revealed that there are different groups of farmers with different levels of risk aversion related to livestock farming. Farmers risk attitude affects farm investment, technology adoption and decisions on risk management strategies.

The finding of factor analysis also suggests that farmers perceive with various sources of risks. It indicated that the likelihood of production, marketing, financial, human and institutional risks were the major challenges to the smallholder farmers. In terms of severity: production, marketing, financial and human risks were perceived as severe sources of risk. In terms of likelihood and impact, production risk was perceived as the major sources of risk. The production risk was related to livestock disease prevalence, morbidity and mortality. The loss of livestock can devastate households' livelihood and perpetuate the cycle of poverty.

The findings revealed that risk sources were influenced by socioeconomic and location variables. Production risks, for example, were perceived higher by older head of households. Perhaps older people are physically weaker to manage their livestock and to control livestock diseases. Farmers in the highland location and farmers adopting zero grazing perceived production risks lower compared to their counterparts. In Ethiopia, the highland location is better in terms of weather condition (namely moderate temperature) and infrastructure compared to lowland areas. As a result, the outbreak of livestock diseases and pests is lower in the highland location. Farmers that have adopted zero gazing also perceived a lower production risks. Farmers adopting zero grazing protect their livestock from diseases and deaths due to limited livestock contact and cattle fighting and limited exposure to high temperature by keeping cattle in their sheds. Human risks were perceived lower for households of large family size and for farmers adopting zero grazing. Households that have larger family can properly feed, herd and manage their cattle thereby minimize labour constraints for livestock farming activities and zero grazing practice can mitigate human risk since there is no to allocate labour for herding.

Risk is an intrinsic component of decision-making in all businesses but is even more important in agriculture because of the exposure to various sources of risks. Farmers are risk averse to technology adoption and new agricultural practices as a result the analysis of risky choices in terms of their average or expected consequences will not lead farmers to efficient allocation of farm resources and optimal decision. Thus, the risk aversion behaviour of farmers has to be taken into account when developing and applying methods of decision analysis. In this regard, it is important at farm level to identify the potential sources of risk and uncertainty and its association with socio-economic and agro-ecological conditions. The findings supports the view that farmers face multiple sources of risks caused by weather and human induced factors such as production, marketing, financial, human and institutional risks. Such sources of risks were influenced by socio-economic, agro-ecological and other farm characteristics. Planning for risk and uncertainty is important since it helps to focus on the possible negative outcomes and ways to prevent or mitigate the negative outcomes. Risk analysis is needed to take into account the negative effects. Thus, programs and policies for farmers should incorporate farmers' risk behaviour, risk sources and its relationships with socio-economic and geographical locations.

8.2.2 Perceptions of risk management strategies

In chapter 7, the second research question is addressed. It aims to examine farmers' perception of existing risk management strategies. Factor analysis suggested that livestock disease control, financial management, participation in safety net program, livestock feed management, participation in cooperatives and diversification were perceived an important risk management strategies.

The result showed that the use of disease control was found to be the most important management strategies to smallholder farmers, especially the use of veterinary service. Disease control such as cleaning livestock shelter and controlling parasites were found important strategy to manage risk. However, the outbreak of FMD in some parts of the study area during the survey resulted in a loss of many livestock due to inadequate veterinary service in the region.

Results show that risk management strategies are influenced by socioeconomic variables. Notably, financial management was influenced by risk attitude, age of head and households' participation in the livestock package program. That is, less risk averse households may be keen to use credit from microfinance institutions and they considered loan allocation and timely loan repayment as an important tool to manage financial risks. Older household heads are more responsible and experienced on loan allocation and loan repayment that they considered financial management as an important risk management strategy. Households that participate in livestock package program were found more aware about credit allocation and repayment obligations and they able to manage their finance activities in a better way.

Larger family size households, households adopting zero grazing and more social networked households perceived safety net program as an important strategy to manage risk. Larger family size households and households that practice zero grazing can supply more labour to be engaged in productive safety net program in order to gain more food or cash. The basic administrative criteria for households to be member of PSNP are either chronically food insecure or households without family support. However, more socially networked households are easily communicated with community and administrative people and more likely to be members and beneficiaries of the PSNP.

Correlation matrix was used to examine the link between perceptions of risk sources (in term of both likelihood and severity) and risk management strategies. The results of the correlation suggested that there is no one-to-one correspondence between the sources of risks and the risk management strategies. Rather the sources of risks were found to be highly associated with various management responses. Namely, feed management was perceived as the most important strategy to manage the likelihood of production risks (cattle mortality and morbidity). Perhaps, proper livestock feed collection and providing adequate feed to livestock may increase livestock disease resistant power. On the other hand, joining cooperatives was perceived as an important strategy to manage the likelihood of institutional risk while participation in safety net program was perceived an important strategy to manage the likelihood of financial risks. Livestock disease prevention and feed management were perceived as an important strategy to manage the severity of production risks. Livestock disease prevention was also found to be an important strategy to mitigate the severity of financial risks since disease prevention can minimize livestock mortality and morbidity and it can increase livestock productivity through selling live animals, milk, butter, hides etc thereby households may minimize financial risks. In addition, participation in safety net program was found to be an important strategy to mitigate the likelihood and severity of financial risk.

Risk and uncertainty are inherent in the agricultural sector. Given the pervasiveness of risks, farm households, governmental and non-governmental organizations are increasingly seeking effective and sustainable strategies and approaches to mitigate or cope with these inherent risks.
This study used an approach looked at the sources of risks and risk management strategies in a broader context of risk sources, management strategies and their association with socio-economic and agro-ecological factors. Given risks and uncertainties, and strong interactions among risk sources, management strategies and government actions, its impact and implications demand in-depth and appropriate analysis in a broader approach. In this regard, all available risk management strategies need to be considered when analysing policy options.

8.2.3 Factors influencing farmers' potential cattle insurance decisions

In general, the result of the study clearly indicated how livestock farmers are challenged with human induced and weather related risks. In order to counter these risks, farm households use informal risk management and publically provided risk management tools. However, the existing

risk management strategies were inadequate and ineffective for smallholder farmers. This study went one step further and attempted to assess the potential of livestock insurance as a complement to the existing risk management strategies. In chapter 8, the third research question aims at shedding some light on farmers' potential participation in cattle insurance and intensity of participation.

Around 94% of the households were willing to participate in livestock insurance, out of which two-third of households was willing to pay the premium bid of 4% value of the cattle. On average, households were willing to pay Birr 79.7 per animal per year, which was nearly equivalent to 4% of the animal's value. Given the 4% premium bid, households on average were interested to insure 2.71 cattle per household.

The effect of socioeconomic variables on farmers' interest in cattle insurance suggested that older household heads were less likely to participate in cattle insurance. Older household heads may be more conservative to adopt new agricultural practices such as agricultural insurance. In addition, older household heads may be more experienced in cattle management and they are less likely to participate in cattle insurance since experience in cattle management may minimize the possibility of cattle loss and the need for insurance. Farmers with more schooling may be aware and understand better about insurance premium and payout policy that could increase the potential of cattle insurance participation and the number of cattle to insure. Increase in households' dependent ratio (children and old age) was found to increase households potential participation in cattle insurance; perhaps households with more number of dependents are more vulnerable to risks and shock that they demand cattle insurance participation to minimize shocks.

Income was also found to increase farmers' potential participation in cattle insurance and the number of cattle to insure. The reason is that higher income households could afford cost of cattle insurance and they are interested to participate in cattle insurance and willing to insure more number of cattle. Male headed households positively and significantly influenced log number (extent) of cattle to insure. This implies that male headed households are interested to insure more number of cattle compared to female headed households; probably male headed households may own larger number of cattle compared to female headed households.

Low farm productivity, low income and destruction of livelihood due to livestock mortality and morbidity is the major problem for smallholder farmers in a mixed farming. To cope up with

these problems agricultural insurance is important, as it will help to provide financial support to farmers in the event of livestock loss caused by accidental damage, diseases and deaths. Sound risk management strategies and agricultural growth are closely linked. Agricultural insurance helps farmers to recover from damages and losses and thereby stabilizes farm production and the income of farmers. This tool helps to optimize allocation and utilization of resources in the production process by providing farmers financial security. Farmers can get loans from banks using insurance as a collateral and it encourages farm investment. With growth in the agricultural sector, the magnitude of shocks is increasing, as is and the need for sound risk management strategies in order to protect farmers against production losses. In this regard, agricultural insurance plays an important role to effectively address risks.

8.3 Contribution to the academic literature

Overall, this thesis contributes to knowledge in the following ways. First, the thesis demonstrate a conceptual framework the shows the relationships between risk sources, risk management strategies, livelihood assets, policies and socio-economic and their effect on the perceived risks (outcome variables). This conceptual framework clearly indicated the major sources of risk, risk management strategies (ex-ante including insurance and ex-post), livelihood asset elements, socio-economic determinants and policy issues that help to formulate hypotheses. Based on empirical literature and local context, a hypothesis is documented in the thesis that adds to literature.

Second, in this thesis risk analysis involving sources of risk in terms of likelihood and severity, attitude to risk, existing management strategies and the potential role of livestock insurance is analysed. In this regard, the existing risk management strategies are found to be inadequate and ineffective considering the scope of risk to many farmers in Ethiopia. In this line, market based risk management strategies such as agricultural insurance is not developed and literature in this area is therefore limited. The risk analysis of risk sources, attitude to risk and existing risk management strategies provide support for the role of livestock insurance as an additional risk management strategy. In this regard, this study analysed farmers' interest for cattle insurance and the intensity of participation. Thus, the new empirical evidence on risk sources, attitude to risk, risk management and the role of cattle insurance is another contribution to knowledge in the context of developing countries.

Third, the implementation of agricultural insurance has many challenges, mainly related to adverse selection and moral hazard. However, sound insurance design can minimize the challenges of practical implementation of livestock insurance. Insurance design in our hypothetical cattle insurance can minimize adverse selection by providing *awaiting period* to avoid pre-existing disease or impairment. Moral hazard in the hypothetical cattle insurance can be prevented through *exclusions* in that a policy does not cover a loss caused by wilful injury, dead animals without tag, lack of veterinary care and so on. Sound insurance design that minimizes the practical implementation of cattle insurance like adverse selection and moral hazard adds to literature. In addition, the outcome variable in the Heckman model 'log number of cattle to insure' is a new variable specification that adds methodological knowledge.

8.4 Implications for policy and practice

Findings showed that there are important differences in farmers' risk attitudes. Attitude to risk affects farmers' decision in input utilization and technology adoption. Risk averse farmers are relatively reluctant on their farm decision and technology adoption. Results of regression showed that farmers' education and participation in livestock package programs have a positive influence on risk attitude. Therefore, it is important to strengthen the expansion of primary schools, adult education and extension programs in the rural areas to teach and aware farmers about technology adoption thereby minimize farmers' risk aversion behaviour in particular and poverty in general.

Finding of factor analysis that merits special note was production risk that associated with cattle mortality and morbidity. Preventing livestock disease was found to be the most important risk management strategy. This is where intervention can be made through linking of production risk and animal health programs. In line with this, two points are recommended: The first is the need to improve veterinary services. With regard to veterinary services, lack of drugs and equipment as well as veterinary staffs should be given more attention. Besides, it would be useful to produce motivated veterinary staff and DA (development agents) by improving their skills and knowledge through training and further education. The second is to create awareness for farmers about animal health management. Farmers' awareness on shelter cleaning, proper milking and on how to prevent parasites can minimize livestock loss in terms of mortality and productivity. Preventing animal diseases instead of curative can help to minimize the cost of animal treatment, livestock loss and the opportunity cost of farmers' time.

Results of factor analysis indicated that market and human risks were perceived the most likelihood and severe sources of risk to smallholder farmers. In this regard, to minimize marketing constraints needs to improve market information by providing extension services, communications and infrastructure. These improvement measures can improve smallholder farmers' income thereby farmers will be motivated to improve the quantity and quality of livestock production. The shortage of family labour (human risk) is partly reflected due to human illness, injury and death of family members that constraint labour involved in livestock farming. To minimize the risks associated with human risk it needs to strengthen the expansion of existing local health center and heath extension package programs in the country.

Findings also indicated that financial risk in terms of likelihood and severity was the greatest worry to smallholder farmers. Financial constraint is one of the main problems that hinder poor farmers for technology adoption. The provision of credit to farmers is one strategy to minimize farmers' cash shortage and promoting adoption of improved agricultural practices and technology. Access to credit can help households to increase income, build productive asset and mitigate economic shocks. On the other hand, the result suggests that farmers' finance management was an important strategy to reduce financial risks through borrowing from formal institution instead of money lenders, proper loan allocation and timely repayment. In this regard, farmers' financial knowledge on proper allocation of loan and repayment would be important part of the financial management. Thus, expansion of farmers' financial literacy would be instrumental tool for both the clients and the financial institutions. Because, financial literacy help farmers to understand the financial concept of the financial institution, take effective action related to financial decisions and it build thrust between clients and the financial institutions.

Findings of regression analysis revealed that farmers adopting zero grazing (cut and carry system) perceived a lower likelihood and severity of production and human risks. Farmers that practice zero grazing system reduce cattle contact thereby minimizing the prevalence of diseases. Zero grazing system might mitigate the possibility of cattle damage caused by car accident and cattle fighting. In addition, zero grazing is found important to mitigate the scarcity of labour (human risk) by avoiding excess herders allocated to keep the cattle in field. Apart from this, livestock feed shortage is a serious constraint to smallholder farmers in the region and zero grazing practice increases the efficiency of grazing land management through hay making and minimizing land degradation caused by overgrazing and free grazing systems. To this end, rules and regulations that encourage zero grazing practices can tackle multiple sources of risks related to production, human and environmental risks.

Results related to cattle insurance participation indicate that the majority of farmers accepted the hypothetical cattle insurance scheme. This implies that there is a market potential for insurance companies to be engaged in cattle insurance in the rural areas of Tigray. Out of those farmers that interested to participate in cattle insurance scheme, around three-fourths of farmers found willing to pay at least the bench mark premium rates. To attract nearly a quarter of farmers towards cattle insurance scheme, it would be important to create innovative way of insurance arrangement through subsidy so as to increase farmers' insurance participation. Such agricultural insurance subsidy can also help for insurance companies to exploit economies of scale and ensure sustainability by increasing farmers' participation on insurance and the extent of cattle to insure. In order to function agricultural insurance effectively, it will be necessary the state or NGOs to provide agricultural subsidy at least in the short run. Cow insurance in China and IBLI in Mongolia are practical examples of livestock insurance subsidy (Xiu et al., 2012; Mahul et al., 2009). In Mongolia, the catastrophic loss is reinsured by the government using public safety net program that protects insurance companies against excessive insured losses. The government subsidy to cattle insurance in Mongolia is to encourage farmers' participation rate and minimize farmers' financial burden.

Results revealed that increase in household income and education can promote participation in cattle insurance scheme and the extent of cattle to insure. With respect to this finding, it is safely recommend short run and long run options on ways to increase both participation and the extent of cattle to be insured. In the short run, it would be important to create awareness for farmers about agricultural insurance through extension services, adult education, and public media. Farmers' insurance participation, the extent of cattle to insure and WTP can be increased if farmers clearly understand about agricultural insurance. In the long run, improvements in farmers' income would be an instrumental tool to increase farmers' interest in cattle insurance participation so that insurance companies can be sustained financially while preventing disaster and losses to farmers. To this end, based on the findings of the hypothetical cattle insurance it is recommended that the establishment of a viable insurance market is given further consideration.

8.5 Limitation and future research

The study areas were in remote rural areas of Tigray. It was a bit challenging to contact certain persons (development agents, tabia leaders, and guiders) and respondents especially at a time of

preliminary assessment of the study tabias and later on the final household survey. Accessibility was considered to select the study sites; however, some of the study sites were not easily accessible for transportation services.

The analysis was based on primary data gathered through cross sectional design. Parameter estimates of the empirical study on cross sectional data were not dynamic. However, the socioeconomic variables and risks are dynamic factors that change overtime. Livestock farmers' risk sources and management strategies vary significantly overtime. However, the static approach does not capture the change of risk sources and management strategies overtime. Therefore, longitudinal studies need to be conducted for further research based on dynamic analyses that capture the changes overtime.

The thesis was focussed on household modelling of specific issues such as perceptions of risk, risk management and role of livestock insurance. It did not consider the potential interaction of risk sources and risk management strategies and its impact on households' welfare. For example credit constraint as a financial risk could be possible to evaluate its impact on households' livestock income and total farm income using impact evaluation techniques. Productive Safety Net Program (PSNP) as one of the risk management strategies is possible to evaluate its impact on households' livestock income and productivity. Furthermore, analysis of the third research question (livestock insurance) was based on hypothetical scenario and households may not reflect real participation in the scheme due to a hypothetical bias.

In a mixed crop-livestock farming systems, there is a strong correlation between crop and livestock in terms of risk sources and management strategies. Smallholders' decision making, therefore, may not be separated as livestock productivity influence crop productivity and vice versa. It may be difficult to extricate the effect of confounding factors on crop risk versus livestock risks. In this regard, further comprehensive research on household modelling can be considered to examine the interaction of crop and livestock risk analysis and the effect on smallholders' livelihood strategies.

9. REFERENCES

Abebe, M. (2010) Disaster management in Ethiopia: A review of its checkered history, its transformation and some implications for a vibrant disaster management system, 1975-2008. *Journal of Sustainable Development in Africa,* 12(4): 237–254.

Abebe, M. (2009) Emerging trends in disaster management and the Ethiopian experience: genesis, reform and transformation. *Journal of the British Interplanetary Society,* 1(2): 60–89.

Abegaz, A. (2005) Farm Management in mixed crop-livestock systems in the Northern highlands of Ethiopia. PhD Thesis, Wageningen University.

Abegaz, A.; van Keulen, H. and Oosting, S.J. (2007) Feed resources, livestock production and soil carbon dynamics in Teghane, Northern Highlands of Ethiopia. *Agricultural Systems,* 94: 391–404.

Adenew, B. and Abdi, F. (2005) Land registration in Amhara Region, Ethiopia Research Report 3, SOS Sahel, Addis Ababa, Ethiopia.

Aditto, S.; Gan, C. and Nartea, G.V. (2012) 'Sources of risk and risk management strategies: the case of smallholder farmers in a developing economy.' In: Banaitiene, N. (ed.), *Risk management: current issues and challenges*, INTECH, pp. 449-674.

ADBG (African Development Bank Group) (2011) Federal Democratic Republic of Ethiopia Country Strategy Paper 2011-2015, April 2011.

Ahsan, D. A. (2011) Farmers' motivations, risk perceptions and risk management strategies in a developing economy: Bangladesh experience. *Journal of Risk Research,* 14(3): 325–349.

Akcaoz, A. and Ozkan, B. (2005) Determining risk sources and strategies among farmers of contrasting risk awareness: A case study for Cukurova region of Turkey. *Journal of Arid Environments,* 62: 661–675.

Akcaoz, H.; kizilay, H. and Ozcatalbas, O. (2009) Risk management strategies in dairy farming: A case study in Turkey. *Journal of Animal and Veterinary Advances,* 8(5): 949–958.

Alderman, H. and Paxson, C. (1992) Do the poor insure? A synthesis of the literature on risk and consumption in developing countries. Policy Research Working Paper, Agriculture and Rural Development Department. The World Bank, WPS 1008.

Alderman, H. and Paxson, C. (1994) 'Do the poor insure? a synthesis of the literature on risk and consumption in developing countries.' In: Bacha, E.L.(ed.) *Economics in a changing world, development, trade and the environment*, Vol. 4, Macmillan, London.

Al-Kouri, S.; Al-Sharafat, A. and Al-Deseit, B. (2009) Attitude of producers toward livestock insurance in broiler industry in Jordan. *Journal of Animal and Veterinary Advances,* 8 (12): 2461–2467.

Amemiya, T. (1984) Tobit models: a survey. Journal of Econometrics, 24(1-2):3–61.

Anderson, J.R. (2001) Risk management in rural development. Rural Development Strategy Background Paper No: 7, Rural Development Department, The World Bank, Washington D.C.

Anderson, J.R. (2003) Risk in rural development: challenges for managers and policy makers. *Agricultural Systems,* 75(2-3):161–197.

Andersson, C.; Mekonnen, A. and Stage, J. (2011) Impacts of the Productive Safety Net Program in Ethiopia on livestock and tree holdings of rural households. *Journal of Development Economics,* 94: 119–126.

Anton, J. (2008) 'Agricultural policies and risk management: A holistic approach.' In: Berg, E., Huirne, R. Majewski, E. and Meuwissen, M. (eds.) *Income stabilization in a changing agricultural world: Policy and Tools*, Wies Jutra Limited, Warsaw, pp. 1-28.

Arun, T. and Steiner, S. (2008) Micro-insurance in the context of social protection, BWPI Working Paper 55, Brooks World Poverty Institute. http://www.bwpi.manchester.ac.uk/resources/Working-Papers/bwpi-wp-5508.pdf

Association of Ethiopian Microfinance Institutions (AEMFI, 2010) The potential for high value livestock indemnity insurance in Ethiopia's Oromiya Region, Ethiopia.

Bante, Z. (2006) Risk aversion behavior of farm households and the role of credit service in Kobbo district, north Wollo zone of Ethiopia. Department of Agricultural Economics School of Graduate Studies, Haramaya University, Ethiopia, Master Thesis.

Barrett, C.B. (2006) Food aid in response to acute food insecurity. ESA Working Paper No. 06-10. Agricultural and Development Economics Division, The Food and Agriculture Organization of the United Nations.

Baum, C.F. (2006) *An introduction to modern econometrics using Stata*. A Stata Press Publication StataCorp LP College Station, Texas, USA.

Beal, D.J. (1996) Emerging issues in risk management in farm firms. *Review of Marketing and Agricultural Economics,* 64(3): 336–347.

Bennett, C. (2012) Economic Rationale for Interventions to Control Livestock Disease. *EuroChoices*, 11(2): 5–11.

Berhane-Selassie, T. (2009) Prestige is the argument: ideas of power and development aid in Ethiopia, In: Ege, S., H. Aspen, B. Teferra and S. Bekele, (eds.), *Proceedings of the 16th International Conference of Ethiopian Studies*, Vol.1-4, NTNU-trykk, Trondheim, Norway, pp.573-587.

Bezabih, M. and Sarr, M. (2012) Risk preferences and environmental uncertainty: Implications for crop diversification decisions in Ethiopia. *Environmental and Resource Economics,* 53:483–505.

Bhattamishra, R. and Barrett, C.B. (2008) Community-based risk management arrangements: An overview and implications for social fund program design. SP Discussion Paper No. 0830. Social Protection and Labor, The World Bank.

Bielza, M.; Conte, C.; Dittmann,C.; Gallego, J. and Stroblmair, J. (2008) Agricultural insurance schemes. Institute for the protection and the security of the citizen, Joint Research Centre, European Commission, Final Report, Italy.

Birru, T. (2009) A Double-hurdle model of computer and internet use at home in the United States. UMI Microform ProQuest LLC, USA.

Boggess, W.G.; Anaman, K.A. and Hanson, G.D. (1985) Importance, causes, and management responses to farm risks: evidence from Florida and Alabama. *Southern Journal of Agricultural Economics,* 17(2) :105–116.

Breusch, T.S. and Pagan, A.R. (1979) A simple test for heteroskedasticity and random coefficient variation. Econometrica, 47(5): 1287–1294.

Briggs, D.C. (2004) Casual inference and the Heckman model. *Journal of Educational and Behavioural Statistics,* 29(4): 397–420.

BoANRD (Bureau of Agriculture and Natural Resources Development) (1997) Tigray livestock development action program. Executive Summary. BoANRD, Mekelle, Ethiopia.

BoARD (Bureau of Agriculture and Rural Development) (2009) Technology adoption of agriculture technical implementation manual, Tigray, Mekelle (Tigrigna version).

BoPF (Bureau of Plan and Finance) (2010) Tigray Regional State. Five Years (2010/11 - 2014/15) Growth and Transformation Plan. September 2003 E.C (2010 G.C), Mekelle, Ethiopia.

Cameron, A.C. and Trivedi, P.K. (2005) *Microeconometrics:* methods and applications. Cambridge University Press, Cambridge, UK.

Campell, S. (2006) Risk and the subjectivity of preference. *Journal of Risk Research*, 9(3): 225–242.

CSA (Central Statistical Agency) (2008a) Summary and statistical report of the 2007 Population and Housing Census: population size by age and sex. Federal Democratic Republic of Ethiopia, Addis Ababa, Ethiopia.

CSA (Central Statistical Agency) (2008b) Agricultural sample survey 2008/09, report on livestock and livestock characteristics, Vol. 2, Statistical Bulletin 446, Federal Democratic Republic of Ethiopia (FDRE), Addis Ababa, Ethiopia.

CSA (Central Statistical Agency). (2010) Agricultural sample survey 2009/10, report on livestock and livestock characteristics, Vol. 2, Statistical Bulletin 468, Federal Democratic Republic of Ethiopia (FDRE), Addis Ababa, Ethiopia.

Cervantes-Godoy, D., Kimura, S. and Antón, J. (2013) Smallholder risk management in developing Countries, OECD Food, Agriculture and Fisheries Papers, No. 61, OECD Publishing.

Chantarat, S.; Mude, A.G.; Barrett, C. B. and Carter, M. R**. (**2013) Designing index-based livestock insurance for managing asset risk in northern Kenya**.** *Journal of Risk and Insurance* 80(1): 205–237.

Chanyalew,D.; Adenew, B.; and Mellor, J. (2010) Federal Democratic Republic of Ethiopia, Ministry of Agriculture and Rural Development. Ethiopia's agricultural sector policy and investment framework (PIF) 2010-2020, Final Draft Report.

Chiburis, R. and Lokshin, M. (2007) Maximum likelihood and two-step estimation of an ordered-probit selection model. *The Stata Journal,* 7 (2): 167–182.

Churchill, C. and McCord, M.J. (2012) 'Current trends in microinsurance', In: Churchill, C. and Matul, M. (eds.), *Protecting the poor a micro-insurance compendium,* Volume II., ILO (International Labour Organization), Germany, pp. 8-39.

Coates, J.; Maxwell, D.; Tadesse, G.; Hailu, S.; Zeweld, W. and Gebrekiros, A. (2010) Institutional assessment report: Tsaeda Amba Woreda, Eastern Tigray, Ethiopia, Research program on livelihood change over time. Feinstein International center, Addis Ababa, Ethiopia.

Cragg, J.G. (1971) Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica*, 39(5): 829–844.

Davies, M., Guenther, C.; Leavy, J.; Mitchell, T. and Tanner, T. (2009) Climate change adaptation, disaster risk reduction and social protection: complementary roles in agriculture and rural growth? working paper 320, Institute of development studies (IDS) UK.

Degefe, B. and B. Nega. (eds.) (2000) The Ethiopian Economic Association (EEA). Annual report on the Ethiopian Economy, Vol. I, Addis Ababa, Ethiopia.

Delgado, C.L.; Narrod, C.A.; Tiongco, M.M.; Barros, G.S.D.; Catelo, M.A.; Costales, A.; Mehta, R.; Naranong, V.; Poapongsakorn, N.; Sharma, V.P and de Zen, S. (2008) Determinants and implications of the growing scale of livestock farms in four fast-growing developing countries. Research Report 157, IFPRI (International Food Policy Research Institute).

Delve, R.J.; Cadisch, G.; Tanner, J.C.; Thorpe, W.; Thorne, P. J. and Giller, K.E. (2001) Implications of livestock feeding management on soil fertility in the smallholder farming systems of sub-Saharan Africa. *Agriculture, Ecosystems and Environment*, 84 :227–243.

Dercon, S. (1996) Risk, crop choice and savings: Evidence from Tanzania. *Economic Development and Cultural Change*, 44(3): 385–514.

Dercon, S. (2002) Income risk, coping strategies and safety nets. *The World Bank Research Observer*, 17(2): 141–166.

Dercon, S. (2009) Innovations in insuring the poor: risks, poverty and insurance. 2020 Vision for Food, Agriculture and the Environment, Focus 17 Brief 3, International Food Policy Research Institute, Washington D.C., USA.

Devereux, S. and Guenther, B. (2009) Agriculture and social protection in Ethiopia FAC (Future Agricultures Consortium), Working Paper No. 08. Brighton: Future Agricultures Consortium.

Doss, C.; Mcpeak, J. and Barrett, C. (2008) Interpersonal, intertemporal and spatial variation in risk perceptions: evidence from East Africa. *World Development*, 36(8):1453–1468.

Drollette, S. (2009a) Understanding Agricultural Risk, Department of Applied Economics, Utah State University, USA.

Drollette, S. (2009b) Managing Financial Risks in Agriculture, Department of Applied Economics, Utah State University, USA.

Edwards, S.; Gebre-Egziabher, T. and Araya, H. (2011) 'Success and challenges in ecological agriculture: experiences from Tigray, Ethiopia.' In: Ching, L.L.; Edwards, S., and Scialabba (eds.), *Climate change and food systems resilience in Sub-Saharan Africa*. FAO (Food and Agriculture Organization of the United Nations), Rome, Italy, pp. 231-294.

Elbers, C.; Gunning, J.W. and Kinsey, B. (2007) Growth and risk: methodology and micro-evidence. *World Bank Economic Review*, 21(1):1–20.

Ellis, F. (1998) Household strategies and rural livelihood diversification. *Journal of Development Studies*, 35 (1): 1–38.

Ellis, F. (2000) The determinants of rural livelihood diversification in developing countries. *Journal of Agricultural Economics*, 51(2): 289–302.

Engida, E.; Tamru, S.; Tsehaye, E.; Debowicz, D.; Dorosh. P. and Robinson, S. (2011) Ethiopia's Growth and Transformation Plan: A computable general equilibrium analysis of alternative financing options. Development strategy and governance division, International Food Policy Research Institute–Ethiopia Strategy Support Program II (ESSP II). ESSP II Working paper 30. IFPRI-EDRI, Addis Ababa, Ethiopia.

EMA (Ethiopian Mapping Authority) (1988) National Atlas of Ethiopia. Ethiopian Mapping Authority, Addis Ababa, Ethiopia.

European Commission (2001) Risk Management Tools for EU Agriculture with a Special Focus on Insurance. Working Document. http://ec.europa.eu/agriculture/publi/insurance/text_en.pdf

Fafchamps, M. (2003) *Rural poverty, risk and development*. ISBN 1843764369, Edward Elgar Publishing Limited, U.K.

Fischer, I. and Buchenrieder, G. (2009) Laptop, livestock drawings and rice wine: a demand analysis for livestock insurance in northern Vietnam. *Savings and Development*, 33: (1): 41–60.

Flaten, O.; Lien, G.; Koesling, M.; Valle, P.S. and Ebbesvik, M. (2005) Comparing risk perceptions and risk management in organic and conventional dairy farming. *Livestock Production Science*, 69 (1-2): 11–25.

FAO (Food and Agricultural Organization) (2011) The state of food and agriculture: women in agriculture: closing the gender gap for development. FAO (Food and Agriculture Organization of the United Nation), Rome, Italy.

Frankenberger, T.R.; Sutter, P.; Teshome, A.; Aberra, A.; Tefera, M.; Seyoum, A.; Bernard, T.; Spangler, T. and Ejigsemahu, Y. (2007) Ethiopia: the path to self-resiliency, Volume II: Regional specific findings. Prepared for: CHF-Partners in rural development on behalf of: Canadian Network of NGOs in Ethiopia (CANGO).

Freeman, H. A; Kaitibie, S.; Moyo, S. and Perry, B.D. (2008) Livestock, livelihoods and vulnerability in Lesotho, Malawi and Zambia: Designing Livestock Interventions for Emergency Situations. ILRI Research Report 8. ILRI (International Livestock Research Institute), Nairobi, Kenya.

Gari, G.; Bonnet, P.; Roger, F. and Waret-Szkuta, A. (2011) Epidemiological aspects and financial impact of lumpy skin disease in Ethiopia. *Preventive Veterinary Medicine,* 102: 274–283.

Gebreegziabher, K. and Tadesse, T. (2011) Household demand for improved water supply services in Mekelle City, Northern Ethiopia. *Water Policy,* 13(1): 125–142.

Gebreegziabher, K. and Tadesse, T. (2014) Risk perception and management in smallholder dairy farming in Tigray, Northern Ethiopia. *Journal of Risk Research* 17(3):367–381.

Gebreegziabher, Z. (2007) Household fuel consumption and resource use in rural-urban Ethiopia. PhD Thesis, Wageningen University, Netherlands.

Gebrehiwot, T. (2012) Food security policy: does it work? does it help? PhD Thesis, University of Twente, Netherlands.

Gebremedhin, B.; Pender, J. and Tesfay, G. (2004) Collective action for grazing land management in crop–livestock mixed systems in the highlands of northern Ethiopia. *Agricultural Systems,* 82: 273–290.

Gebreyohannes, G. and Hailemariam, G. (2011) Challenges, opportunities and available good practices related to zero grazing in Tigray and Hararghe, Ethiopia. Drylands Coordination Group (DCG) Report No. 66.

Georgakopoulos, G. and Thomson, I. (2005) Organic salmon farming: risk perceptions, decision heuristics and the absence of environmental accounting. *Accounting Forum,* 29: 49–75.

Gilligan, D.O.; Hoddinott, J. and Taffesse, A.S. (2008) An analysis of Ethiopia's productive safety net program and its linkages. International Food Policy Research Institute, Washington, DC, USA.

Greene, W.H. (2003) *Econometric analysis*, 4th ed. Prentice Hall, Upper Saddle River, New Jersey, USA.

Grisley, W. and Kellog, E. (1987) Risk-taking preferences of farmers in Northern Thailand: measurements and implications. *Agricultural Economics*, 1(2): 127–142.

Gujarati, D.N. (2004) *Basic econometrics*, 4th ed, The McGraw-Hill companies. New York, USA.

Habb, T.C. and McConnell, K.E. (2002) *Valuing environmental and natural resource: The econometrics of non-market valuation***.** New Horizons in Environmental Economics. Edward Elgar Publishing Limited, Glensanda House, Montpellier Parade, Cheltenham, UK.

Habing, B. (2003) Exploratory factor analysis, University of North Carolina. http://www.stat.sc.edu/~habing/courses/530EFA.pdf

Hagos, F., Pender, J. and Gebreselassie, N. (1999) Land degradation in the highlands of Tigray and strategies for sustainable land management. Socio-economics and Policy Research Working Paper 25. ILRI (International Livestock Research Institute), Addis Ababa, Ethiopia.

Haile, N. (2007) An Economic analysis of farmers' risk attitudes and farm households' responses to rainfall risk in Tigray, Northern Ethiopia. PhD Thesis, Wageningen University, Netherlands.

Haile, T. (2008) Impact of irrigation development on poverty reduction in northern Ethiopia. PhD thesis, University Cork Cork, Ireland.

Hair, F.F., Black, W.C.; Babin, B.J. and Anderson, R.E. (2010) *Multivariate data analysis*,7th ed., Pearsons Education, Inc., New Jersey, USA.

Hall, D.C.; Knight, T.O.; Coble, K.H.; Baquet, A.E. and Patrick, G.F. (2003) Analysis of beef producers' risk management perceptions and desire for further risk management education. *Review of Agricultural Economics*, 25(2): 430–448.

Hansson, S. O. (2010) Risk: objective or subjective, facts or values. *Journal of Risk Research*, 13 (2): 231–238.

Hardaker, J. B.; Huirne, R.B.M. and Anderson, J.R. (1997) *Coping with Risk in Agriculture*, CABI, Publishing, U.K.

Hardaker, J.B.; Huirne,R.; Anderson, J.R. and Lien, G. (2004) *Coping with risk in agriculture*, 2nd ed., CABI Publishing, U.K.

Harwood, J.; Heifner, R.; Coble, K.; Perry, J. and Somwaru, A. (1999) Managing risk in farming: concepts, research, and analysis. Agricultural Economics Report No. 774. US Department of Agriculture, Washington, D.C., USA.

Heckman, J. (1979) Sample selection bias as a specification error. *Econometrica*, 45(1): 153–161.

Heijmans, A. (2001) Vulnerability: a matter of perception. Disaster Management Working Paper 4/2001, Benfield Greig Hazard Research Centre, University College London, U.K.

Herrero, M.; Thornton, P.K.; Notenbaert, A.M.; Wood, S.; Msangi, S.; Freeman, H.A.; Bossio, D.; Dixon, J.; Peters, M.; van de Steeg, J.; Lynam, J.; Parthasrathy Rao, P.; Macmillan, S.; Gerard, B.; McDermott, J.; Sere, C. and Rosegrant, M. (2010) Smart investments in sustainable food production: revisiting mixed crop livestock systems. *Science*, 327(5967): 822–825.

Hess U; Wiseman, W. and Robertson, T. (2006) Ethiopia: integrated risk financing to protect livelihoods and foster development. Discussion Paper.

Hess, U and Wiseman, W. (2007) Reforming humanitarian finance in Ethiopia: a model for integrated risk financing. Elsevier Editorial System(tm) for Food Policy, Manuscript Draft. The World Bank.

Hill, R.C.; Adkins, L.C. and Bender, K.A. (2003) 'Test statistics and critical values in selectivity models.' In: Fomby, T.B. and Hill, R.C. (eds.), *Maximum Likelihood Estimation of Misspecified Models: Twenty Years Later (Advances in Econometrics, Volume 17),* Emerald Group Publishing Limited, U.K, pp.75-105.

Hill, R.V.; Hoddinott, J. and Kumar, N. (2011) Adoption of weather-index insurance: Learning from willingness to pay among a panel of households in rural Ethiopia. International Food Policy Research Institute (IFPRI) discussion Paper No. 1088, Washington, D.C, USA.

Holden, S. Deininger, K. and Ghebru, H. (2009) Impacts of low-cost land certification on investment and productivity. *American Journal of Agricultural Economics,* 91(2): 359–373.

Holton, G.A. (2004) Defining risk. *Financial Analysts Journal,* 60 (6): 19–25.

Holzmann, R and Jorgensen, S. (1999a) Social protection as social risk management: conceptual underpinnings for the social protection sector strategy paper. *Journal of International Development,* 11:1005–1027.

Holzmann, R and Jorgensen, S. (1999b) Social protection as social risk management: conceptual underpinnings for the social protection sector strategy paper. Social Protection Discussion Paper series No. 9904. The World Bank, 1818 H Street, N.W., MSN G8-802, Washington, D.C.

Holzmann, R and Jorgensen, S. (2000) Social risk management: A new conceptual framework for social protection and beyond. Social Protection Discussion Paper series No. 0006. Social Protection Unit, Human Development Network. The World Bank, 1818 H Street, N.W., MSN G8-802, Washington, D.C.

Holzmann, R and Jorgensen, S. (2001) Social risk management: A new conceptual framework for social protection, and beyond. *International Tax and public Finance,* 8: 529–556.

Holzmann,R., L. Sherburne-Benz and E. Tesliuc. (2003) Social risk management: The World Bank's Approach to Social Protection in a Globalizing World. The World Bank, Washington D.C., USA.

Horn of Africa Risk Transfer for Adaptation (HARITA) (2009) Project coordination plan (PCP) and multi-party agreement (MPA) April-May 2009, Unpublished Draft Paper, Ethiopia.

Hosseini, S.J and Zadeh, N.H. (2011) The role of educational factors in adopting agricultural insurance to reduce risks by livestock owners (Case Study: Golestan Province). *Annals of Biological Research*, 2(5): 444–448.

HDR (Human Development Report) (2013) The rise of the south: human progress in a diverse world. Explanatory note on 2013 HDR composite indices: Ethiopia, UNDP.

Hurni, H. (1998) Soil conservation research programme, agro ecological belts of Ethiopia: Explanatory notes on three maps at a scale of 1:1,000,000, Ethiopia research report. Centre for Development and Environment, University of Bern, Switzerland in association with The Ministry of Agriculture, Ethiopia.

IPCC (Intergovernmental Panel Convention on Climate Change) (2007) 'Contribution of working group II to the fourth assessment report of the Intergovernmental Panel on Climate Change: Impacts, Adaptation and Vulnerability Summary for Policymakers.' In: Parry, M.L.; Canziani, O.F.; Palutikof, J.P.; van der Linden, P.J. and Hanson, C.E. (eds.), Cambridge University Press, Cambridge, U.K.

International Atomic Energy Agency (IAEA) (2006) Improving Animal Productivity by Supplementary Feeding of Multi-nutrient Blocks, Controlling Internal Parasites and Enhancing Utilization of Alternate Feed Resources. A publication prepared under the framework of an RCA project with technical support of the Joint FAO/IAEA. Programme of Nuclear Techniques in Food and Agriculture, IAEA, Austria.

Kassie, G.T.; Abdulai, A. and Wollny, C. (2012) 'Estimating the worth of traits of indigenous breeds of cattle in Ethiopia.' In: Caliskan, M. (ed.), *Analysis of Genetic Variation in Animals*, pp. 337-360.

Kazianga, H., and Udry, C. (2006) Consumption smoothing? livestock, insurance and drought in rural Burkina Faso. *Journal of Development Economics*, 79(2): 413– 446.

Khan, M.A.; Chander, M. and Bardhan, D. 2013. Willingness to pay for cattle and buffalo insurance; an analysis of dairy farmers in central India. *Tropical Animal Health and Production*, 45: 461–468.

Klopper, E.; Vogel, C. and Landman, W. (2006) Seasonal climate forecasts-potential agricultural-risk-management tools? *Climatic Change*, 76:73–90.

Knight, F. H . (1921) Risk, uncertainty, and Profit. New York: Hart, Schaffner, and Marx; Boston: Houghton Mifflin Company, The Riverside Press, Cambridge.

Korir, L.K. (2011) Risk management among agricultural households and the role of off-farm investments in Uasin Gishu County, Kenya. Master Thesis, Egerton University, Agricultural and Applied Economics, Kenya.

Kostov, P. and Lingard, J. (2003) Risk management: a general framework for rural development. *Journal of Rural studies*, 19: 463–476.

Kouame, E.B.H and Komeman, A.N. (2012) Risk preferences and demand for insurance under price uncertainty: an experimental approach for Cocoa farmers in Cote d'lvoire. Research Paper No-13. International Labour Office (ILO), Geneva.

Kurosaki, T. and Fafchamps, M. (2002) Insurance market efficiency and crop choices in Pakistan. *Journal of Development Economics*, 67: 419–453.

Lautze, S. and Maxwell, D. (2006) 'Why do Famines Persist in the Horn of Africa? Ethiopia 1999-2003.' In: Devereux, S. (ed.), *New Famines': Why Famines Persist in an Era of Globalization.* Routledge Press, London, UK, pp. 222–244.

Leeuwen, I.V. (2005) Gender and Micro insurance. Working Paper Series No. 418, Institute of Social Studies, Hague, The Netherlands.

Legesse, B. (2000) Smallholders' risk perception and coping strategies: the case of Kersa and Babile, Eastern Ethiopia. Master thesis, Swedish University of Agricultural Sciences, Department of Rural Development Studies Uppsala, Master Thesis.

Legesse, B. and L. Drake. (2005) Determinants of smallholder farmers' perceptions of risk in the eastern highlands of Ethiopia. *Journal of Risk Research,* 8 (5): 383–416.

Legesse, B. (2006) 'Risk perceptions, risk minimizing and coping strategies of smallholder farmers in the Eastern Highlands of Ethiopia', In: Havnevik, K.; Negash, T. and Beyene, A. (eds.), *Of Global Concern: Rural Livelihood Dynamics and Natural Resource Governance,* Sida, pp. 45–83.

LeMay-Boucher. (2009) Beninese and Ethiopian informal insurance groups: a comparative analysis. *Development Policy Review,* 27 (3): 333–347.

Linnerooth-Bayer, J. and Mechler, R. (2006) Insurance for assisting adaptation to climate change in developing countries: a proposed strategy. *Climate Policy,* 6:621–636.

Linnerooth-Bayer and Mechler, R. (2009) Insurance against losses from natural disasters in developing countries, DESA Working Paper No. 85, United Nations, New York, USA.

Liua, B.; MaoSong, L.; Guoa, Y. and Shan, K. (2010) Analysis of the Demand for Weather Index Agricultural Insurance on Household level in Anhui, China. *Agriculture and Agricultural Science Procedia,* 1: 179–186.

Mahajan, V. (2005) Micro insurance enhancing the outreach and sustainability of risk mitigation services for the poor, Access Finance Newsletter, No.8, World Bank's Financial Sector Vice Presidency, India.

Mahul, O. and Skees, J. (2007) Managing agricultural risk at the country level: The case of Index-Based Livestock Insurance in Mongolia, Policy Research Working Paper 4325. The World Bank, Financial and Private Sector Development, Financial Markets for Social Safety Net Unit.

Mahul, O.; Belete, N. and Goodland, A. (2009) Innovations in insuring the poor. Index-Based Livestock Insurance in Mongolia. Focus 17, Brief 9. In: Hill, R. V. and Torero, M.(eds.), Innovations in insuring the poor. 2020 Vision for Food, Agriculture and the Environment, IFPRI (International Food Policy Research Institute), Washington, D.C., USA.

Martin, S. (1996) Risk management strategies in New Zealand agriculture and horticulture. *Review of Marketing and Agricultural Economics,* 64:31–44.

Matsaert, H., Kariuki, J. and Mude, A. (2011) Index-based livestock insurance for Kenyan pastoralists: an innovation systems perspective. *Development in Practice,* 21(3): 343–356.

Mazid, A. and Elizabeth, B. (1992) Incorporating risk in the economic analysis of agronomic trials: fertilizer use on barley in Syria. *Agricultural Economics,* 7(2): 167–184.

McCarthy, M. and Henson, S. (2005) Perceived risk and risk reduction strategies in the choice of beef by Irish consumers. *Food Quality and Preference,* 16(5): 435–445.

McPeak, J. (2006) Confronting the risk of asset loss: What role do livestock transfers in northern Kenya play? *Journal of Development Economics,* 81: 415–437.

Melyukhina, O. (2011) Risk management in agriculture in the Netherlands, OECD Food, Agriculture and Fisheries Working Paper, No. 41, OECD Publishing.

Mensah, E.R.; Karantininis, K.; Adégbidi, A. and Okello, J.J. (2012) Determinants of commitment to agricultural cooperatives: cashew nuts farmers in Benin. Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguacu, Brazil, 18-24 August, 2012.

Meuwissen, M.P.M.; Huirne, R.B.M. and Hardaker, K.B. (2001) Risk and risk management: an empirical analysis of Dutch livestock farmers. *Livestock Production Science,* 69(1): 43–53.

Meuwissen, M.P.M.; Tsion, Taye. and van Asseldonk, M.A.P.M. (2013) Supporting insurance in European agriculture: experience of mutuals in the Netherlands. *EuroChoices, 12(3): 10-16.*

Meze-Hausken, E. (2000) Migration caused by climate change: how vulnerable are people in dryland areas? *Mitigation and Adaptation Strategies for Global Change,* 5 (4): 379–406.

Meze-Hausken, E.; Patt, A. and Fritz, S. (2009) Reducing climate risk for micro-insurance providers in Africa: A case study of Ethiopia. *Global Environmental Change,* 19: 66–73.

MoA (Ministry of Agriculture) (1995) Land use systems and soil conditions of Ethiopia. Department of Land Use Study and Administration. Addis Ababa, Ethiopia.

MoA (Ministry of Agriculture) (2010) Animal and plant health regulatory directorate, Ethiopia. FAO (Food and Agricultural Organization of the United Nations), Addis Ababa,

MoARD (Ministry of Agriculture and Rural Development) (2007) Livestock Development Master Plan Study, Addis Ababa, Ethiopia.

MoARD (Ministry of Agriculture and Rural Development) (2010) Federal Democratic Republic of Ethiopia, Ethiopia's Agricultural Sector Policy and Investment Framework (PIF) 2010-2020, Ministry of Agriculture and Rural Development. Draft Final Report, Ethiopia, Addis Ababa.

MoFED (Ministry of Finance and Economic Development) (2002) Ethiopia: sustainable development and poverty reduction program, Federal Democratic Republic of Ethiopia (FDRE), July 2002, Addis Ababa, Ethiopia.

MoFED (Ministry of Finance and Economic Development) (2005) Ethiopia: Sustainable development and poverty reduction program (SDPRP), annual progress report (2003/04). Development Planning and Research Department (DPRD), Addis Ababa, Ethiopia.

MoFED (Ministry of Finance and Economic Development) (2006a) The Federal Democratic Republic of Ethiopia Growth and Transformation Plan (GTP) 2010/11-2014/15 Draft paper, September 2010, Addis Ababa, Ethiopia.

MoFED (Ministry of Finance and Economic Development) (2006b) Ethiopia: building on progress: A plan for accelerated and sustained development to end poverty (PASDEP) (2005/06-2009/10), Volume I: main text, September 2006, Addis Ababa, Ethiopia.

MoFED (Ministry of Finance and Economic Development) (2007) Ethiopia: Building on progress: a plan for Accelerated and Sustained Development to End Poverty (PASDEP), Annual Progress Report 2006/07, Addis Ababa, Ethiopia.

MoFED (Ministry of Finance and Economic Development) (2010) The Federal Democratic Republic of Ethiopia, Growth and Transformation Plan (GTP) 2010/11-2014/15, Addis Ababa.

MoFED (Ministry of Finance and Economic Development) (2012) Federal Democratic Republic of Ethiopia, Growth and Transformation Plan (2010/11-2014/15). Annual Progress Report for F.Y. 2010/11, March 2012, Addis Ababa, Ethiopia.

Mitchell, V. W. (1999) Consumer perceived risk: conceptualizations and models. *European Journal of Marketing*, 33: 163–195.

Moges, N. and Bogale, B. (2012) Assessment of major animal production and health Problems of livestock development in Lay-Armacheho District, Northwestern Ethiopia. *American-Eurasian Journal of Scientific Research*, 7 (3): 136–141.

Morduch, J. (1995) Income smoothing and consumption smoothing. *Journal of Economic perspective*, 9(3): 103–114

Moschini, G. and Hennessy, D. A., (2001) 'Uncertainty, risk aversion, and risk management for agricultural producers.' In: Gardner, B.L. and Rausser, G.C (eds.), *Handbook of Agricultural Economics*, Elsevier, Vol. 1, chapter 2, pages 88-153.

Mude, A.; Barrett, B.C; Carter, M.R; Chantarar, S.; Ikegami, M.; McPeak, J. (2010) Project Summary, Index Based Livestock Insurance for Northern Kenya's Arid and Semi-Arid Lands: The Marsabit Pilot, Kenya.

Narayanan, A.V.G and T. P. Saravanan. (2011) A study on customers' perception towards general insurance products (livestock and crop insurance) with special reference to erode rural, Tamilnadu, India. *European Journal of Social Sciences,* 25(2): 219–233.

NMA (National Meteorological Agency) (2007) The Federal Democratic Republic of Ethiopia, Ministry of Water Resources. Climate change national adaptation programme of action (NAPA) of Ethiopia, Addis Ababa, Ethiopia.

NMSA (National Meteorological Services Agency) (2001) Federal Democratic Republic of Ethiopia, Ministry of Water Resources. Initial National Communication of Ethiopia to the United Nations Framework Convention on Climate Change (UNFCCC), Ethiopia, Addis Ababa.

Negassa, A.; Rashid, S. and Gebremedhin, B. (2011) Livestock production and marketing. Development Strategy and Governance Division, International Food Policy Research Institute-Strategy Support Program II (ESSPII), Working Paper 26, Addis Ababa, Ethiopia.

Nelson, J.A. (2012) Are women really more risk-averse than men? Global Development and Environment Institute, Working Paper No. 12-05, Tufts University, Medford MA 02155, USA.

Njuki, J., J. Poole, N. Johnson, I. Baltenweck, P. Pali, Z. Lokman and S. Mburu. (2011) Gender, livestock and livelihood indicators. ILRI (International Livestock Research Institute).

Nmadu, J.N.; Eze, G.P. and Jirgi, A.J. (2012) Determinants of risk status of small scale farmers in Niger State, Nigeria. *British Journal of Economics, Management & Trade,* 2(2): 92–108.

O'Connor, D., Keane, M. and Barnes, E. (2008) 'Managing Price Risk in a Changing Policy Environment: The Case of the EU Dairy Industry.' In: Berg, E.; Huirne, R.; Majewski, E. and Meuwissen, M. (eds.), *Income Stabilization in a Changing Agricultural World: Policy and Tools*. Wies Jutra Limited, Warsaw, pp. 74-83.

Ogurtsov, V.A. (2008) Catastrophic risk and insurance in farm-level decision making. PhD Thesis, Wageningen University.

Ogurtsov, V.A.; van Asseldonk, M.A.P.M. and B.M. Huirne. (2008) Purchase of catastrophic insurance by Dutch dairy and arable farmers. *Review of Agricultural Economics,* 31(1): 143–162.

OECD (Organisation for Economic Co-operation and Development) (2009) Risk management in agriculture: a holistic conceptual framework, Working Party on Agricultural Policies and Markets. TAD (Trade and Agriculture Directorate)/Committee for Agriculture (CA) /Agricultural Policy and Markets (APM) /World Bank (WB).

Osgood, D. and Warren, D. (2007) Drought insurance in Malawi. In: M. Hellmuth, Moorhead, A. ; Thomson, M.C. and Williams, J. (Eds.), Climate risk management in Africa: learning from practice. International Research Institute for Climate and Society (IRI) Columbia University, New York, pp. 75–88.

Otieno, D.J.; Oluoch-Kosura, W.; Karugia, J.T.; Drucker, A. and Rege, E. (2006) Risk Management in Smallholder Cattle Farming: A Hypothetical Insurance Approach in Western Kenya. Contributed paper prepared for presentation at the 26th International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12–18, 2006.

Pan, L. (2008) Poverty, risk and insurance: Evidence from Ethiopia and Yemen. PhD thesis, VU University Amsterdam.

Patt, A., Suarez, P. and U. Hess. (2010) How do small-holder farmers understand insurance, and how much do they want it? Evidence from Africa. *Global Environmental Change,* 20: 153–161.

Paudel, K.P.; Lohr, L. and Martin, N.R. (2000) Effect of risk perspective on fertilizer choice by sharecroppers. *Agricultural Systems,* 66 (2): 115–128.

Pennings, J.M.E; Wansink, B. and Meulenberg, M.T.G. (2002) A note on modeling consumer reactions to a crisis: The case of the mad cow disease. *International Journal of Research in Marketing,* 19 (1): 91–100.

Pennings, P.; Keman, H. and Kleinnijenhuis, J. (2006) *Doing research in political science. An introduction to comparative methods and statistics*, 2nd ed. SAGE publication Ltd. London.

Platteau, J-P. (1997) Mutual insurance as an elusive concept in traditional rural communities. *Journal of Development Studies*, 33(6): 764–796.

Reynaud, A. and Couture, S. (2012) Stability of risk preference measures: results from a field experiment on French farmers. *Theory Dec*.73: 203-221 [online] http://link.springer.com/content/pdf/10.1007%2Fs11238-012-9296-5.pdf [accessed on June 17, 2013]

Roberts, R.A.J. (2007) *Livestock and aquaculture insurance in developing countries*. FAO Agricultural Services Bulletin 164, Food and Agriculture Organization of the United Nations, Rome, Italy.

Roncoli, C.; Ingram, K. and Kirshen, P. (2001) The costs and risks of coping with drought: livelihood impacts and farmers' responses in Burkina Faso. *Climate Research*, 19:119–132.

Roth, J. and McCord, M.J. (2008) *Agricultural Micro insurance global practices and prospects*, 1st ed., The microinsurance center, LLC, Appleton, USA.

Sakurai, T. and Reardon, T. (1997) Potential demand for drought insurance in Burkina Faso and its determinants. *American Journal of Agricultural Economics*, 79(4): 1193–1207.

Sena, L. and Weldemichael, K. (2006) Disaster prevention and preparedness. Jimma University in collaboration with the Ethiopia Public Health Training Initiative (EPHI), The Carter Center, the Ethiopia Ministry of Health, and the Ethiopia Ministry of Education. Funded under USAID Cooperative Agreement No. 663-A-00-00-0358-00.

Singh, V. (2004) Crop insurance in India: a brief review. *Journal of the Indian Society of Agricultural Statistics*, 57 (Special Volume): 217–225.

Slegers, M.F.W. (2008) If only it would rain: farmers perceptions of rainfall and drought in semi-arid central Tanzania. *Journal of Arid Environment*, 72: 2106–2123.

Smidts, A. (1990) Decision making under risk: a study of models and measurement procedures with special reference to the farmer's marketing behavior. PhD Thesis, Wageningen University.

Smith, V.H., and Baquet, A.E. (1996) The demand for multiple peril crop insurance: evidence from Montana wheat farms. *American Journal of Agricultural Economics*, 78:189–201.

Smith, V.H. and Glauber, J.W. (2012) Agricultural insurance in developed countries: where have we been and where are we going? *Applied Economic Perspectives and Policy*, 34(3): 363–390.

Tachiiri, K.; Shinoda, M.; Klinkenberg, B. and Morinaga, Y. (2008) Assessing Mongolian snow disaster risk using livestock and satellite data. *Journal of Arid Environments*, 72: 2251–2263.

Tadesse, T. (2012) The contribution of town functions to the development of rural areas: empirical analysis for Ethiopia. PhD Thesis, Wageningen University.

Tarawali, S.; Herrero, M.; Descheemaeker, K.; Grings, E. and Blümmel, M. (2011) Pathways for sustainable development of mixed crop livestock systems: taking a livestock and pro-poor approach. *Livestock Science*, 139:11–21.

Teffere, B. (2003) 'Efforts for Sustainable Land Management in Tigray: The role of extension.', In: Gebremedhin, B., Pender, J.; Ehui, S. and Haile, M. (eds.), *Policies For Sustainable Land Management in the Highlands of Tigray, Northern Ethiopia.* Summary of Papers and Proceedings of a Workshop, EPTD Workshop Summary Paper No: 14, Axum Hotel, Mekelle, Ethiopia, pp. 3–5.

Tesfamariam, K. (2012) Determinants of saving behaviour of cooperative members survey evidence from Tigrai region, Ethiopia. *Journal of Research in Economics and International Finance*, 1(5):150–158.

Tesfay, H. (2011) Rural land dispute settlement mechanisms in Tigray: the case of Humera. School of law, Master of Laws (LLM), Addis Ababa University, Ethiopia.

Tesfay, Y. (2010) Feed resources availability in Tigray Region, Northern Ethiopia, for production of export quality meat and livestock. Ethiopia Sanitary and Phytosanitary Standards and Livestock and Meat Marketing Program (SPS-LMM) Texas A&M University System, United States Agency for International development (USAID), Mekelle University, Ethiopia.

Teweldemedhin, M.Y and Kafidii, L. (2009) Risk management strategies of cattle farmers in Namibia: case study from Omaheke and Otjozondjupa regions. *Journal of Agricultural Extension and Rural Development*, 1(2): 63–70.

Tilahun, H., and E. Schmidt. (2012) Spatial analysis of livestock production patterns in Ethiopia. Development Strategy and Governance Division, International Food Policy Research Institute (IFPRI) – Ethiopia Strategy Support Program II (ESSP II), Working Paper 44, IFPRI, Addis Ababa, Ethiopia.

Tolera, A. (2007) Feed resources for producing export quality meat and livestock in Ethiopia. Examples from selected woredas in Oromia and SNNP regional State. Ethiopia standards and livestock and meat marketing program sanitary and phytosanitary (SPS-LMM). Texas agricultural experiment station (TAES)/Texas A and M University system, Hawassa University, Addis Ababa, Ethiopia.

Torress-Reyna, O. (2007) Getting started in data analysis using STATA 10. STATA tutorial topic, 1st draft. Linear regression (Ver. 6), Princeton University, USA.

Townsend, R.M. (1994) Risk and insurance in village India. *Econometrica*, 62(3): 539–591.

Townsend, R.M. (1995) Consumption insurance: an evaluation of risk-bearing systems in low income economies. *Journal of Economic Perspectives*, 9 (3):83–102.

UNDP (United Nations Development Programme) (*2005) Human Development Report 2005: International Cooperation at a Crossroad. Aid, trade and security in an unequal world (Human Development Report)*, UNDP, New York, USA.

UNDP (United Nations Development Programme) (2012) Promoting ICT based agricultural knowledge management to increase production and productivity of smallholder farmers in Ethiopia. Development Brief, UNDP Ethiopia.

UNECA (United Nations Economic Commission for Africa) (1997) Livestock development in Tigray: forage development strategy as a major entry point towards a sustainable minimum grazing system, Part I. Sustainable Development and Environmental Rehabilitation Program (SAERP), UNECA, Addis Ababa, Ethiopia.

Valdivia, C.; Dunn, E.G. and Jetté, C. (1996) Diversification as a risk management strategy in an Andean agro-pastoral community. *American Journal of Agricultural Economics,*78 (5): 1329–1334.

Valvekar , M.; Chavas, J.P.; Gould, B.W. and Cabrera., V.E. (2011) Revenue risk management, risk aversion and the use of Livestock Gross Margin for Dairy Cattle insurance. *Agricultural Systems.* 104 (9): 671–678**.**

Van der Veen, A. and Gebrehiwot, T. (2011) Effect of policy interventions on food security in Tigray, Northern Ethiopia. *Ecology and Society,* 16(1):18. [online] URL: http://www.ecologyandsociety.org/vol16/iss1/art18/ [accessed on June 13, 2013]

Vandeveer, M.L. (2001) Demand for area crop insurance among litchi producers in northern Vietnam .*Agricultural Economics,* 26: 173–184.

Verbeek, M. (2008) *A Guide to Modern Econometrics,* 3rd edition. John Wiley and Sons, Ltd., Chichester, UK.

Vigh, M. (2008) Risk coping in rural Ethiopia: the liquidity and productivity of Livestock, Tinbergen Institute, Netherlands.

Wenner, M. (2005) Agricultural insurance revisited: new developments and perspectives in Latin America and the Caribbean. Working Paper with Reference No. RUR-05-02. Inter-American Development Bank, Washington, DC, USA.

White, H. (1980) A hetroskedasticity-consistent covariance matrix estimator and a direct test for hetroskedasticity. *Economerica*, 48(4): 817–838.

White, P.; Pelling, M.; Sen, K.; Seddon, D.; Russels, S. and Few, R. (2005) Disaster risk reduction: a development concern. A scoping study on links between disaster risk reduction, poverty and development. Department for International Development (FfID), London, UK.

Wik, M., and Holden, S. (1998) Experimental studies of peasant's attitudes toward risk in Northern Zambia. Discussion Paper No. 14/1998, Department of Economics and Social Science, Agricultural University of Norway, Norway.

Wilson, P.N.; Luginsland, T.R. and Armstrong, D.V. (1988) Risk perceptions and management responses of Arizona dairy producers. *Journal of Dairy Science*, 71(2): 545–551.

Wilson, P.N.; Dahlgran, R.G. and Conklin, N.C. (1993) Perceptions as reality on large-scale dairy farms. *Review of Agricultural Economics*, 15(1): 89–101.

Woldehanna, T. (2000) Economic analysis and policy implications of farm and off-farm employment: a case study in the Tigray region of northern Ethiopia. PhD Thesis, Wageningen University.

Woldehanna, T. (2004) The experiences of measuring and monitoring poverty in Ethiopia, for the inaugural meeting of the Poverty Analysis and Data Initiative (PADI) held on may 6-8 2004 in Mombassa, kenya. Addis Ababa, Ethiopia.

WBISPP (Woody Biomass Inventory and Strategic Planning Project) (2004) A report on the natural grazing lands and livestock feed resources. Tigray Regional State, Final Report, Ethiopia.

Wooldride, J.M. (2002) *Econometric analysis of cross section and panel data*. Massachusetts Institute of Technology, USA.

World Bank. (2005) Managing agricultural production risk: innovations in developing countries. Agriculture and Rural Development Department, Report No. 32727-GLB. The World Bank, 1818 H Street, New York, USA.

WDR (World Development Report) (2008) Agriculture for development. The World Bank, Washington, DC, USA.

WFP (World Food Programme) and Oxfam (2012) R4 Rural resilience initiative. Quarterly Report, January-March2012.

www.google.ie/search?q=tigray+region+map&rlz=1C1CHMO_enIE499IE499&es_sm

Wynes, J. (2013) Explaining travel distance during same-day visits. *Tourism Management*, 36: 133–140.

Xiu, F., Xiu, F. and Bauer, S. (2012) Farmers' willingness to pay for cow insurance in Shaanxi Province, China. *Procedia Economics and Finance,* 1: 431–440.

Yakob, A. (2011) Lifting Livelihoods with Livestock: A review of REST's livestock value addition practices in Raya Azebo, Ethiopia and potentials for diversification. Feinstein International Center, Tufts University, USA.

Yesuf, M. and Bluffstone, R. (2007) Risk aversion in low-income countries: experimental evidence from Ethiopia. IFPRI Discussion Paper 00715. International Food Policy research institute, Washington DC. Ethiopian Development Research Institute, Addis Ababa University, Ethiopia.

Yesuf, M. and Bluffstone, R. (2009) Poverty, aversion, and path dependence in low-income countries: Experimental evidence from Ethiopia. *American Journal of Agricultural Economics,* 91(4): 1022–1037.

Zerai, B. and Gebreegziabher, Z. (2011) Effect of Nonfarm Income on Household Food Security in Eastern Tigrai, Ethiopia: An Entitlement Approach. *Food Science and Quality Management* [online] http//:www.iiste.org [accessed on April 10, 2013].

Appendix 1: KMO and communalities

1.1 KMO and communalities of risk sources

Items of risk sources	KMO for likelihood	Communalities for likelihood	KMO for severity	Communalities for severity
High price of forage	0.64	0.72	0.51	0.74
Small farm income	0.72	0.50	0.71	0.73
Shortage of family labour	0.61	0.73	0.56	0.81
Livestock price variability	0.70	0.54	0.68	0.62
Cash shortage	0.63	0.72	0.82	0.73
Lack of saving	0.64	0.68	0.73	0.77
Forage shortage	0.68	0.56	0.56	0.68
Shortage of herders	0.71	0.76	0.64	0.79
Non- epidemic livestock diseases	0.80	0.61	0.80	0.81
Epidemic livestock diseases	0.74	0.75	0.86	0.74
Cattle death	0.76	0.68	0.74	0.87
Property rights conflict (water, land)	0.78	0.53	n.i	n.i
Inadequate government support	0.82	0.56	n.i	n.i
Cattle accident	0.79	0.60	n.i	n.i
Lack of road and communication	0.77	0.69	n.i	n.i
Overall	72.5	-	71.9	-

1.2 KMO and communalities of risk management

Items of risk management strategies	KMO	Communalities
Use of veterinary services	0.85	0.78
Own crop-livestock	0.87	0.53
Control parasites	0.81	0.80
Prevent disease	0.81	0.86
Borrow from formal institution	0.75	0.90
Separate cattle home	0.89	0.58
Stalk	0.76	0.62
Loan allocation	0.75	0.93
Clean cattle shelter	0.83	0.57
Minimize debt	0.81	0.90
Join association	0.55	0.71
Spatial diversification	0.80	0.53
Buy enough hay	0.77	0.51
Lease land (in or out)	0.57	0.59
Rotational grazing	0.72	0.69
Food or cash for work	0.52	0.88
Enterprise diversification	0.65	0.61
Productive safety net program (PSNP)	0.52	0.78
Credit and saving cooperative	0.80	0.59
Overall	76.7	-

Appendix 2: Questionnaire of the main household survey

'Risk Perception and management in Livestock Farming'

INTRODUCTION TO THE RESPONDENT:

Throughout this survey, you will be asked questions about perceptions on the existing risk and risk management in livestock farming. The interview will take a few minutes and the answer will be completely confidential and strictly for academic purpose only.

1: HOUSEHOLD/RESPONDENT CHARACTERISTICS

1.1 Name of interviewer:	1.2 Name of respondent:	1.3 Are you head of household? 1. Yes 0. No
1.4 Gender (head): 1. Male 0. Female	1.5 Age of Head:	1.6 Family size:
1.7 Place of interview (woreda):	1.8 Tabia:	1.9 kushet:
1.10 Date of interview	1.11 Code:	

1.12 What is the household head's marital status ?
1. Single
2. Married
3. Widowed
4. Separated
5. Divorced

1.13 Education level of head
1. Illiterate
2. Informal literate (Church and Kuran)
3. Formal literate

1.14 If formal literate 1.13, which category?
1. Primary school (1-8)
2. Secondary school (9-12)
3. New technical college (10+2)
4. Old technical college (10+3)
5. Diploma (12 +2)
6. Degree and above

1.15 If formal literate 1.13, what is his/her grade? _____ (grade).

1.16 What is the total number of family members whose age is less than 15 years? _____

1.17 What is the total number of family members whose age is greater than 64 years?_____

2: VILLAGE CHARACTERISTICS, CULTIVATED AND GRAZING LAND

2.1 Agro-ecology
1. Highland
2. Intermediate highland
3. Lowland
4. Others (specify)_____

2.2 Predominant vegetation type (if more than one, rank the major that apply).
1. Bush
2. Grass
3. Wood
4. Forest
5. Others (specify)_____

2.3 What is/are the feeding practice for your cattle?
1. Zero grazing
2. Free grazing
3. Partly enclosure and partly free grazing
4. Rotational grazing
5. Others (specify)_____

2.4 What are the major crops you grow in normal season? (Rank the major that apply).
1. Sorghum
2. Wheat
3. Barely
4. Maize
5. Teff
6. Pulses
7. Others (specify)_____

2.5 How many plots of cultivated land your family own?_____ (number).

2.6 What is the total cultivated land holding of the family? _____(timad).

2.7 What are the main feeds for your cattle during dry season? (If more than one, rank the major).
1. Straw
2. Crop residue (aftermath)
3. Cactus
4. Stalk
5. Hey
6. Others (specify) _____

2.8 What are the main feeds for your cattle during wet season? (If more than one, rank the major).
1. Green fodder
2. Crop residue
3. Straw
4. Stalk
5. Hey
6. Others (specify)____

2.9 Do you have access for communal grazing land in the tabia?
1. Yes 0. No

2.10 Is grazing land during rainy season adequate in the village?

1. Yes 0. No

2.11 If no 2.10, what is the major reason for the inadequacy of grazing land during the rainy season?

1. Extensive cultivation
2. Area closure
3. Too many cattle
4. Others (specify)_____

2.12 Is grazing land during dry season adequate in the village?

1. Yes 0. No

2.13 If no 2.12, what is the major reason for the inadequacy of grazing land during the dry season?

1. Extensive cultivation
2. Area closure
3. Too many cattle
4. Small size of grazing land
5. Others (specify)_____

2.14 How do you alleviate the problem of shortage of grazing land? (If more than one, rank the major)

1. Buying forage
2. Farm weed
3. Cactus
4. Cut and carry
5. De-stocking
6. Others (specify)___

3. HOUSEHOLD'S RISK AND CONSTRAINTS

3.1 How frequently have you experienced drought conditions during the last 10 years ?

1. Every year
2. Every other year
3. Once every three years
4. Twice during the ten years
5. Once during the last ten years
6. Others (specify)_____

3.2 Is the frequency of drought during the last 10 years greater or less than what you experienced before then?

1. Drought has become more frequent
2. Drought has become less frequent
3. Frequency of drought is about the same
4. Others (specify)_____

3.3 By local standards, do you consider your household to be:

1. Rich
2. Medium
3. Poor
4. Extremely poor
5. Others (specify)_____

3.4 How likely are you to face drought with in the next five years?

1. Not at all likely
2. Unlikely
3. Less likely
4. More likely
5. Most likely

3.5 How likely are you to face livestock disease in the next five years?

1. Not at all likely
2. Unlikely
3. Less likely
4. More likely
5. Most likely

4: LIVESTOCK FACILITIES

4.1 What is your main source of water for livestock drinking ?

1. On-site well
2. Stream
3. River
4. Dam
5. Others (specify)_____

4.2 Do you think there is enough water in your area for livestock drinking in dry season?

1. Yes 0. No

4.3 If no 4.2, what is the main reason for shortage of water for livestock drinking?

1. Drought
2. High turbidity of dam water or river
3. Large livestock population in the area
4. Others (specify)_____

4.4 Do you have access for livestock vaccination?

1. Yes 0. No

4.5 In your livestock farming, what are the main problems? (Rank the major three).

1. Shortage of feeding/grazing land
2. Livestock diseases
3. Livestock drinking water
4. Poor productivity (infertility, low milk , low revenue from sale).
5. Poor/inadequate shelter
6. Others (specify)_____

4.6 Did you participate in any Livestock Extension Program?

1. Yes 0. No

4.7 If yes to 4.6, what was the type of the package you involved? (Circle all apply)

1. Dairy development package
2. Fattening development package
3. Poultry development package
4. Honey and wax development package
5. Others (specify)_____

5: MARKET CONDITION

5.1 Did you sell cattle in the last three year?

1. Yes 0. No

5.2 If yes 5.1, where are your cattle sold?_____ (place).

5.3 In which season you sold livestock?

1. Dry season
2. Wet season
3. Dry and wet season
4. Others (specify)_____

5.4 What were the main reasons for selling livestock? (Rank the major that apply).

1. Personal needs (food, cloth, medical and other expenses)
2. To repay loans
3. Buying input (fodder, veterinary drugs, fertilizer, seed)
4. Ceremonial expenses (Wedding, funeral, festival etc)
5. Others (specify)_____

5.5 What are the main problems about livestock marketing? (Rank the major that apply).

1. Roads
2. Poor animal condition in dry season
3. Inadequate livestock markets place
4. Livestock marketing information
5. Others (Specify)_____

6: PERCEPTION ON RISK SOURCES

Assess the following statement: "The relevance of different risk sources". Tick the first box if the sources of risk are "Not Applicable" (NA) or "Not in Place" (NP) . Following this, please tick the successive box across of each line while rating the likelihood of occurrence and consequences (severity) of risk sources.

Likelihood of occurrence (frequency) and the severity (consequences) is given: 1=very low 2= low 3= medium 4= high 5= very high						
Risk sources (Rating its relevance)	NA/NP	1	2	3	4	5
6.1 Production risk						
6.1.1 Forage shortage (likelihood)						
6.1.2 >> >> (severity)						
6.1.3 Epidemic animal disease (likelihood)						
6.1.4 >> >> (severity)						
6.1.5 Milk yield variability (likelihood)						

6.1.6 >> >> (severity)						
6.1.7 Death for cattle (likelihood)						
6.1.8 >> >> (severity)						
6.1.9 Accident damage for cattle (likelihood)						
6.1.10 >> >> (severity)						
6. 1.11 Drought/rain failure (likelihood)						
6.1.12 >> >> (severity)						
6.1.13 Shortage of cattle drinking water (likelihood)						
6.1.14 >> >> (severity)						
6.1.15 Non-epidemic animal disease (likelihood)						
6.1.16 >> >> (severity)						
6.2 Market risk						
6.2.1 Milk price variability (likelihood)						
6.2.2 >> >> (severity)						
6.2.3 Butter price variability (likelihood)						
6.2.4 >> >> (severity)						
6.2.5 Livestock price variability (likelihood)						
6.2.6 >> >> (severity)						
6.2.7 Inadequate livestock market (likelihood)						
6.2.8 >> >> (severity)						
6.2.9 Poor market information on livestock (likelihood)						
6.2.10 >> >> (severity)						
6.2.11 High price of forage (likelihood)						
6.2.12 >> >> (severity)						
6.3 Financial risk						
6.3.1 Change in interest rate (likelihood)						
6.3.2 >> >> (severity)						
6.3.3 Shortage of cash on hand (likelihood)						
6.3.4 >> >> (severity)						
6.3.5 Lack of credit access (likelihood)						
6.3.6 >> >> (severity)						
6.3.7 small farm income (likelihood)						
6.3.8 >> >> (severity)						
6.3.9 Lack of saving money (likelihood)						
6.3.10 >> >> (severity)						
6.4 Human risk						
6.4.1 Death of family members (likelihood)						
6.4.2 >> >> (severity)						
6.4.3 Injury/ illness of family members (likelihood)						
6.4.4 >> >> (severity)						
6.4.5 Conflict among members of household (likelihood)						
6.4.6 >> >> (severity)						
6.4.7 Shortage of family labour (likelihood)						
6.4.8 >> >> (severity)						
6.4.9 Shortage of labour for herders (likelihood)						
6.4.10 >> >> (severity)						
6.5 Technological risk						
6.5.1 Ineffective Artificial Insemination (AI) (likelihood)						
6.5.2 >> >> (severity)						

6.5.3 Shortage of AI (likelihood)						
6.5.4 >> >> (severity)						
6.5.5 Ineffective cross/exotic cattle breed (likelihood)						
6.5.6 >> >> (severity)						
6.5.7 Ineffective local breed cattle (likelihood)						
6.5.8 >> >> (severity)						
6.5.9 Problem related to vaccination (likelihood)						
6.5.10 >> >> (severity)						
6.6 Institutional risk						
6.6.1 Loss of farm/grazing land due to divorce (likelihood)						
6.6.2 >> >> (severity)						
6.6.1 Loss of farm/grazing land due to death of spouse (likelihood)						
6.6.4 >> >> (severity)						
6.6.5 Land tenure insecurity (likelihood)						
6.6.6 >> >> (severity)						
6.6.7 Inadequate of government support (likelihood)						
6.6.8 >> >> (severity)						
6.6.9 Lack of roads/communication (likelihood)						
6.6.10 >> >> (severity)						
6.6.11 Lack for veterinary service (likelihood)						
6.6.12 >> >> (severity)						
6.6.13 Landlessness of family members (likelihood)						
6.6.14 >> >> (severity)						
6.6.15 Property rights conflict (land/forest/water) (likelihood)						
6.6.16 >> >> (severity)						

6.7 Point out in ranked order from question 6, the three sources of risk you fear most in terms of frequency and severity. Put in number from Question 6?

6.7.1 The most frequent sources of risk: 6.7.1.1_____6.7.1.2 _____6.7.1.3 _____

6.7.2 The most severe sources of risk: 6.7.2.1_____6.7.2.2 _____6.7.2.3 _____

7: RISK ATTITUDE

Assess the following statement: "I/we are willing to take more risk than others with respect to the following"

Items 1= fully disagree 2=disagree 3= neutral 4= agree 5= fully agree					
	1	2	3	4	5
7.1 Production risk (Namely: putting maximum effort to prevent cattle morbidity and mortality)					
7.2 Marketing risk (Namely: buying enough fodder at any price in expecting future feed shortage).					
7.3 Finance and investment risk (Namely: taking credit at any rate of interest and invest on-farm or off-farm or non-farm)					
7.4 Technology risk (Namely: Making utmost effort for having modern/improved cattle breed)					
7.5 Institutional risk					

8: CHOOSE ANY ONE OF THE FOLLOWING PAY OFF UNDER VARIOUS ARRANGEMENTS

Choice	**Head**	**Tail**
	High pay off (in Birr)	**Low pay off (in Birr)**
O	50	50
A	45	90
B	40	120
C	30	150
D	10	190
E	0	200

9: PERCEPTION ON RISK MANAGEMENT STRATEGIES

Risk may be managed in a number of ways. Point out your perception on the major/relevant risk management strategies below. For each strategy, tick in the first column if "Not Applicable" (NA) or "Not in Place" (NP) . Then *tick one across of each line according to your perception.*

1=least relevant 2= less relevant 3= moderately relevant 4= more relevant 5= most relevant						
Risk management strategies (Rating the relevant)	**NA/ NP**	1	2	3	4	5
9.1 Financial management						
9.1.1 Loan allocation in productive activity						
9.1.2 Put cash in cooperative or bank in saving account						
9.1.3 Minimize debt (efficient loan repayment)						
9.1.4 Producing at lowest cost						
9.1.5 Borrowing from formal institutions (like DECSI)						
9.1.6 Borrowing from informal source (relative, friends, money lender)						
9.1.7 Join credit and saving cooperative group						
9.1.8 Reduce consumption expenditure						
9.1.9 Use community saving pool (Iddir, Equb)						
9.2 Diversification						
9.2.1 Off-farm or non farm investment						
9.2.2 Enterprise diversification						
9.2.3 Spatial diversification						
9.2.4 Off-farm or non farm wage work of any members						
9.2.5 Own a variety of cattle breed (local, cross etc)						
9.2.6 Own crop and livestock						
9.2.7 Own a variety of livestock (cattle, shoots etc)						
9.3 Sale/transfer asset						
9.3.1 Cattle contract (keep cattle to share the produce)						
9.3.2 Selling livestock						
9.3.3 Selling productive assets (like Farm tools)						
9.3.4 Selling personal asset (like gold, jewellery)						
9.3.5 Lease in or lease out cultivated land						
9.3.6 Cattle offered to families or relatives						
9.3.7 Migration to better grazing land						
9.4 Disease prevention						
9.4.1 Washing hand before milking						
9.4.2 Washing udder before milking						
9.4.3 Cleaning cattle shelter at least every week						
9.4.4 Prevention of livestock disease						
9.4.5 Control cattle parasites (internal& external)						
9.4.6 Use of veterinary service						
9.4.7 Use of traditional medication service						
9.4.8 Use of isolated cattle home from others						
9.5 Cooperatives						
9.5.1 Join cooperative marketing						
9.5.2 Use of telephone or mobile phone						
9.5.3 Use of broker						
9.5.4 Network relation (DAs, families and neighbours)						

9.5.5 Join association (farmers, women, youth)						
9.6 Relief/assistance						
9.6.1 Work for productive safety net programme						
9.6.2 Food/cash for work in soil and water conservation						
9.6.3 Emergency food aid (GOs and NGOs)						
9.6.4 Food assistance from relatives of better areas						
9.6.5 Remittance from families						
9.7 Feed management						
9.7.1 Hay making						
9.7.2 Heap Straw						
9.7.3 Piling of stalk (from maize and sorghum)						
9.7.4 Rotational grazing						
9.7.5 Cut and carry						
9.7.6 Feed planting (Luccinia, Sasbania, Alfa-Alfa)						
9.7.7 Growing cactus for feeding in dry season						
9.7.8 Buying enough hay/straw in expecting bad season						
9.8 Community asset building						
9.8.1 Building/improving roads						
9.8.2 Building irrigation canal						
9.8.3 Construct dam /dug well for livestock drinking						
9.8.4 Construct trough (for livestock drinking)						
9.8.5 Soil and water conservation						

9.9 Point out in ranked order from 9 above, the three most relevant risk management strategies . Put in number from 9? 9.9.1_____9.9.2. _____9.9.3. _____

10: CATTLE INSURANCE POLICY (adopted from Nyala Insurance S.C)

i) Coverage

The company will (subject to the conditions contained herein) indemnify the insured against loss in the event of the covered livestock be lost or destructed during the period of insurance by death or emergency slaughter on medical grounds as a result of the following: *accident, illness and disease (including epidemic diseases), smoke, fire, lighting, Windstorm.*

With respect to loss by slaughter it is a condition precedent to liability that a qualified veterinary surgeon, appointed by the insure, shall first have given a certificate that the suffering of the animal is incurable and therefore immediate destruction is imperative. Besides, insurance covers accidents of road transit of animals for a day when moving among home and market place.

Cattle covered

Insured cattle include heifer, cow, bulls and ox whose age is between 2-8 years. Based on the purpose of rearing cattle insurance can include like draught, breeding, dairy, fattening and others.

Waiting period

In the event of disease the insurance takes effect from the 31st day after inception of the policy so as to avoid pre-existing diseases or impairments. The same waiting period also applies to any changes /increases in the sum insured per animal (from the date of the change) and to animals newly included in the insurance covers (from the date purchase).

ii) Indemnification

a) Premium rate and deductibles

Insurance scheme is explained to farmers in the survey through brief scenarios as follows. The cattle insurance scheme would compensate farmers the value of their animals after verifying that the cause of their animals' death is justified in accordance to the insurance policy. Insurance can include individual farmers, commercial farms, a group of farmers and cooperatives, credit and saving associations. Insurance is covered individual animal or herd. The insurance policy would sell membership certificate per animal with a premium rate of 4% per year for smallholder farmers (individual farmers, saving and credit cooperatives). The insurance policy is premium with deductibles of 5% and 1.5% of the total sum insured for loses from epidemic and non-epidemic diseases, respectively. In addition to this, the deductible for a loss resulting from accident, fire, lighting or windstorm is 10% of the total sum insured. The animal insurance certificate is used for one year and it can be renewed up to the age limit of the animals. No premium refund is allowed if claim arises in the earlier years.

The premium will be paid by an individual farmer or it can be collected by farmers' representatives or institutions. Farmers' organization /institutions can pay it in advance and then collect from individual farmers through possible means. The premium will be paid first following the agreement between inured and insurer. Farmers who have cattle insurance certificate can approach credit institution for more credit using the certificate given to them by the insurance as collateral.

If the animal is sold within the insurance period, the unexpired premium will be paid to the insured or the insured can substitute another animal on the bases of plus/minus methods. Furthermore, if the insured animal is sold in the near/the same place, insurance can be transferred from seller to buyer depending on their agreement.

b) Exclusions

This policy does not cover any loss or damage directly or indirectly caused by or arising from or inconsequence of or contributed by:

1. Any disease proved to have started before or during the waiting period.
2. Slaughter which is not ordered by the veterinary surgeon or due to a lack of veterinary care.
3. Defective feed or feed additive.
4. Hereditary defects and diseases.
5. Abortion, calcified fetuses, mummified fetuses and dead fetuses
6. Transport by sea and air.
7. All claims received without ear tag.
8. Loss or damage from war, rebellion, riot.
9. Willful injury or neglect

iii) Duties of insured

The compliance with the following requirements is a condition precedent to any liability of the company.

a) Good management practices

- At the commencement of this insurance, all cattle must be free from diseases.
- The insured shall practice due diligence in the husbandry, provide proper care and comply with all local legal requirements for the livestock insured under this policy so as to minimize, diminish or avoid any loss or damage.
- The required and recommended vaccination programs have to be followed.
- All animals have to be clearly identifiable with an ear tag or by similar means when entering the insurance.

b) In case of event

1. If an insured animal falls ill or has an accident, the insured shall immediately at his own expense employ qualified veterinary surgeon and carry out treatment or accept advice given.
2. In case of death or if slaughter is advised on medical grounds, the insured shall immediately at his own expense arrange for a post-mortem by a qualified veterinary and/or representatives from elders, cooperatives and associations.

3. In case of the event mentioned above, the company must be informed with in 24 hours and the veterinary certificate and /or the record of slaughter must be submitted within 72 hours to the company.

iv) Duties of insurer (company)

The company settles the claim when occurred and perform the pay off arrangement with in one month period.

BASED ON THE ABOVE INFORMATION, ANSWER THE FOLLOWING

10.1 Would you want to purchase cattle insurance certificate if it is offered to you?

1. Yes 0. No

10.2 If yes 10.1, let the value of one of the insured cattle is Birr 2000. Are you interested to buy the ticket at a rate of 4 % premium (Birr 80) per cattle per year?

1. Yes 0. No

10.3 How much maximum would you be willing to pay per animal per year for loss-reducing insurance scheme? _____Birr?

10.4 How do you pay the insurance premium?

1. Personal saving
2. Credit from informal source (friends/relatives/money lenders)
3. Credit from informal institution (Equb, Iddir, mahber)
4. Credit from formal institution (DECSI/Commercial Bank)
5. Selling crop/livestock
6. Others (specify)_____

10.5 What benefits would you expect from buying cattle insurance?

1. Feel more secure
2. For credit access
3. Getting cash during cattle loss
4. Others (specify)_____

10.6 What features would make cattle insurance attractive to you?

1. Minimize disaster

2. Earning stable income
3. Recover from shock
4. Credit access
5. Others (specify)_____

10.7 What features would not make cattle insurance attractive to you?

1. Cost of premium
2. Bureaucracy during pay off
3. Practicing good management practice
4. Others (specify)_____

10.8 For which type of cattle you are most interested to insure (Rank the major that all apply)?

1. Oxen
2. Cows
3. Bull
4. Heifer

10.9 If no, 10.1, what is your reason?

1. I can not afford the premium
2. Currently I do not have cattle whose age mentioned
3. I do not trust any insurance company
4. I do not understand insurance
5. Others (specify)_____

10.10 FILL THE FOLLOWING CATTLE INSURANCE

Cattle type	Number (a)	Cattle (age less than2) (Number) (b)	Cattle (age greater than 8) (Number) (c)	Cattle (age 2 - 8) (Number) (d)	Interest to insure cattle (age 2-8) yes=1; No=0 (e)	Cattle you are interested to insure (Number) (f)
10.10.1 Calf						
10.10.2 Heifer						
10.10.3 Cow						
10.10.4 Bull						
10.10.5 Ox						

11: LIVESTOCK LOSS IN THE LAST THREE YEAR (IF ANY)

Livestock	Current owned at farm (No) **(a)**	Death due to disease (No) **(b)**	Death due to accident (No) **(c)**	Lose due to others (No) **(d)**
11.1 Cow				
11.2 Heifer				
11.3 Ox				
11.4 Bull				
11.5 Calf				
11.6 Donkey				
11.7 Mule				
11.8 Horse				
11.9 Camel				
11.10 Poultry				

12: ACCESS FOR SOCIAL SERVICES OR INSTITUTIONS

12.1. How long is from homestead to reach to the nearest of the following (for single trip).

Social service	Distance (in km) **(a)**	Walking time (in minute) **(b)**
12.1.1 Supply of cattle drinking water wet season		
12.1.2 Supply of cattle drinking water dry season		
12.1.3 In search of pasture dry season		
12.1.4 In search of pasture wet season		
12.1.5 Livestock market		
12.1.6 Veterinary clinic		
12.1.7 All weather road (asphalt)		
12.1.8 All weather road (gravel)		

13: HOUSEHOLD MONTHLY EXPENDITURE (in Birr)

No	Item	Expenditure	Remark	No	Item	Expenditure	Remark
13.1	Food			13.11	Equb/Iddir		
13.2	Health			13.12	Fertilizer		
13.3	Education			13.13	Insecticide/pesticide		
13.4	Transport			13.14	Selected seed		
13.5	Telephone			13.15	Servant/labour		
13.6	Electricity/Fuel			13.16	Buying livestock		
13.7	Water (if any)			13.17	Others (specify)		
13.8	Veterinary service			13.18			
13.9	Clothes			13.19			
13.10	Fodder/hay			13.20			

14. HOUSEHOLDS' LIVELIHOOD ASSET

14.1 Human capital	**Number**
14.1.1 Livestock farming experience (in year)	
14.1.2 No of family labour involved in farming in the last one year	
14.1.3 No of non-family labour involved in farming in the last one year	
14.1.4 Number of household members whose education is secondary and above	
14.1.5 Number of household members whose age is between 15-64 years	
14.2 Physical capital	**Ownership: Yes=1; No=0**
14.2.1 Triddle pump	
14.2.2 Drip irrigation	
14.2.3 Horse/mule/ cart	
14.2.4 Wheel barrow	
14.2.5 Mobile phone/telephone	
14.2.6 Motor pump for irrigation	
14.3 Financial capital	**Amount (in Birr)**
14.3.1 Amount of saving for the family in the last one year	
14.3.2 Amount of credit the family receive in the last five years from DECSI/Bank	
14.3.3 Amount of credit the family receive in the last five year from informal sources (relatives, friends, neighbours, money lender and equb).	
14.3.4 Revenue from selling livestock in the past three years	
14.3.5 Annual farm income of family members from livestock productivity (milk, meat, hides, skins, butter, cheese, honey, egg.)	
14.3.6 Annual off-farm and non-farm income of family members	
14.3.7 Annual farm income from crops	
14.3.8 Annual farm income of family members from fruits, vegetables, pulses and spices	
14.3.9 Income from trees/fuel wood/charcoal/dung cakes/straw	
14.3.10 Remittance in the last one year (food for work, cash for work and gifts)	
14.3.11 Other family income (specify)	
14.4 Social capital (Network)	**Number**
14.4.1 Number of iddir in which you are a member	
14.4.2 Number of equb you are a member	
14.4.3 Number of mahber you as a member	
14.4.4 Number of visit to church/mosque per month	
14.4.5 Number of days you met DAs last year	
14.4.6 Number of days you visit market per month	
14.4.7 No of days your member of household meet women's association last year	
14.4.8 No of days your member of household meet youth association last year	
14.4.9 No of days your member of household meet farmer's association last year	

14.5: Social capital (Trust)

1=Fully disagree 2=Disagree 3= Neutral 4= Agree 5= Fully agree									
Rating social capital	1		2		3		4		5
14.5.1 Most people I know is trusted									
14.5.2 I believe that the government does what is right for the people									
14.5.3 I am confident of the ability of Tabia leaders to do their job									
14.5.4 I feel I can trust my neighbours to look after my house if I am Away									
14.5.5 I believe I have good relationship with DAs/ regulatory agencies									
14.5.6 I believe I have good relationship with other farmers in our Woreda									