COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ACCOUNTING AND FINANCE

PASTORALIST HOUSEHOLDS' WILLINGNESS TO PAY FOR INDEX-BASED LIVESTOCK INSURANCE IN BORANA ZONE: THE CASE OF MOYALE WOREDA

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MASTER THESIS SUBMITTED TO THE DEPARTMENT OF ACCOUTING & FINANCE, COLLEGE OF BUSINESS AND ECONOMICS IN PARTIAL FULFULMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ACCOUNTING AND FINANCE (M.Sc.)

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This is to certify that the master thesis prepared by **Ifa Deneke**, entitled: "**Pastoralist Households' Willingness To Pay For Index-Based Livestock Insurance in Borana Zone: The Case of Moyale Woreda**" is submitted in fulfillment of the requirements for the degree of Master of Master of Accounting and Finance (M.Sc.) complies with the regulation of the university and meets the accepted standards with respect to originality and quality.

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Declaration

I, IFA DENEKE, undersigned, and affirm that this thesis is my original work and has not been presented for a degree in any other university, and all sources of materials used for the thesis has been properly recognized.

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KELIFA SRMOLO (Ph.D.)

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Abstract

This study assessed the pastoralist household's willingness to pay for index-based livestock insurance. The study used mixed research design. Data were collected from both secondary and primary sources. A multi-stage sampling technique was used to collect data from a cross-sectional survey of 200 pastoralist households in Moyale woreda. Data was collected using desk reviews, Key Informant Interview (KIIs), Focus Group Discussions (FGDs) and household survey. This study employed the Contingent Valuation Method (CVM) to determine the willingness to pay for the purchase of index-based livestock insurances. Data were analyzed by various descriptive statistics such as frequency distribution tables, graphs, charts, mean and standard deviations. Further logistic regression model was used to determine the factors that influence pastoralist household's willingness to pay for IBLI. In addition, qualitative data were presented in a rephrased and verbatim form and were analyzed by content analysis and narratives of case studies.

The study found that livestock is the main source of livelihood for Borana pastoralists. Livestock keeping is important economic activity and has vital role in the livelihoods of the population as a source of food, draft power and much needed cash income. Largest proportion (92.41%) of respondents indicated that cattle is the dominant livestock species in the study area. The study revealed that among the problems that create multi-hazard situations in pastoral areas, drought is ranked first, and index-based livestock insurance is one of the mechanisms to reduce the impacts of drought. The study revieled that, largest majority (89 %) were aware of the existing livestock insurance policy. The study found that largest proportion (91.5%) of the respondents purchased livestock insurance for cattle, while the remaining 7 %, 1.5 % purchased the insurance for shoats and camels respectively. Further, the study also found that the maximum insurance purchase for cattle is 760, while the maximum purchase for shoats and camels is 250 and 500 respectively. The mean purchase for cattle is 299. 68, while it is 125 for camel, 98.33 for goats, and 68.75 for sheep. Concerning the payout received, the maximum payout received during the previous payout is 43,100 birr and the mean payout is 15,420 birr. Moreover, the study found that, about 76 percent of the households had a positive willing to pay for different categories of livestock. The study found that the households WTP is influenced by age of households, family size, sex of household head, IBLI training, drought shock and received payout. It is concluded that, given the exposure to the recurrent droughts' pastoralist households are more willing to pay for livestock insurance. Therefore, to increase the pastoral households' willingness to pay for index-based livestock insurance NGOs, local and national government should work on improving the socioeconomic status of the pastoralist households, provisions of the continuous training on the adverse impact of drought shock and role of insurance.

***Keywords**: Pastoralist, Drought, Livestock Insurance, Willingness to pay, Borana*

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Dedication

To my parent and family for their love, support andencouragement

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Acronyms

ARIDA: Agency for Rangeland Information and Development

ASALs: Arid and Semi-Arid Lands

CVM: Contingent Valuation Method

FGDs: Focus Group Discussions

IBLI: Index-Based Livestock Insurance

KIIs: Key Informant Interviews

NGOs: Non-Governmental Organizations

OCHA: Organization for Cooperation of Humanitarian Affairs

OIC: Oromia Insurance Company

TLU: Tropical Livestock Unit

WTP: Willingness To Pay

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1. Introduction

1.1. Background to the Study

Pastoralism is a complex interaction of people, natural resources, and livestock, primarily practiced globally in arid and semi-arid lands (ASALs) and hot sub-humid pockets (Gebremeskel et al., 2019). It is an economic activity, a land use system, and a way of life for people who derive most of their income or sustenance from keeping domestic livestock (Dika, 2021). Pastoralists make up about 14 percent of Ethiopia's population— approximately 110 million people—and inhabit about 60% of the country's landmass (Dika et al., 2022). Pastoralism, a complicated connection involving people, animals, and natural resources, is mostly carried out in hot, subhumid regions as well as arid and semi-arid lands (ASALs) worldwide (Zewdie et al., 2020). Livestock represent a large share of the household assets of pastoralists and are therefore key for sustaining rural livelihoods and human welfare.

Climate risks pose significant threats to sustained agricultural development in developing countries and livestock production is now considered a risky business (Aina et al., 2018). In the pastoralist context, livestock, which is the primary store of wealth and source of livelihood for pastoralists in the Horn of Africa's arid and semi-arid lands (ASAL), are extremely vulnerable to frequent droughts. Livestock losses can be particularly devastating because of the resultant poverty. Shocks can push prosperous households into chronic destitution (Jensen et al., 2015). Currently the ability of the livestock sector to accommodate and recover from the effects of a hazardous event in a timely and efficient manner is low (Aina et al., 2018). The need to reduce household's vulnerability to climate shock has encouraged the adoption of various techniques, including insurance (Aina et al., 2018). In much of the world, insurance is used to mitigate such shocks (Jensen et al., 2015). Insurance for livestock production is still relatively small in developing countries because formal insurance has remained underdeveloped and ineffective in most poor, rural areas. Problems such as high administrative costs, moral hazard, adverse selection, and a long delay in indemnity payment have discouraged reliance on this insurance option. As a result, low-income farming households are increasingly encouraged to consider other options for building resilience against covariate climate risks. Index-based insurance is a relatively new product that has only been implemented in developing countries within the last decade, particularly in East Africa (Aina et al., 2018).

Ethiopia is one of the most vulnerable countries to climate change (Debela et al., 2015). This is due not only to the country's vulnerability to droughts and floods, but also because the vast majority of Ethiopians (80-85 percent) rely on agriculture and pastoralism for a living. With each successive drought and flood, the impact grows — particularly on poverty, hunger, and livelihoods — as those far behind face even greater obstacles and struggle to catch up. Naturally occurring climate event is having unusual impacts though El Niño and La Niña's. In 2011, a strong La Niña resulted in the worst drought in 60 years in East Africa. In 2015, the country experienced two consecutive failed rainy seasons, resulting in the lowest recorded rainfalls in 55 years for some parts of the country. The El Niño phenomenon, which occurs every two to seven years, exacerbated the weather emergency (OCHA, 2022). The United Nations Office for the Coordination of Humanitarian Affairs labeled the 2015-16 El Niño one of the 3 strongest episodes on record, with lasting impact on 60 million people around the world. 9.7 million of those people were Ethiopians (Giovetti, 2022).

The literature agrees that small-scale pastoral households in low-income countries face critical environmental risks, and there is growing support for the use of index-based livestock insurance. However, the hype surrounding the potential of IBLI as an effective weather shock mitigator has been questioned (Aina et al., 2018). The Index-Based Livestock Insurance (IBLI) product takes advantage of the strong correlation between a remotely sensed vegetation index and livestock losses caused by forage shortages to provide insurance coverage to pastoralists in areas without access to traditional insurance products. The IBLI product was first launched in January 2010 and is now available in several areas of northern Kenya and the Borana region of southern Ethiopia (Jensen et al., 2015).

The performance of IBLI varies greatly across households and locations with different natures of exposures and risk characteristics (Aina et al., 2018). More strikingly, the impact of insurance on household welfare dynamics is shown to be significantly influenced by household herd size relative to the critical herd threshold, which was determined to be around 15-20 Tropical Livestock Unit (TLU) per household. The poorest (with herd sizes less than the critical threshold), who are already on their way to destitution, appear to benefit the least from the product. IBLI has been shown to be most valuable for those with larger herd sizes than the threshold but who are still at risk of falling below it, as it helps prevent collapses into poverty after a bad shock. This implies that that pastoralists with large herds are expected to be the key (Chantarat, Mude, & Barrett, 2009). Households' willingness to pay for insurance can also have

an impact on IBLI performance. Analyzing community awareness of livestock insurance policies and willingness to pay for insurance products is critical for understanding pastoral community's awareness of IBLI and to assess their level of willingness to pay for insurance.

1.2. Statement of the problem

Climate change is one of the major risks that expose rural communities, especially those whose livelihoods directly depend on livestock, to a variety of shocks (Sibiko, 2016). The recent prolonged drought experienced by almost all East African pastoralists is an unusual example of climate change. When weather shocks reduce household herds below the critical threshold, this could have irreversible long-term consequences for livestock production (A. G. Mude et al., 2012). In recent years, index-based livestock insurance (IBLI) has been deemed a viable and modern risk-management tool for pastoralists in developing countries such as Ethiopia. Index insurance has generated excitement as a tool to extend access to formal insurance into environments hostile to conventional insurance, such as the ASAL (Jensen et al., 2015).

IBLI seems to hold promising welfare benefits and reduced adverse consequences of drought (Aina et al., 2018). This insurance is designed to manage the risks of livestock mortality among pastoralist (Keno et al., 2018) as it mainly based on the policies on signals that are easy to observe (Jensen et al., 2015). Currently, pastoralist households in various parts of the pastoralist areas have received IBLI payments. As a result, livestock insurance policy progressed, and community acceptance increased to some extent. Though livestock insurance contributed to reducing the adverse impacts of climate shocks, there is still a low adoption rate among the intended population (Aina et al., 2018). Mude et al. (2013) for instance indicated that even though insurance policy could pay huge economic dividends for African countries, the design of contracts still faces a number of challenges from the demand side.

Although index-based livestock insurance is so new in Ethiopia, demand is generally low, and the uptake of this product continues to be below expectations in Africa (Jensen et al., 2015; Keno et al., 2018). The causes for failure and low uptake of this introduced insurance, such as livestock insurance by pastoralists and agro-pastoralists, remains scarce in Ethiopia (Amare et al., 2019). Weather Index livestock insurance was introduced in the Borana Zone of southern Ethiopia in 2012 by the International Livestock Research Institute (ILRI) in collaboration with Oromia Insurance Company (OIC) and humanitarian organizations as a tool to help protect pastoralist herders from drought-related livestock mortality. Acceptance and community

willingness to pay for insurance are also challenges for Borana pastoralists. Despite efforts to introduce the IBLI in various woredas of Borana zone, the community's awareness level is not equal. Different studies (Amare et al., 2019; Gebrekidan et al., 2019) dealt with insurance coverage and its role to deal with disaster. While a significant portion of households have already begun to benefit from insurance payouts, there is still reluctance to insure livestock on the other side (Gebrekidan et al., 2019). Insurance coverage is also not uniform. This indicate that there gaps in the level of awareness, acceptance and low level of community willingness to pay (WTP) for livestock insurance. This study aims to fill these gaps by assessing Pastoralist household's awareness on the livestock insurance policy and willingness-to-pay for Index-Based Livestock Insurance among pastoralists in Moyale woreda using contingent valuation method (CVM). By doing so the study will address (i) the gaps in knowledge and awareness of the Pastoralist Households on the livestock insurance policy, (ii) the pastoralist households willingness to pay for IBLI and the maximum amount they are willing to pay, and (iii) the factors influencing pastoralist Households Willingness to Pay for IBLI.

1.3. Objectives of the Study

The main objective of this study is to assess pastoralist households' willingness-to-pay for Index-Based Livestock Insurance in Moyale Woreda

The specific objectives addressed by this research were:

- To assess knowledge and awareness of the Pastoralist Households on the livestock insurance policy in Moyale woreda.
- To assess the pastoralist households willingness to pay for Index-Based Livestock Insurance in Moyale Woreda
- To identify the Determinants of Pastoralist Households Willingness to Pay for Index-Based Livestock Insurance in Moyale Woreda

1.4. Research Questions

This study answered the following basic questions.

I. What is the level of knowledge and awareness of pastoralist households regarding livestock insurance policy in Moyale woreda?

II. What is the level of Pastoralist households' willingness to pay for Index-Based Livestock Insurance in Moyale Woreda?
III. What are the factors that influence the Pastoralist Households Willingness to Pay for Index-Based Livestock Insurance in Moyale Woreda?

1.5. Scope of the Study

This study was conducted in the Borana zone, a region located in the Oromia Regional State of southern Ethiopia. The Borana zone is predominantly inhabited by pastoralist communities whose livelihoods heavily depend on livestock production. This area has been one of the regions most severely affected by recurrent and prolonged droughts, which have significantly threatened the economic stability and food security of local households. Drought, as one of the major manifestations of climate change, has led to widespread livestock mortality and forced herd offtake, reducing the resilience of pastoralist communities. As a result, there is growing interest in sustainable risk management tools such as Index-Based Livestock Insurance (IBLI), which is designed to provide a safety net against covariate livestock losses due to climatic shocks.

The introduction of IBLI in the Borana zone is believed to have had a positive impact on reducing the adverse consequences of extreme weather events, particularly prolonged drought. By offering financial compensation linked to predetermined climate indices such as rainfall or forage availability, IBLI enables insured households to better cope with livestock losses without resorting to distressful coping strategies, such as selling off remaining assets or reducing food consumption. Several empirical studies have demonstrated that IBLI can contribute to improved livelihood resilience and foster long-term economic planning among pastoralist households. However, despite the potential benefits, the uptake of IBLI in the Borana zone remains limited. One of the key challenges identified is the community's low level of awareness and understanding of the insurance mechanism, coupled with mistrust and unfamiliarity with formal financial products.

Given these challenges, this research focuses on three key aspects related to the implementation and effectiveness of IBLI in the Borana pastoralist context. First, it seeks to assess the level of awareness among pastoralist communities regarding the IBLI policy—specifically, how well the target population understands the structure, benefits, and procedures of the insurance scheme. Second, the study investigates pastoralist households' willingness to pay (WTP) for

IBLI, which reflects their valuation of the insurance product and its perceived relevance to their livelihoods. Third, the research aims to identify and analyze the socio-economic, demographic, and institutional factors that influence households' WTP for IBLI. Understanding these dimensions is essential for designing more inclusive and effective insurance programs that address the real needs and constraints of pastoralist communities in drought-prone areas like Borana.

1.6. Significance of the Study

This study has made significant contributions both methodologically and empirically to the existing body of knowledge on index-based livestock insurance (IBLI). From a methodological standpoint, the research employed appropriate analytical tools and frameworks to examine key determinants of awareness and willingness to pay (WTP) for IBLI among pastoralist households in the Borana zone. The study's rigorous approach enhances the reliability of its findings and sets a precedent for future research in similar contexts. Furthermore, by focusing on a climate-vulnerable region, the study adds empirical depth to the discourse on climate adaptation strategies in pastoralist systems. The results help to clarify the roles that socioeconomic, institutional, and demographic factors play in shaping IBLI uptake, which is critical for tailoring insurance products to the needs of marginalized communities.

Academicians are among the primary beneficiaries of this study, as it contributes new insights to the theoretical and empirical literature on index-based insurance in developing countries. The study not only narrows existing knowledge gaps but also introduces context-specific variables relevant to pastoralist economies, which have often been underrepresented in academic research. By incorporating new dimensions of analysis—such as social capital, proximity to weather stations, and trust in financial institutions—the study provides a strong foundation for further academic exploration. Graduate students and researchers can use the findings as a springboard for more advanced studies that may include comparative analyses, policy simulations, or longitudinal investigations across different agro-ecological zones.

Beyond academia, the study has practical implications for a wide range of stakeholders. Policymakers and development practitioners can use the findings to design more effective and inclusive insurance schemes that better align with the socioeconomic realities of pastoralist households. The study provides valuable information on community-level awareness and WTP, which can help insurance providers to adjust their outreach, pricing, and coverage

strategies. Local and regional government officials, who play a key role in implementing risk mitigation programs, will benefit from the study's insights when formulating policies and allocating resources. Moreover, development partners engaged in climate resilience, rural finance, or disaster risk reduction initiatives can incorporate the study's findings into program planning and policy advocacy aimed at enhancing the adoption and sustainability of IBLI in vulnerable regions like Borana.

1.7. Limitations of the study

While conducting this study, the researcher encountered various difficulties. Lack of funding was the first and most significant obstacle. Second, researchers had to contend with transportation issues. Due to the few roads connecting villages, some of the zones were far from the kebele's center. In these situations, we used expensive motorbikes that could only serve one person. Thirdly, the major issue was that respondents weren't available in the village because of their regular schedules. For instance, some of them take care of cattle, travel a long distance to bring home water for household use, and bring livestock to watering sites. Therefore, the researcher had to spend long time to able to get in contact with the respondents wherever they were.

1.8. Organization of the Thesis

There are five chapters in this thesis. The first chapter covers the introduction which includes the background of the study, problem statement, study objectives, research questions, significance, scope, and limitations of study. The second chapter describes the theoretical underpinnings of the study, how they shape the research and lay the groundwork for it, as well as a survey of literature that has been done on the current study. It also describes the conceptual framework. The third chapter is about research methodology. The study area description, research design, study population, data types, and sources, sampling procedures and sample size, methods of data collection, methods of data analysis, and methods of data presentation are briefly detailed in the methodology section. Results and discussion are covered in the fourth chapter, which presents, analyzes, and discusses the results. The fifth chapter concludes with a summary of the key conclusions and offers suggestions based on the research's findings.

2. Literature Review

2.1. Introduction to Index-Based Livestock Insurance

Drought is the most common natural or man-made hazard that households in semi-arid lands (ASALs) face on a broad scale. This is particularly true for the whole Horn of Africa, including northern Kenya, southern Ethiopia, and millions of pastoralist households that experience increasingly severe droughts on a regular basis. The high livestock death rate that results has devastating impacts on livelihoods that depend entirely or partially on livestock, making these pastoralists among the most vulnerable groups in the region. The relationship between drought risk, susceptibility, and poverty is becoming increasingly stronger as the effects of climate change become apparent (Mude, 2012).

A program financed by donors, index-based livestock insurance (IBLI) aims to create, develop, and implement market-mediated, index-based insurance products to shield livestock keepers from asset losses caused by drought, especially in drought-prone arid and semi-arid lands (ASALs). Based on satellite data, the IBLI index assesses pastureland quality every 10–16 days. These data are used as inputs into a statistical model of cattle mortality that was created with the help of local historical data. The insurance compensates contract-holding pastoralists for their losses when changing range conditions indicate livestock mortality will exceed a crucial threshold (let's say 15%) over a predefined area. This enables them to control their personal risk (ARID Kenya, 2018).

In impoverished rural areas where access to commercial insurance products is usually limited, index insurance has garnered significant attention as a tool for mitigating uninsured covariate risk in recent years. For example, over the past ten years, interest in investigating the possibility of using a specific type of microinsurance—insurance tailored to the needs of the poor—to cover the potential losses of smallholder farmers associated with weather shocks has grown among researchers, international multilateral and non-governmental organizations, and national governments (Amare et al., 2019). It is a promising invention for helping pastoral households in Kenya and Ethiopia manage the risks associated with climate change. The potential for index-based products to reduce the risk of drought in the area has been demonstrated by extensive research on pastoral risk management (ARID Kenya, 2018).

2.2. IBLI Development Process

2.2.1. Aridity, Drought Risk and Limited Coping Mechanisms

Over 10 million pastoralists in Eastern Africa's ASALs rely on pastoral livestock herds for their livelihood, which accounts for over 60% of their total revenue (Agency for Rangeland Information and Development in Kenya [ARID Kenya], 2018). Therefore, losses to livestock herds have the potential to lock thousands of individuals in poverty in addition to having a disastrous effect on household income. Over the last century, there have been over 20 droughts that have severely affected cattle mortality in southern Ethiopia and northern Kenya. The 2010–2011 drought in Eastern Africa impacted 13 million people and resulted in livestock losses exceeding $500 million (Hillier and Dempsey, 2012 cited in ARID Kenya, 2018). Most recently, "At least 36.1 million people have been affected by the drought across the Horn of Africa, including 24.1 million in Ethiopia, 7.8 million in Somalia, and 4.2 million in Kenya." By February 2023, there might be between 23 and 26 million people experiencing severe food insecurity, up from the current minimum of 20.5 million people who wake up to this situation every day" (OCHA, 2022).

Including most rural farmers, pastoral households largely adopt ineffective and declining husbandry techniques including transhumance migration in response to drought circumstances and social transfers of cattle where losses occur as their primary means of risk management. In the absence of substitute risk transfer mechanisms, vulnerable pastoral households have continual uncertainty about livelihood shocks due to droughts, which leads to constant and increasing exposure to drought and other risks and the loss of valued livelihood assets (Agency for Rangeland Information and Development in Kenya [ARID Kenya], 2018). Therefore, pastoral households' ongoing exposure to drought has negative effects that extend beyond the near term and impact opportunities in the cattle industry that could potentially lessen their reliance on subsistence farming and overall poverty (Ayal et al., 2018). These and other difficulties facing pastoral herders' livelihoods are a blatant sign that more risk management solutions must be made available to them to lessen their susceptibility. But not all hazards are covered by insurance; some occur frequently but have little consequence (like spilled milk), while others occur infrequently but severely harm household finances (like cattle theft).

2.2.2. Index Insurance Innovation

A possible innovation for mitigating the risks associated with climate change that pastoral households in Kenya and Ethiopia face is index-based insurance products. According to ARID Kenya (2018) the ssubstantial research in pastoral risk management has pointed to the potential of index-based products in alleviating drought risk in the region. The International Livestock Study Institute (ILRI), in partnership with Cornell University and the USAID-funded BASIS Research Program, conceived and conducted the most important study that resulted in the creation of an index-based product for pastoral households (ARID Kenya, 2018). The goal of this partnership was to create, develop, and execute index-based insurance products that are mediated by the market to shield pastoral herders from livestock losses caused by drought. ILRI and its partners not only created the first index-based product in Africa, but they also made it possible for substantial fieldwork, stakeholder consultation, and the product's 2010 pilot in Marsabit.

An index insurance contract has three main components relevant to the development process of the index-based product. According to A. G. Mude et al. (2012), these components are:

- A well-defined index and an associated strike level that triggers an insurance payout
- A well-defined, time-specific geographical coverage with a matching premium pricing
- A clear payout timing and structure for all covered premium holders conditional on strike levels reaching contractually agreed specified levels.

Thus, the primary characteristic of the IBLI product is its ability to react to forage availability, which is represented by a well-defined index, at a specified location within a predetermined time frame (A. Mude et al., 2013). IBLI design uses remotely sensed normalized differential vegetation index (NDVI) as a measure of forage availability to predict livestock mortality because the availability of forage is a prerequisite for pastoral grazing systems as well as livestock health and survival. IBLI uses real-time, publicly available NDVI data to track local forage conditions in order to determine the severity of drought, predict area-average livestock losses, and compute indemnity payments to policyholders. This is because it is widely accepted that the majority of livestock mortality is related to drought, and that widespread livestock mortality during droughts is primarily caused by forage scarcity (ARID Kenya, 2018).

2.2.3. Designing an IBLI Product for Pastoral Commons in Kenya and Southern Ethiopia

With a wealth of knowledge on the ASALs in Eastern Africa and international partnerships, ILRI and its technical partners conducted a thorough study of pastoral communities in Kenya in 2008, involving fieldwork in several places and household surveys. Following this initial phase, the procedures were concentrated on contract design and product piloting (ARID Kenya, 2018). ILRI created a contract encompassing long rain long drought (LRLD) and short rain short drought (SRSD) in accordance with the rainy-dry seasons in northern Kenya. Under this method, insurance contracts are evaluated after the conclusion of the dry season to ascertain if indemnity payments should be made. The contracts are sold for a period of about two months, right before the start of the rainy season. Contracts are defined at a predetermined value per tropical livestock unit (TLU) (A. Mude et al., 2013). Pastoralist clients select the entire worth of their animals to insure, pay the premium to the insurance broker, and in the event of a payout, get indemnity payments based on their IBLI coverage. Based on the expected mortality rate as a function of the vegetation index unique to that location's grazing range, the contract is location-specific (Amare et al., 2019).

The expected area average mortality rate, which is determined as a function of the NDVI, is the index on which the insurance contract is written. Over the length of the contract period, the expected mortality index can be updated continually because NDVI data are available in real time. To clearly link the index to contract holders' insurable interest, we express the index in terms of % projected mortality rather than NDVI (ARID Kenya, 2018). Two similar methods, based on distinct underlying distributions, can be used to price an insurance contract. The first is a straightforward historical burn rate technique, where the contract price is determined solely by the previous vegetation distribution data that is now available. The second method is the simulation approach, which entails pricing the contracts based on the estimated parametric or semi-parametric distributions of the underlying vegetation index (NDVI) after first estimating them. While assigning probabilities based on guessing probabilities without knowing the exact data generating process is a drawback of the second technique, it has the advantage of giving non-zero probabilities to events that might not show in the available historical data. IBLI price is based on historical burn rate pricing, which is updated annually and is based on 27 years of available NDVI data.

2.2.4. IBLI Structure and Key Features

According to ARID Kenya (2018) like all designs and development processes of index insurance, the IBLI development process began with the utilization of information gathered on household-level livestock mortality data collected monthly from 1996 in various northern Kenya locations and NDVI data collected on the same locations. But the information by itself was not enough to produce the level of accuracy needed to create a useful index insurance policy. The NDVI was used by IBLI design to address this issue as, in addition to being dependable and affordable, it can offer historical data that is readily connected with comparable historical livestock mortality. Primarily, since animals in pastoralist systems rely only on accessible forage for sustenance, the NDVI should be a reliable predictor of both livestock mortality and the amount of vegetation that is available for consumption.

Table 1: IBLI Structures and Key Features

Features	**Explanation**
The risk	A product called index-based livestock insurance (IBLI) is intended to guard against livestock mortality caused by drought. Pastoralists who expect cattle losses as a result of severe drought-related feed scarcity are compensated by IBLI.
The index	Predicted livestock mortality is the index in the IBLI. The normalized difference vegetation index (NDVI), a measure of pasture availability obtained from satellite data, is used to generate the index. This vegetation parameter is supplied into a reaction function that links livestock mortality caused by drought to pasture availability.
Contract strike (trigger) level	The contract strike level is the index barrier that must be met before compensation are required. For IBLI's contracts in northern Kenya, the strike levels were either 10% or 15%, with different premium amounts available for purchase. Then, depending on the contract held, IBLI insurers will pay out if the NDVI forecast livestock mortality is more than 10% or 15%.
Geographical coverage of contract	A county in the IBLI northern Kenya example would have distinct contracts with variable contract strike premiums based on the risk of livestock mortality based on historical data on livestock mortality.

	Administrative division borders serve as the foundation for the current IBLI contract. Different payouts may be given in the same bigger geographical area (county) because they are determined by the index level. All policyholders in the impacted division will get payouts at the same rate, nevertheless, provided the index remains over the strike level selected by the client.

Sources: Adopted from (Chantarat, Mude, Barrett, et al., 2009)

2.3. IBLI Pricing and Risk Exposure Analysis

The distribution of expected area average herd death rates, a vegetation-based livestock index for IBLI, and consequently the actuarially fair pricing of IBLI based on historical data are determined in large part by the predicted mortality profiles just described (Chantarat, Mude, Barrett, et al., 2009). Two similar methods, based on distinct underlying distributions, can be used to price an insurance contract. The first is a straightforward historical burn rate technique, where the contract price is determined solely by the previous vegetation distribution data that is now available. The second method is the simulation approach, which entails pricing the contracts based on the estimated distributions of the underlying vegetation index (zndvi) after first estimating those distributions parametrically or semi-parametrically. While assigning probabilities based on guessing probabilities without knowing the exact data generating process is a drawback of the second technique, it has the advantage of giving non-zero probabilities to events that might not show in the available historical data (A. Mude et al., 2013).

2.4. Understanding the Concept of Willingness-to-Pay

The highest quantity or amount of money a person is willing to pay for an improved situation, or the maximum amount a person must spend to prevent a decline in the scenario, is known as willingness-to-pay (WTP) (Onainor, 2019). WTP is the amount of money an individual is willing to pay to procure a product given his income, background characteristics and risk preferences. According to Aina et al. (2018), the amount a person is willing to pay is subject to the perceived economic value and the expected utility of the good. WTP is important because consumers' response to price influences their consumption of goods or services provided and the revenues collected.

When calculating WTP, it is implicitly assumed that people with positive WTP values should be able and willing to pay the full price of the goods or service (Kebede et al., 2020). WTP measurements are regarded as advantageous since they offer insight into the value that customers place on products or services, allowing for the evaluation of their prices. In a similar vein, WTP metrics can be useful instruments for determining relative values and rankings of the desired-ness of products and services (Onainor, 2019).

2.4.1. Approaches used in estimating WTP

Economists have devised a variety of approaches, generally classified into revealed and stated preference methods, to assess the value of non-marketed commodities and services (Onainor, 2019). The key distinction between revealed and stated preference approaches is that the former rely on values that are directly observed from people's behavior in the market (such as demand for or uptake of a good or service), while the latter use responses about their behavioral intentions to infer people's behavior toward a non-marketed good or service (Kebede et al., 2020). As such, stated preference methods use respondents' ranking of different products to estimate their preference, such as for hypothetical insurance policy profiles from which WTP can be derived (Onainor, 2019).

2.4.2. Revealed Preference Methods of Valuation

The use of surrogate or related markets is a defining feature of revealed preference techniques for environmental valuation. Consumer behavior in the surrogate market indicates or reveals consumer preferences for non-marketed environmental resources. The travel cost method and hedonic pricing are examples of these techniques (Robinson, 2001).

The travel cost technique: The travel cost technique estimates an environmental value (such as a national park) by measuring the cost of using the asset as a surrogate estimate of the WTP. (Kebede et al., 2020). The costs of using the resource included travel expenses, entrance fees, and boat rentals. For the most part, this method does not attempt to measure the value of a change in the quantity or quality of a specific resource, but rather estimates the direct use value of the resource in its entirety as a demand function (Robinson, 2001).

The hedonic pricing technique: The hedonic pricing technique defines an environmental resource as a set of characteristics that describe a traditionally marketed good. A park, for example, could be described in terms of its land area and access to water, both of which would apply to any land being marketed in the area. The method seeks a relationship between the

level of the environmental good and the price of the marketed goods. (Robinson, 2001). According to Robinson (2001) this technique was adopted by Lockwood et al. (2000) to estimate a value for remnant native vegetation. The Lockwood study encountered a problem, which is frequently reported when hedonic pricing models are used for environmental valuation, namely a lack of data (in this case, property sales) to develop and value a vector of environmental good characteristics.

2.4.3. Stated Preference Methods of Valuation

Stated preference techniques use surveys to estimate stakeholder preferences by directly asking individual stakeholders about their preferences (Robinson, 2001). These methods include contingent valuation, contingent rating, contingent ranking, and choice modeling. Contingent rating, contingent ranking, and choice modelling are all examples of conjoint analysis, a survey technique that was previously used for market research but has recently been recognized as a resource management technique. Contingent valuation and a variation on it, choice modelling, are discussed in greater detail below.

The Contingent Valuation Method (CV): Contingent valuation is the stated preference technique that is commonly regarded as superior to the others in terms of validity and reliability for environmental valuation (Robinson, 2001). This technique directly assesses WTP or WTA for a particular environmental outcome in a carefully constructed hypothetical or simulated market (Kebede et al., 2020; Oduniyi et al., 2020). One of the technique's advantages is that it assesses both use and non-use values of an environmental resource. It entails providing a description of the existing situation and the potential changes to the environment that are expected to result from proposed changes in management or use to a sample of the population and then directly asking about how much they are WTP or willing to accept WTA to prevent the proposed change in the environment (Robinson, 2001). The payment vehicle is important because respondents may file a protest bid if they object to the method by which the payment will be made. Respondents, for example, are more likely to object to a payment in the form of an increase or additional tax. Recently, payment vehicles in the form of a payment into a trust account that would be dedicated to the environment have been adopted. Responses are regressed against a number of socio-economic and attitudinal characteristics of respondents, the availability of substitutes as well as price in cases where a discrete choice format is used.

Choice Modelling or Choice Experiments using Conjoint Analysis: Conjoint analysis is the process of breaking down a set of discrete decisions from a planned set of Multi-attribute options into part-worth utilities or values (Louviere, 1988: 93 cited in Robinson, 2001). The design, implementation, and analysis of judgment data—which are described as "evaluative rankings or ratings of a set of multi-attribute alternatives obtained from individuals"—are frequently done using this technique in marketing studies. In a conventional conjoint analysis, respondents are asked to express their relative preferences for combinations of qualities that are created using experimental design procedures.

2.5. IBLI Ethiopia

It has been acknowledged that there has been a recent increase in the frequency of droughts and other climate-related risks, which has resulted in the loss of a significant number of animals and livelihoods and has a particular impact on pastoralist/agro-pastoralist communities in Ethiopia and throughout Africa (Amare et al., 2019). Because they make up a sizable portion of pastoralists' household assets, livestock are essential to maintaining both human wellbeing and rural livelihoods. Drought has long been one of the main risks to pastoral households' ability to make ends meet. While Ethiopian pastoralists have created a number of customary coping strategies to get over obstacles to their way of life, such as the difficulties they encounter during droughts (Zewdie et al., 2020). Working with Oromia Insurance Company and humanitarian organizations, the International Livestock Research Institute (ILRI) introduced index-based livestock insurance as a contemporary risk-management tool in Ethiopia in 2012. This insurance product has drawn a lot of interest in addition to its ability to lessen the broad welfare loss caused by large-scale covariate weather hazards. This is because it is free from issues with moral hazard, adverse selection, and information asymmetry (Amare et al., 2019). Index insurance indemnity payments are derived from readily observable, objective weather or environmental data, such as temperature, precipitation, or remotely sensed estimations of vegetation levels that are substantially connected with losses, rather than from actual losses incurred by policyholders (Aina et al., 2018) that constrain individual the opportunity to manipulate the record.

2.6. IBLI Borana

In order to help pastoralists' herders guard against livestock mortality caused by drought, the International Livestock Research Institute, in collaboration with Oromia Insurance Company

and humanitarian organizations, has been offering index-based livestock insurance in the Borana zone of southern Ethiopia since 2012. Pastoralists and agro-pastoralists have not adopted index-based livestock insurance in large numbers, despite some encouraging results from coordinated efforts (Amare et al., 2019). Retail insurance for four livestock species—camelbacks, cattle, goats, and sheep—was first offered under the IBLI-Borana brand. For this product, the commercial underwriter is Oromia Insurance Share Company (OIC). In addition, OIC oversees a number of activities linked to insurance extension and promotion, such as marketing, premium collecting, community awareness, sales monitoring, and claims payment. Primary cooperatives handle the collection of sales and premiums as well as the payment of claims on behalf of OIC (Zewdie et al., 2020).

2.7. Empirical Review of Literature

Index-based livestock insurance (IBLI) has emerged as a critical tool for managing climate-induced risks, particularly in drought-prone regions where pastoralist livelihoods are heavily dependent on livestock. The growing body of empirical research on IBLI highlights the multifaceted nature of its adoption and effectiveness across different socio-economic and geographic contexts. This section synthesizes empirical findings from various countries, including Nepal, South Africa, and Ethiopia, to provide a deeper understanding of the factors that influence livestock insurance uptake, willingness to pay, and the broader implications of IBLI on pastoralist behavior and household welfare.

A study conducted in Nepal's Surkhet district offers valuable insights into livestock farmers' behavioral and financial approaches toward risk management (Nepali, 2021). The research revealed that many farmers relied on personal savings and loan repayments for managing capital, while social networks such as cooperatives, friends, and family played a significant role in influencing insurance decisions. Among the twenty insurance companies operating in the district, Everest Insurance Company Limited emerged as the most preferred. Despite the perceived relevance of livestock insurance, overall awareness remained low. Only 64.44% of respondents had insured their animals, and an even smaller proportion—37.93%—opted to renew their policies. Notably, goats were the most commonly insured animals. The study underscores the importance of simplifying insurance procedures and raising awareness to improve adoption rates. Process transparency, coupled with educational outreach, is vital for ensuring broader and sustained participation in livestock insurance schemes (Nepali, 2021).

Comparative evidence from South Africa further contributes to understanding the dynamics of IBLI adoption. Oduniyi et al. (2020) utilized the Heckit sample selection model to explore factors affecting farmers' willingness to pay (WTP) for index-based livestock insurance. The study identified farmer experience, age, education level, marital status, insurance awareness, and the number of household dependents as statistically significant predictors of WTP. The maximum WTP observed was R600 (approximately $42). These findings suggest that socio-demographic characteristics substantially influence farmers' valuation of risk mitigation tools. Consequently, policy frameworks aiming to expand IBLI must consider these attributes and develop targeted interventions to support vulnerable groups. Similar conclusions were drawn in related studies, which emphasized that providing tailored financial education and inclusive insurance product designs could enhance IBLI uptake (Mapfumo et al., 2022; Bageant & Barrett, 2017).

Ethiopia, particularly the Borana zone, has been a focal point for IBLI studies due to its vulnerability to prolonged drought and heavy reliance on pastoralist systems. Gebrekidan et al. (2019) conducted a fixed-effects model analysis to evaluate the impact of IBLI coverage on household decision-making. The results demonstrated that households with IBLI coverage were significantly less likely to offtake their herds under stress. This suggests that insurance coverage not only provides financial protection but also fosters psychological security among pastoralists, enabling them to maintain livestock assets during adverse climatic events. By reducing distress-driven livestock sales, IBLI contributes to long-term household economic stability. These findings align with global literature indicating that livestock insurance has the potential to transform livelihood strategies and reduce vulnerability to climate shocks (Jensen, Barrett, & Mude, 2017).

Further empirical research by Amare et al. (2019), also conducted in the Borana zone, delved into the determinants of demand for IBLI. The study found that households engaged in moisture-stressed farming systems, those who perceived high climate-related risks, and those who were already aware of insurance mechanisms were more inclined to adopt IBLI. Additionally, higher education levels, access to financial institutions, and involvement in off-farm income-generating activities positively influenced insurance uptake. The research also highlighted the importance of social capital; households that participated in multiple social organizations demonstrated higher demand for IBLI. Conversely, elderly households and those located far from weather stations were less likely to adopt insurance. The latter finding is

especially relevant for IBLI, where proximity to weather stations affects the perceived reliability of index triggers—a factor commonly referred to as basis risk (Carter et al., 2014).

Several additional studies have expanded on the concept of basis risk and trust, both of which are crucial for the sustainability of IBLI programs. Basis risk, the gap between actual losses experienced by the insured and the payouts triggered by the index, can undermine confidence in insurance products. In their randomized control trial, Carter et al. (2014) emphasized that minimizing basis risk through improved data granularity—such as integrating high-resolution satellite imagery and increasing the density of weather stations—could significantly improve customer satisfaction and retention. Similarly, trust in insurance providers has been cited as a major factor in the adoption of IBLI. Berhane et al. (2021) identified transparency, past payout performance, and involvement of local institutions as critical to building trust and increasing uptake.

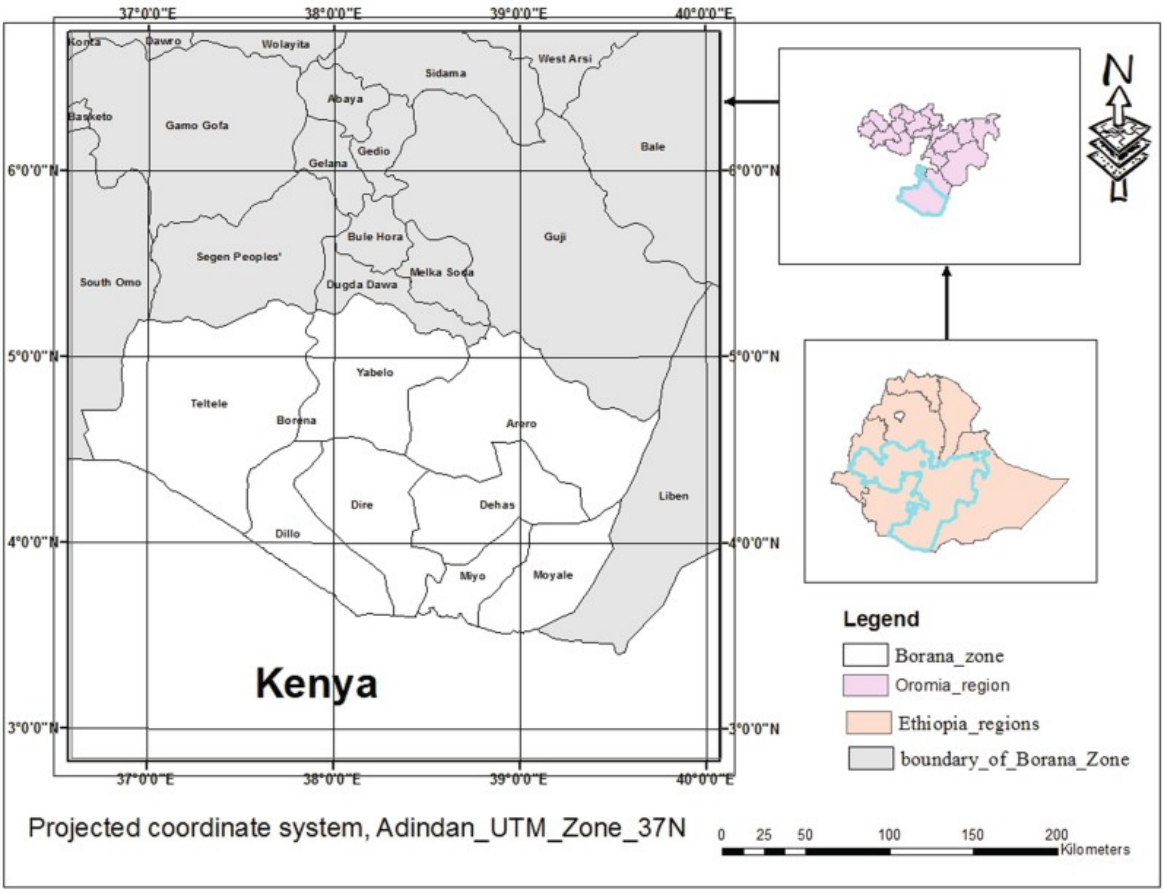
Moreover, the behavioral effects of IBLI have also been explored. Jensen et al. (2017) found that insured households were more likely to invest in productive assets and engage in long-term planning. Insurance coverage reduced the need for precautionary savings and allowed households to adopt a more stable consumption pattern, thereby enhancing overall welfare. These findings mirror the results of studies in Kenya and northern Ethiopia, where the introduction of IBLI led to increased investment in livestock health and better herd management practices (Mude et al., 2010).

3. Research Methodology

3.1. The Study Area

The study was conducted in Moyale woredas of the Borana zone of the Oromia region. Geographically, the Borana zone is found in the southern part of Ethiopia between 3°26′ and 6°32′ north latitudes, and 36°43′ and 40°46′ east longitudes (Dika et al., 2022). The zone occupies a total land area of about 95,000km2 with lowland and mid-highland area agro-ecology based on their climatic condition. The lowland area is characterized by livestock production in open grazing system over communally owned rangelands with emerging privatization of land for crop and *Kaloo* whereas the mid-highland is characterized by mixed livestock crop farming activity (Takele et al., 2014).

Figure 1: Location Map of the Study Area



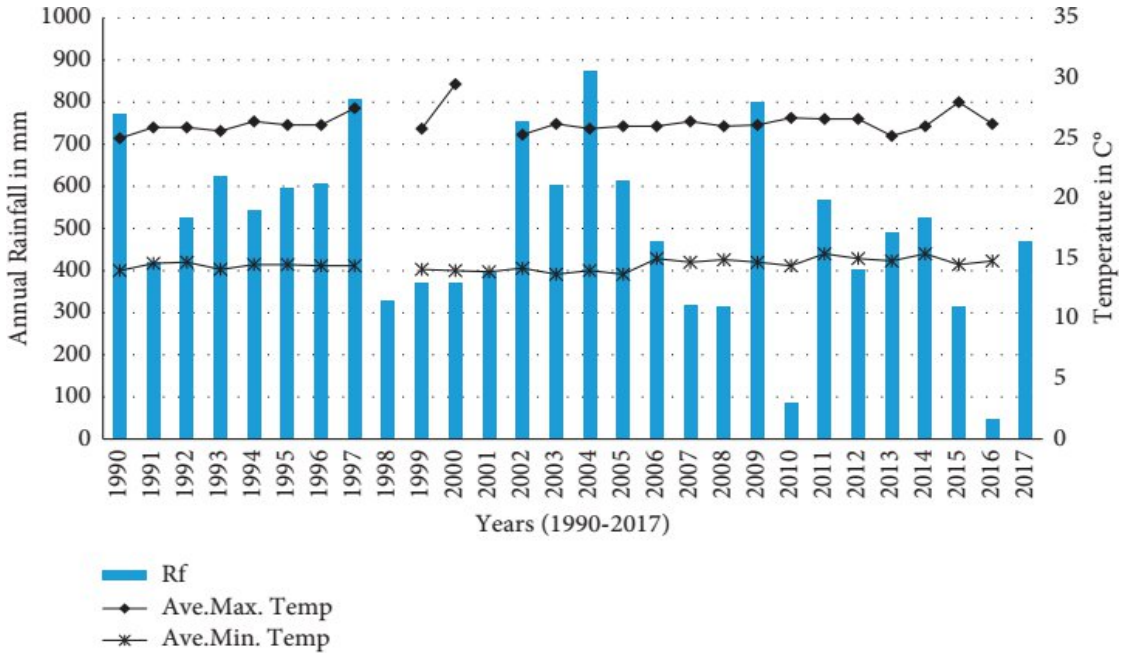
Sources: Adopted from (Dika et al., 2021)

The topography of the Borana rangelands is characterized by plain rangelands, intersected with occasional mountain ranges, volcanic cones and depressions. The altitude of the study area ranges from 750 to about 2000m above sea level, resulting in rich flora and fauna (Dalle et al., 2006). Borana area receives a bimodal pattern of rainfall with the main rains (*ganna*) falling between March and May, and the short rains (*hagayya*) between September and November. The average mean minimum and maximum temperature of the area ranges from 14.2◦C to 25.4◦C (Dika et al., 2021). Recently, the rainfall patterns in the area have shown significant variability and changes from the normal trends. Due to the climate change effects, the intensity of rainfall has been reduced in terms of amount and duration. The frequency of drought which used to happen seldom in the past has now increased to every 1–2 years (Riché et al., 2009) leading to high vulnerability of the pastoral communities.

The livelihood of Borana pastoralists mainly depends on pastoralism. Livestock production is the main source of livelihood of the people, with increasing engagement in crop production and non-pastoral activities (Dika et al., 2022).

Borana Oromo have well preserved indigenous institutions. One such institution is Gadaa, which is egalitarian indigenous political system. Gadaa has becomes a conceptual abstraction, something in which all Oromo are supposed to identify themselves (Bassi, 1996; Dika, 2021).

Figure 2: Annual rainfall, annual max, and min temperature at Yabello station



Source: Adopted from (Dika et al., 2022)

3.2. Research approach and design

The study was guided by mixed research design. The qualitative and quantitative research approach was used in the design of the research and analysis. Qualitative approach have the strong qualities and can enable the researchers to construct the social reality and understand the feeling of society. Whereas quantitative approach have also strong qualities in presenting the data using numbers and different quantitative models. By using both methods, the researcher would be able to understand the perceptions of the participants by in-depth analysis of the views of participants. Qualitative research involves finding out what people thinks and how they feel. Quantitative approach however involves collecting quantitative data and presenting the results by tables, figures and models. Therefore, in order to understand community level of awareness for insurance policy and willingness to pay for livestock insurance mixed research approach was be used.

3.3. Data types and sources

Data required for this study was collected from both secondary and primary sources. The secondary data were obtained through rigorous desk reviews of both published and unpublished sources. These can be from articles, government and NGO official reports, books, book chapters, conference papers and so forth. In the same way, primary data were directly collected from the community, and representatives of state and non-state actors operating in Borana Zone that are working on livestock insurance. These include representatives of the community like Dheeda council, pastoral and Agropastoral communities, women and youth representatives and other relevant stakeholders. In addition, primary data were gathered from the leaders and key staff of non-governmental organizations (NGOs), and representatives of relevant government offices.

3.4. Sampling Techniques and Procedures

A multi-stage sampling technique was used to select the participants for the study. Three stages of sampling were involved in this study. In the first stage, the study area, Moyale woreda, was purposively selected because of time and budget constraints. In the second stage, two kebeles of the Moyale Woreda, namely: Bokola and Buladi were selected purposely. The third stage involve a random selection of the pastoralist households from the study area. This study mainly

used primary data, which were collected through a contingent valuation survey using personal interviews.

3.5. Sample Size Determination

Considering homogeneity and/or heterogeneity of population, level of precision and confidence level, sample size for the study was determined using a formula. The precision level is taken to be 0.05, with a confidence interval of 95%. Therefore, sample size (n) was determined using the formula proposed by Yamane (1967).

$$n = \left(\frac{N}{1 + N(e)^2}\right.$$

Where: n= sample size, N=Household size

e=Level of precision

Then, N = 900 (total hhs of two kebeles) and e = 0.05, sample size would be:

$$n = \left(\frac{900}{1 + 900\ (0.05)^2}\right) = 211.7 \sim 212$$

3.6. Methods of Data Collections

To collect data required for this study, different tools were used. The tools was designed in a way that both qualitative and qualitative data required for this study were gathered and integrated in a complimentary manner to give the broader picture of the study.

The following tools were used to collect the data:

- Desk Reviews
- Key Informant Interview (KIIs)
- Focus Group Discussions (FGDs)
- Household Survey

3.6.1. Desk Reviews

Reviews of the secondary data were conducted throughout the study. The review provided the opportunity to familiarize with the subject of the study. Literature reviews were done throughout the study period to provide essential reference material for the formulation of the study report. The researcher reviewed both published and unpublished sources. These includes articles, government and NGO official reports, books, book chapters, conference papers and so forth. Published secondary data like articles, thesis, and other documents were collected from different search engines like Google, Google Scholar, yahoo, and others by using different techniques over the Internet. The researcher used university institutional repositories, and libraries to find secondary materials. Unpublished official reports and documents were collected by the researcher directly requesting the concerned local offices.

3.6.2. Key-Informants Interview (KIIs)

To substantiate the evidence generated by reviewing relevant literature, primary data were gathered by semi-structured interview checklists (guiding questions) from key informants representing community representatives, IBLI beneficiaries, NGOs, and government representatives and IBLI policyholders were interviewed. The study conducted **30** KIIs to assess pastoralist households' awareness on the livestock insurance policy and willingness-to-pay for Index-Based Livestock Insurance. The study conducted 21 KIIs from community representatives, 5 KIIs from NGOs and 4 KIIs from local government representatives. All interviews were recorded, and pictures were taken. Community representatives like Dheeda council, pastoral and agro-pastoral communities; women and youth representatives and other relevant stakeholders were interviewed. The interviews were conducted at different places in the study area. The key informants were selected based on their rich knowledge of index-based livestock insurance.

Table 2: KII from Community Representatives, and government sectors and NGOs (CSOs)

Respondents category	**Specific group**	**Number of KII respondents**
	Dheda Council	1

Community representatives	Kebele leader	2
	IBLI beneficiaries	4
	Elders	4
	Women	4
	Youth	4
Government representatives	Zonal and woreda Climate change authority	2
	Disaster risk preparedness and prevention offices of zone and woreda	2
	Agriculture and NRM office of woreda and zone	2
NGOs (CSOs)	ILRI	1
	HEKS EPER	1
	CARE	1
	Helvetas	1
	CIFA	1
Total		**30**

3.6.3. Focus Group Discussion (FGDs)

Focus group discussions were conducted to assess Borana pastoralist household's awareness on the livestock insurance policy and willingness-to-pay for Index-Based Livestock Insurance. The number of participants in each FGD range from 6-12. The participants were heterogeneous groups with men, youth, and women participants.

3.6.4. Household Survey

Household surveys were carried out to collect information related to household awareness on the livestock insurance policy and willingness-to-pay for IBLI. Data was collected from sample households by the research assistants hired for this purpose. The questionnaire includes both open and closed ended questions. Four research assistants were hired to assist in the field data collection. Research assistants were trained by the researcher on how the household survey can be administered, the way they can approach the respondents, and research ethics.

3.7. Contingent Valuation Method (CVM)

This study employed the Contingent Valuation Method (CVM) to determine the willingness to pay for improved IBLI purchases. The CVM can be carried out in several ways. The method involve asking the respondents the amount he or she is willing to pay for a good/service described. CVM involves three basic things. First, the respondent was given detailed information about the commodity to be valued and the hypothetical scenario under which it is made available. For example, the structure under which the commodity is provided, the range of available substitutes and the method of payment. Second pay (WTP) is required. The respondents are asked for their maximum WTP (based on the IBLI conditions). Third, demographic information (such as age, gender, income) is needed to estimate the valuation function for the environmental commodity.

3.8. Data Analysis and Presentation

The data were entered, cleaned and analyzed using IBM SPSS Statistic 20 software. Both qualitative and quantitative techniques of data analysis were used. Quantitative data were analyzed by various descriptive statistics such as frequency distribution tables, graphs, charts, mean and standard deviations. Further logistic regression models were used to determine the factors that influence pastoralist household's willingness to pay to IBLI. In addition, qualitative data were presented in a rephrased and verbatim form and were analyzed by explorative analysis, which includes descriptions of response, content analysis and narratives of case studies.

3.8.1. Model Specification

Following the concept of the model from Gujarati and Porter (2009) the logit model for determinants of pastoralist household's willingness to pay for IBLI can be specified as below:

(1) $$P(Y_i = 1) = \frac{1}{1 + e^{-(\beta_i X_i)}}$$

(2) $$P(Y_i = 1) = \frac{1}{1 + e^{-Z_i}}$$

Where: P (Yi=1) is the probability that a household is willing to pay, Zi= the function of a vector of explanatory variables), e- represents the base of natural logarithms and equation (2) is the cumulative distribution function. If P (Yi=1) is the probability of households willing to pay, then 1- P (Yi=1) represents the probability that the household is not willing to pay and is expressed as: Dependent variable is variable, which takes 0 if the household is willing and 1, otherwise.

(3) $$1 - P(Y_i = 1) = 1 - \frac{1}{1 + e^{-Z_i}} = \frac{1}{1 + e^{Z_i}}$$

(4) $$\frac{P(Y_i = 1)}{1 - P(Y_i = 1)} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} = e^{Z_i}$$

Equation (4) simply is the odds ratio, the ratio of the probability that a pastoralist household willing to pay to the probability that household is not willing to pay. Taking the natural log of equation (4), we obtain

(5) $$L_i = \ln\left(\frac{p(Y_i = 1)}{1 - P(Y = 1_i)}\right) = Z_i$$

Where: L_i is the log of the odd ratio which is not only linear in the explanatory variables but in the parameters also. Thus, introducing the stochastic error term (u_i), the logit model can be written as

(6) Z_i ● β_0 $\beta_1 X_1$ $\beta_2 X_2$ ~~~. $B_n X_j$ u_i

Where X's = are explanatory variables that determines the household willingness to pay.

β_o is the constant term and β's are coefficients to be estimated.

3.8.2. Variable Definitions

Table 3: Variables definitions

Variables	**Variable definitions**	**Expected sign**
Age of household head	Continuous variable	-
Sex of household head	Nominal dummy variable, which takes 0 if male headed and 1 if female headed.	+/-
Marital status of household head	This is nominal categorical variable which takes 0 if single, 1 if married, 2 if married to two and above/polygamous, 3 if widowed and 4 if divorced.	+/-
Household size	Continues variable.	+
Literacy level of household head	This is dummy variable which takes 0 if non-literate, 1 literate	+/-
Exposure to drought risk	This is dummy variable which takes 0 if Yes, 1 if No	+
Access to training on IBLI	This is dummy variable which takes 0 if Yes, 1 if No	+
IBLI uptake	This is dummy variable which takes 0 if Insured, 1 if uninsured	+
Received payout before	This is dummy variable which takes 0 if Yes, 1 if No	+/-

3.9. Ethical Considerations

The study was conducted in a way that meets ethical standards. The researcher followed proper ethical standards by clearly communicating the purpose of the study to the respondents. The study ensured that (1) participation in the study was fully based on their willingness, (2) the data were used only for the purpose of the study, and (3) information were used without the name of the respondents attached to it (that is, under anonymity). Besides, the respondents were informed about their rights not to participate in the study.

4. Results and Discussions

4.1. Demographic Characteristics of the Respondents

The study, focusing on the perceptions and willingness to pay for Index-Based Livestock Insurance (IBLI) products, was carried out in Moyale Woreda, located within Ethiopia's Borana Zone. To ensure a representative sample, data was collected from two randomly selected kebeles: Bokola and Buladi.

Understanding how respondents' demographic traits affect their opinions on livestock insurance and their willingness to invest in IBLI is a crucial component of this study. Consequently, the basic demographic background of the study participants will be covered in detail in this section. It will specifically analyze their age, sex, marital status, and educational attainment, all of which are thought to have a major influence on how well they comprehend and accept livestock insurance mechanisms. The study intends to provide a thorough demographic profile of the respondents by looking at these fundamental traits, laying the groundwork for examining their opinions and willingness to pay for IBLI products.

Table 4: Demographic Characteristics of Households

Characteristics	Category	Freq. (%)
Age	Below 25	50 (25)
	25-65	143 (71.5)
	>=65	7 (3.5)
Sex	M	121 (60.5)
	F	79 (39.5)
Education status	Read & Write	44 (22)
	Non-literate	156 (78)
Marital status	Single	53 (26.5)
	Married (monogamous)	142 (71)
	Married (polygamous)	2 (1)
	Widowed	3 (1.5)
	Divorced	0 (0)

Source: Own Field Survey, 2023

The demographic profile of the respondents offers a foundational understanding of the community being studied, particularly in relation to their potential engagement with livestock insurance. The age distribution reveals a robust adult population, with 71.5% falling within the economically active 25-65 age bracket. This significant majority suggests that the study primarily captures the perspectives of individuals likely to be actively involved in livestock management and household financial decisions, making their insights highly relevant to understanding the uptake of IBLI products. A quarter of the respondents are younger than 25, representing a crucial segment whose risk perception and financial priorities might differ from older cohorts. Conversely, the small proportion (3.5%) of individuals over 65 indicates that the study's findings may be less representative of the very elderly, who might have different risk exposure or depend more on intergenerational transfers.

In terms of gender, the 60.5% of sample were male, while 39.5% are female respondents. This imbalance is important to consider, as gender roles within pastoralist communities often dictate distinct responsibilities and decision-making power concerning livestock and household finances. While men traditionally lead livestock sales and major financial transactions, women frequently manage daily animal care and household budgets, which could influence their perception of insurance benefits and their willingness to allocate resources towards it. Understanding these gendered dynamics will be crucial for interpreting the study's findings on insurance adoption.

Perhaps one of the most striking findings is the high rate of illiteracy, with 78% of respondents unable to read or write. This pervasive lack of literacy presents a significant challenge for communicating the often-complex concepts of insurance. It underscores the critical need for communication strategies that go beyond written materials, emphasizing oral explanations, visual aids, and community-based outreach to ensure that potential clients fully grasp the mechanics and benefits of IBLI. This characteristic highlights that product design and dissemination must be culturally sensitive and accessible to a largely non-literate audience.

Further, the predominant marital status among respondents is married, accounting for 71% of the sample. This suggests that household-level decision-making, which often involves a shared assessment of risks and benefits between spouses, will be a key factor in the adoption of insurance. The presence of single (26.5%), polygamous (1%), and widowed (1.5%) individuals introduces further nuances, as their household structures and financial responsibilities may vary, potentially influencing their perception and willingness to pay for IBLI. The strong

representation of married individuals implies that strategies targeting households as collective decision-making units may be particularly effective in promoting insurance uptake.

4.2. Livestock Holding

Livestock is not just a financial resource for the Borana pastoralists in Moyale Woreda and the larger Borana Zone; it is the foundation of their way of life and sense of cultural identity. Animal husbandry is the most important economic activity in the area since it is the foundation of their entire system of subsistence. In addition to being a major source of food through milk, meat, and occasionally blood, livestock offers a wide range of other advantages. In addition to being consumed directly, these animals are essential for generating revenue through sales, which enables pastoralists to purchase other necessary goods and services. Additionally, larger animals—cattle and horses in particular—provide crucial draft power for a variety of tasks, though this is more common in agro-pastoral settings where some cultivation takes place.

The harsh, arid, and semi-arid conditions that define the Borana's environment highlight the strategic significance of livestock. Livestock provides a robust and portable way to transform limited natural resources into material wealth and sustenance in regions where crop cultivation is frequently unstable due to erratic rainfall and recurrent droughts. By relocating their herds to access pasture and water resources, they are able to make use of large rangelands.

Cattle, camels, goats, sheep, and horses are the most common livestock species in the study woreda. Although their pastoral identity and wealth have traditionally revolved around cattle, especially the well-known Borana breed, there has been a growing trend towards diversification. Due to their increased drought tolerance and ability to adapt to harsher environments, camels and shoats (sheep and goats) are becoming more and more popular, particularly as a coping strategy against frequent droughts. Because these species can use a greater variety of forage and water sources, this diversification shows a practical response to environmental challenges and increases the resilience of pastoralist households. An essential component of a pastoralist lifestyle, mobility and transportation are further supported by the presence of horses. The Borana people's complete reliance on their animals for survival and prosperity is highlighted by this composition of livestock species, which shows a finely tuned adaptation to the local ecology and economic realities.

Largest proportion (92.41%) of respondents indicated that cattle is the dominant livestock species in the study area. In addition almost all (96.2%) respondents indicated that goat is domonant. Further signinficant percentages of respondents also replied that sheep (87.34%), camel (57.69%) and equines (12.66%) are the dominant livestock species in the study woreda. However, in KIIs and FGDs participants congurently attested that the number of livestock owned by pastoralists has reduced significantly due to the recent drought experienced in the Borana zone. Pastoralist in the woreda have lost over millions cattle. The number of cattle has reduced than other livestock species like goats and sheep. Currently, most households remained stockless.

4.3. Dominant Risks to Pastoral Livelihoods

Multi-hazardous situations often creates risks by disrupting livelihoods, damaging properties and life of people. The Borana pastoralist areas are a good example of how multi-hazard situations can severely disrupt livelihoods, destroy property, and claim lives. The study unequivocally highlights drought as the paramount threat, consistently ranked as the most frequent and economically devastating disaster impacting pastoralist communities. A staggering 86% of respondents explicitly identified drought as the most frequent shock they face.

While the Borana drylands have historically endured recurrent droughts, the current situation is unprecedented in its severity, length, and frequency. The damage and losses experienced by Borana pastoralists due to recent droughts are described as "never seen before in history." This is corroborated by participants in Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs), who attested to experiencing a catastrophic drought that persisted for three consecutive years. This prolonged absence of rainfall has led to critical shortages of pasture and water, resulting in the widespread emaciation and massive deaths of livestock, particularly cattle, which are the primary asset and pride of the Borana. Reports indicate that over 2.3 million heads of livestock have died due to prolonged drought, leaving over 67,000 households with no livestock whatsoever. This complete loss has transformed formerly wealthy pastoralists into destitute individuals, with some even resorting to suicide.

Beyond the devastating environmental impacts, the study also reveals that inter-ethnic conflict poses the second most catastrophic hazard, particularly in areas where Borana pastoralists share boundaries with other ethnic groups. These prolonged conflicts are a disastrous hazard for both the Borana and their neighboring communities. These conflicts, often rooted in competition

over increasingly scarce resources like grazing land and water due to intensifying drought, have escalated significantly. For instance, violent clashes between the Borana and Garri clans, particularly around Moyale town, have claimed hundreds of lives and led to massive displacement. The implementation of ethnic federalism in Ethiopia, which delineated administrative boundaries along ethnic lines, has also complicated traditional resource-sharing mechanisms and exacerbated these disputes. This ongoing instability further compounds the vulnerabilities of pastoralists, hindering their ability to recover from environmental shocks and sustain their traditional way of life.

According to *Borena Zone Multi-Agency Rapid Assessment Report* (Borana zone, 2022), the absence of five consecutive seasons of rainfall resulted in prolonged drought in the area. Borana area receives a bimodal pattern of rainfall with the main rains (ganna) falling between March and May, and the short rains (hagayya) between September and November. The recent drought is due to the failure of rain for three years. Lack of rain for three years increased earth's surface temperature and dryness, which resulted in a critical shortage of pasture and water that lead to the emaciation of livestock and massive deaths of livestock particularly cattle, which is the main livelihood asset of the community. All of the respondents (100%) reported the death of livestock particularly cattle. Zonal report confirmed that above 2.3 million heads of livestock have died due to prolonged drought, which left above 67 thousand households with no livestock. Not only is the productivity of livestock affected, but also the production of agro-pastoralist communities that practice farming beside livestock. These three years have been suffering for Borana pastoralists.

According to participants in KIIs and FGDs, this prolonged drought resulted in critical shortage of pasture and water that lead to deterioration of livestock body condition and productivity, and massive deaths of livestock particularly cattle, which is the main livelihood asset of the community. In some areas shoat and camel showed poor physical conditions and death is also recorded. One of the KII indicated that on the other hand, the price of livestock dramatically declined during the drought. This attributed to the macro-economic challenges (inflation), and the decline in labor income, and presence of drought induced IDPs negatively affected the household food security situation.

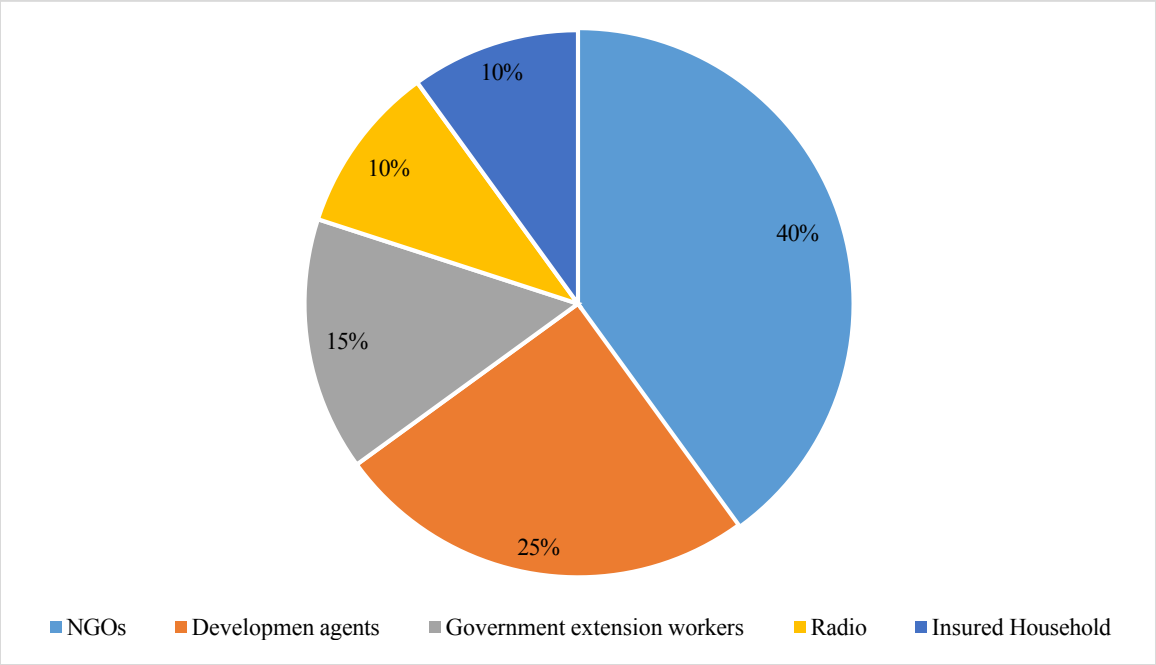
4.4. Knowledge and Awareness of the Pastoralist Households on the Livestock Insurance Policy

4.4.1. Awareness of Pastoralist on Livestock Insurance

The study revieled that, out of the 200 pastoral and agropastoral households participated in the survey, largest majority (89 %) were aware of the existing livestock insurance policy. This indicates that community are highly aware of index based livestock insurances. Similar study in Nepal found that largest proportion of the farmers responded they aware that insurance as an effective tool for risk management (Nepali, 2021). High awarness of community about livestock insurances is attributed to high awarness creation works created through various means of communications by various development actors that operates in the woreda. From various means of information dissemintation mechanisms, 40 percent had learned about the the existing insurance policy from NGOs, 25 percent had learned from development agents, 15 percent from government extension workers,10 percent learned from radio, 10 percent from insured household.

During the interview, most respondents indicated that different national and internation NGOs operate in their kebele. One of the respondents from Bokola kebele affirmed that, CIFA and other NGOs gave them the awareness on the benefits of index-based livestock insurance. Not only CIFA gave them awareness, but also “they support fifty percent of the insurance you purchase,” he added. The informants confirmed that, Bokola kebele is among the top beneficiary of livestock insurance and received the highest payout, which helped build the resilience of pastoralists to some extent. Another respondent from Buladi kebele confirmed that, large numbers of their kebele members benefited from livestock insurance payout during severe drought. The study also revieled that somehow, the government developmenet agents and extension workers are also raising the awarness of the pastoralist on livestock insurance policy. Further, small amount of pastoralist also learned about the scheme from the radio and insured household. This indicate that pastoralist have low access to radios and low willingness of households not insured to learn about the the scheme from insured household. The study by Nepali (2021) also confrimed that sources of information for insurances were radio, television, newspaper in Nepal.

Figure 3: Sources of Livestock Insurance Information



The insights from the Focus Group Discussions (FGDs) provide a rich qualitative complement to the quantitative data, strongly reinforcing the finding that Borana pastoralist households possess a notable level of awareness regarding existing livestock insurance policies. More importantly, these discussions revealed that this awareness extends beyond mere recognition; participants demonstrated a clear understanding of the insurance's fundamental role in mitigating risks associated with their cattle production activities.

This nuanced comprehension suggests that pastoralists are not just vaguely familiar with the concept of insurance, but actively perceive it as a tool for safeguarding their most vital asset. Their discussions often centered on how such policies could alleviate the devastating financial repercussions of cattle losses, particularly in the face of escalating environmental shocks like recurrent droughts, which have been increasingly severe. This indicates a pragmatic assessment of insurance as a strategic component of their overall risk management portfolio, rather than just an abstract financial product.

The direct testimonies from the FGDs illuminate how pastoralists connect the policy to tangible benefits, such as ensuring a more stable livelihood even when faced with significant challenges to their herds. Their insights likely stem from lived experiences of vulnerability and the imperative to protect their cattle, which serve as their primary source of food, income, and social standing. This deep-seated understanding of the insurance's protective function for their

cattle, as expressed in the FGDs, bodes well for the potential for broader adoption and effective utilization of such risk reduction mechanisms within these vulnerable communities. It also emphasizes the importance of continuing to tailor and communicate insurance products in a way that resonates with their lived realities and perceived needs.

The knowledge and awareness of pastoralists on the index-based livestock insurance was assessed based on five scale Likert scale questions asked to explore the perceptions and awareness of the pastoralists on IBLI. The pastoralists were asked to state their agreement level as strongly agree (SA), agree (A), neutral (N), disagree (D), and strongly Disagree (SD). The result of these questions is presented in the **Table 5** below.

Table 5: The Knowledge and Perception of Pastoralists on IBLI

Statement	**Knowledge and Perception**				
	SA Freq. (%)	**A** Freq. (%)	**N** Freq. (%)	**D** Freq. (%)	**SD** Freq. (%)
I have heard about index-based livestock insurance	80 (40)	112 (56)	3 (1.33)	0 (0)	5 (2.67)
I know it sold by Oromia insurance company (OIC)	16 (8)	27 (13.34)	66 (33.33)	91 (45.33)	0 (0)
I know how it is sold	28 (14)	56 (28)	48 (24)	60 (30)	8 (4)
I have attended training on IBLI	13 (6.67)	(41.33)	(29.33)	(20)	(2.67)
It is effective mechanisms to mitigate weather shocks	16 (8)	77 (38.67)	48 (24)	48 (24)	11 (5.33)
It can reduces adverse consequences of drought	33 (16.44)	90 (45.21)	41 (20.55)	31 (15.07)	5 (2.74)
I know benefits of insurance policy	120 (60)	40 (20)	30 (15)	10 (5)	0 (0)
I have insured all of my livestock	90 (45)	64 (32)	30 (15)	12 (6)	4 (2)

I have insured only cattle	104 (52)	48 (24)	30 (15)	10 (5)	8 (4)
I have received IBLI payout	142 (71)	38 (19)	12 (6)	8 (4)	0 (0)

Note: (SD): Strongly Disagree, (D): Disagree, (N): Neutral, (A): Agree, (SA): Strongly agree

Source: Own field survey, 2023

As can be seen from the **Table 5** above, more than half (56%) of respondents agreed that they have heard about index-based livestock insurance. Quite good proportion of respondents strongly agreed with the idea. Closely looking at the idea that, insurance is sold by the Oromia Insurance Company (OIC) nearly half (45%) of pastoralist responded they disagree with the idea, while (33.33%) again say they are neutral with the idea. Regarding the idea that pastoralists know about how the insurance is sold, some proportion (30%) from the respondents revealed they disagree, while 28% of respondent agreed with the idea. Furthermore, a proportion of the respondents quite nearest to half (41.33%), agreed with the idea that, they have attended the training on IBLI. However, 29.33% of them wanted to stay neutral from this idea. In addition, 38.67% of the students agreed that, index based livestock insurance is effective mechanisms to mitigate weather shocks. However, 24% from respondents say they rather prefer to stay neutral and 24% disagree with the idea. Further, respondents were asked whether IBLI reduces adverse consequences of drought or not. Consequently, nearly half (45.21%) of the respondents agreed with the idea. Generally largest proportions (60%) of the respondents strongly agreed that they know the benefits of the insurance policy. Significant proportion of the respondents (40%) said they have benefited from the livestock insurance policy. Further, nearly half (45%) the respondents strongly agreed that they have insured all of their livestock, while more than half (52%) strongly agree that they have insured only cattle. The study also found that largest proportion (71%) of the respondents have received payout.

4.4.2. Status of Insured households

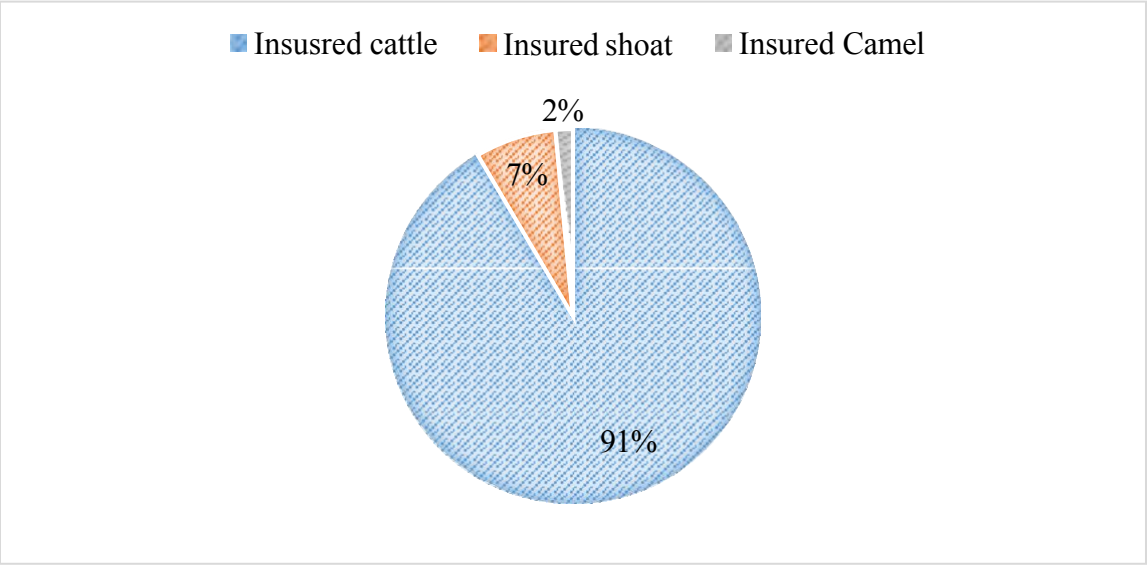
Figure 4 provides a critical insight into the composition of insured livestock within the study area, revealing a strong preference for insuring cattle among Borana pastoralists. The data indicates that an overwhelming majority of respondents, specifically 91.5%, have chosen to purchase livestock insurance for their cattle. This significant proportion underscores the paramount economic and cultural importance of cattle to these communities, aligning with their traditional reliance on cattle as the primary store of wealth, source of sustenance, and symbol of social status. The high concentration of insurance coverage on cattle suggests that

pastoralists perceive this species as their most valuable and vulnerable asset, thus prioritizing its protection against adverse events.

In contrast, the uptake of livestock insurance for other species, such as shoats (sheep and goats) and camels, remains considerably lower. Only 7% of respondents purchased insurance for shoats, while an even smaller 1.5% opted for camel insurance. This disparity can be attributed to several factors. Cattle generally represent a higher individual value compared to shoats, making their loss more financially catastrophic for a household. While camels are also highly valued for their drought resilience and transport capabilities, their relatively smaller numbers within individual herds and potentially different risk profiles or existing coping mechanisms might explain the lower insurance penetration.

This distribution of insured livestock highlights a potential area for targeted intervention and awareness campaigns for IBLI providers. While the current focus on cattle is understandable given its central role in pastoral livelihoods, promoting the benefits of insuring shoats and camels could further enhance the overall resilience of pastoralist households. Shoats, for instance, are often seen as a crucial asset for faster recovery after droughts due to their quicker reproductive cycles and adaptability, while camels offer unparalleled resilience in the face of extreme aridity. Understanding the specific risk perceptions, economic valuations, and traditional risk management strategies associated with each livestock type would be essential for designing and promoting more diversified and comprehensive IBLI products that cater to the full spectrum of pastoralists' needs.

Figure 4: Percent of Insured Livestock Species



As can be seen from the table 6 below, pastoralist has been paying different prices for insurances for different livestock species. For instance, largest proportion of the respondents (80%) indicated that the previous insurance price for one cattle is less than 300 Ethiopian birr (ETB), while 20% of the respondents indicated that the insurance price for one cattle is greater than 300 ETB. The insurance price for one camel is also greater than or equal to 500 birr as confirmed by largest proportions (75%) of the respondents. The study indicated that for shoats (Goat and sheep) they insurance price is greater than 100 birr as confirmed by 67% of the respondents.

Table 6: Previous Insurance Price for Different Livestock Categories

Livestock category	
Cattle	**Freq. (%)**
< = 300	160 (80)
> 300	20 (20)
Camel	
<500	50 (25)
>= 500	150 (75)
Goat and Sheep	
< 100	66 (33)
>= 100	134 (67)

The financial aspects of livestock insurance among Borana pastoralists, as detailed in Table 7, illuminate the tangible impact of these policies on their livelihoods. All monetary values discussed are in Ethiopian Birr (ETB).

The study found a clear prioritization in the allocation of insurance coverage. For cattle, the most significant asset, the maximum insurance purchase recorded was 760 Birr. This figure suggests a substantial commitment by individual pastoralists to protect their cattle herds. In comparison, the maximum purchase for shoats was considerably lower at 250 Birr, and for camels, it was 500 Birr. This hierarchy of insured values directly reflects the perceived economic importance and vulnerability of each livestock species.

Delving into the average investment, the mean purchase for cattle was 299.68 Birr, reinforcing that a notable average sum is consistently allocated to cattle insurance. The mean purchases for

other livestock types were significantly less: 125 Birr for camels, 98.33 Birr for goats, and 68.75 Birr for sheep. This pattern confirms that pastoralists are strategically investing their resources, focusing on safeguarding their highest-value assets while perhaps managing risks for smaller ruminants and camels through other traditional or informal mechanisms.

Crucially, the effectiveness of this insurance mechanism is evident in the payouts received. The data shows that the maximum payout received by a respondent during a previous payout period was a remarkable 43,100 Birr. This substantial sum highlights the capacity of the insurance scheme to provide significant financial relief during times of severe losses. Furthermore, the mean payout received was 15,420 Birr, indicating that on average, insured pastoralists are receiving considerable compensation. These payouts are vital, acting as a critical safety net that enables pastoralist households to cope with the devastating economic consequences of events like drought-induced livestock mortality. Such financial injections can be used for restocking lost animals, purchasing supplementary feed and veterinary services for surviving livestock, or even for direct household consumption, thus preventing deeper destitution and facilitating recovery. The tangible value of these Birr payouts solidifies the perceived benefit and utility of livestock insurance within the Borana community.

Table 7: Livestock Insurance Purchase and Payout Received

Variable	Obs	Mean	Std. Dev.	Min	Max
Cattle insurance price	200	299.68	149.31	0	760
Camel insurance price	200	125	250	0	500
Goat insurance price	200	98.33	64.85	0	250
Sheep insurance price	200	68.75	88.38835	0	250
Payout received	200	15420	16894.96	0	43100

4.4.3. Constraints of Livestock Insurance

The study found that pastoralist faces different constraints/challenges. Table 8 below shows the constraints of livestock insurance among livestock owners. Lack of awareness, inadequate information and limited choices on livestock insurance products were major constraints.

Kandel (2019) reasoned out lack of awareness, unwillingness of the farmers due to complex process of insurance and delay in the claim payment by the insurance company for livestock not insuring their livestock. However, insurance companies also faced problems like moral hazard and adverse selection. Moral hazard was the reason for livestock insurance yet to be widely adopted in most countries (A. Mude et al., 2013). Kandel (2019) reported lack of awareness, complex documentation and tedious claim payment for having low number of insurance adopting farmers. Similar findings and suggested adequate publicity of insurance scheme, making insurance procedure easier and quick settlement of claims (Kebede et al., 2020).

Table 8: Distribution of the respondents based on the constraints of livestock insurance

Constraints of livestock insurance among livestock owner	Strongly agree (%)	Agree (%)	Disagree (%)
Inadequate information about livestock insurance	62.22	20	17.78
Complex procedure for attainment of livestock insurance	35.56	28.89	35.56
Excessive wastage of time during procedure of livestock insurance	15.56	28.89	55.56
Inadequate information about claim amount	33.33	35.56	31.11
Post-mortem of animal was not done in due course of time	15.56	37.78	46.67
Getting livestock insurance claim is a lengthy and time taking process	31.11	35.56	33.33
Inability to pay insurance premium in one installment	6.67	28.89	64.44
Less number of financial institution providing livestock insurance	44.44	33.33	22.22
Less faith of livestock owner in getting adequate livestock insurance claim	42.22	31.11	26.67

Financial institution providing less coverage against risk	42.22	42.22	15.56
Inadequate awareness program by Government Animal Husbandry Department about livestock insurance	68.89	24.44	6.67
Distantly located veterinary hospital for contacting veterinarian and conducting post-mortem of animal	17.78	33.33	48.89
Less coverage by insurance policies	26.67	53.33	20
Presence of limited choices in insurance product suitable to socio- economic condition of livestock owner	53.33	42.22	4.44
Maintenance and preservation of documents for getting claim after loss of animal	20	42.22	37.78

4.5. Pastoralist Households Willingness to Pay for Index-Based Livestock Insurance

To accurately gauge the economic value pastoralist households place on Index-Based Livestock Insurance (IBLI), a Contingent Valuation Method (CVM) was strategically employed in this study. This robust survey-based approach is particularly effective for eliciting willingness to pay (WTP) for non-market goods and services, such as insurance, where traditional market prices are not readily available. The findings are highly encouraging: out of the total respondents, a significant 76% expressed a positive willingness to pay for IBLI across various categories of livestock. This high percentage signals a strong recognition among Borana pastoralists of the inherent value and protective benefits that livestock insurance can offer in mitigating the severe risks they face, particularly from increasingly frequent and intense droughts. The specific maximum willingness to pay for each livestock category, as presented in Table 7, further disaggregates this overall positive sentiment, offering granular insights into how pastoralists prioritize their insurance investments across different types of animals within their herds.

4.5.1. The Maximum Willingness to Pay

The survey utilized the Contingent Valuation Method to specifically ascertain the maximum willingness to pay (WTP) for IBLI for each key livestock category: cattle, camels, and shoats. The results, comprehensively detailed in Table 9, reveal a nuanced distribution of WTP values across the surveyed households, indicating that pastoralists hold diverse perceptions of the optimal premium they are willing to bear for this critical risk management tool.

For cattle insurance, which is clearly the most prioritized, a significant proportion of respondents exhibited a willingness to pay within a specific range. The largest single group, 32% of households, were prepared to pay 150 Birr for cattle insurance. This suggests a strong clustering around a particular price point that many perceive as affordable and justifiable for protecting their most valuable assets. Closely following, 30% of respondents expressed a WTP of 300 Birr, indicating another substantial segment that values the insurance highly and is willing to invest a greater sum. Furthermore, about 13% were willing to pay 200 Birr, while 8% were prepared to pay 280 Birr. The distribution also includes smaller, yet notable, segments at higher price points: 5.5% willing to pay 320 Birr, 3.5% at 350 Birr, and 2% at 400 Birr for cattle insurance. This detailed breakdown of WTP values for cattle insurance is particularly insightful, as it provides crucial information for designing tiered premium structures or flexible payment options that could cater to the varying financial capacities and risk perceptions within the Borana pastoralist community, ultimately enhancing the accessibility and uptake of IBLI products.

Table 9: Summary of Maximum Willingness to Pay for Purchase Insurance

Reported Maximum WTP for cattle (Birr)	Freq. (%)	Reported Maximum WTP for camel (Birr)	Freq. (%)	Reported Maximum WTP for shoat (Birr)	Freq. (%)
less than 150	12 (6)	less than 200	46 (23)	less than 50	34 (17)
150	64 (32)	300	40 (20)	50	34 (17)
200	26 (13)	500	114 (57)	100	71 (35.5)
280	16 (8)			110	21 (10.5)

300	60 (30)			150	24 (12)
320	11 (5.5)			250	16 (8)
350	7 (3.5)				
400	4 (2)				

Source: Own field survey, 2023

Beyond cattle, the survey also meticulously captured the willingness to pay (WTP) for insurance on other vital livestock, namely camels and shoats, revealing distinct patterns that reflect their differing economic roles and perceived values within pastoralist households.

For camel insurance, a significant majority of respondents, 57%, expressed a willingness to pay 500 Birr. This strong consensus around a higher premium for camels highlights their increasing importance in an era of climate change, given their superior drought resilience compared to cattle. This high WTP suggests that pastoralists recognize the strategic value of camels as a more reliable asset in harsh conditions and are prepared to invest accordingly to protect them. The remaining respondents were divided, with 20% willing to pay 300 Birr and 23% willing to pay less than 200 Birr, indicating some variability in perceived value or affordability, but with a clear lean towards higher investment.

When it comes to shoat insurance, the WTP values, while lower in absolute terms, still show a strategic intent to protect these faster-reproducing assets. The most common response, from 35.5% of respondents, was a willingness to pay 100 Birr for shoat insurance. This suggests a perceived optimal balance between the premium cost and the value of protecting smaller ruminants. A substantial portion, 17% of respondents, were willing to pay 50 Birr or even less than 50 Birr, indicating that for some, even a minimal premium for shoats is acceptable. Furthermore, 12% were willing to pay 150 Birr, while 10.5% opted for 110 Birr, and 8% were willing to pay 250 Birr. This spread of WTP values for shoats, though generally lower than for cattle or camels, provides critical data for developing flexible and affordable insurance products tailored to the specific economic contribution and risk profile of small ruminants within pastoralist livelihoods. The insights gained from these varying WTP figures for all livestock categories are invaluable for designing IBLI products that are not only actuarially

sound but also culturally relevant and economically feasible for the Borana pastoralist community.

4.6. Determinants of Pastoralist Households' Willingness to Pay for Index-Based Livestock Insurance

To identify the factors influencing pastoralist households WTP for index based livestock insurance the dependent variable was regressed against socioeconomic characteristics of the households and the results reported in table 8 below. The study revealed that the majority of the respondents were willing to pay for IBLI. To identify the factor that influences the pastoralists household's willingness to pay, binary logistic regression model was used. Though logit models do not make several assumptions that linear models made, certain assumptions need to be met to undertake logit regression model. Binary logistic regression model is one of the econometric model used to analyze the relationship between the dichotomous dependent variable and the independent variables. It enabled to determine the impact of multiple independent variables on the dependent variable. The objective was to identify the factors that determine households WTP in the study area. Thus, households WTP was measured as a binary dummy variable (0 = willing, 0 = not willing).

The assumptions of binary logistic regression were tested before using the results of the binary logistic regression. Thus, the assumptions of goodness of fit, model specification and multicollinearity were tested. The goodness-of-fit test was conducted to test model specification and whether data fitting was made. The result (pseudo R2 = 0.6756, Prob > chi2 = 0.0000) revealed that the model as a whole is statistically significant, as compared to the empty model with no predictors. The pseudo-R squared of 0.6756 indicates that 67.56 % of variability in household willingness to pay was explained by the predictors. In addition, Variance Inflation Factor (VIF) is used to check the occurrence of multicollinearity problems. As a result, the value of VIF was less than 10 for all independent variables. Therefore, there is no multicollinearity problem. The independent variables determine the dependent variable very well and the model is reasonably fitted well.

Table 10: Logistic regression result for factors influencing the households WTP

HH WTP	Coefficient(β)	S.E.	Sig.
Age	-0.184	0.049	0.000*
Famsize	0.828	0.257	0.001*
Sex	-1.549	0.818	0.058**
Litracy	1.849	1.296	0.154
Marital status	-0.005	0.017	0.764
IBLI training	2.759	0.723	0.000*
Insured livestock	0.606	0.582	0.298
Drought shock	3.038	0.916	0.001*
Received payout	3.104	0.728	0.000*
Constant	4.217	1.572	0.007
			Number of obs = 200
			Wald chi2 (27) = 89.71
			Prob > chi2 = 0.0000
			Pseudo R2 = 0.6756

* Statistically significant at 1% (p<0.01), ** statistically significant at 10% (p<0.1)

As can be seen from the Table 10 above, generally, households' willingness to pay for the purchase of index-based livestock insurance was associated with various household demographic characteristics. Households WTP are influenced by Age of households, family size, sex of household head, IBLI training, drought shock and received payout.

Age of household head: The binary logistic regression analysis revealed that the age of the household head was negatively and significantly related to community participation in SWC practices at 1% significant level. Age of household head was strongly and negatively associated with households WTP. An additional increase in age of household head decrease household WTP. It can therefore be understood that for every year of increase in age of a head, the probability of not willing to pay for index-based livestock insurance is lower for household lead by elderly. Similarly the study by (Oduniyi et al., 2020) states that age of household head is associated with pastoralists willingness to pay for livestock insurance.

Sex of Household head: Similarly, sex of household head was statistically significant and negatively affects households WTP. The study found that male-headed households were more willing to pay to IBLI. The results of econometric model showed that one unit change in sex of household head, i.e., changing from male headed to female-headed decrease households willingness to pay for livestock insurance.

Household size: The binary logistic regression analysis revealed that family size was positively and significantly related to household WTP at a 1% significant level. This show that the likelihood of households WTP for the purchase of livestock insurance increases as respondents' family sizes increase. Households willingness to pay for livestock insurance probably increase due to the fact that largest families are more vulnerable to drought shocks and thus they are more likely to purchase livestock insurance to receive good payout later.

IBLI training: Training on the IBLI is believed to have positively influenced the households WTP to purchase livestock insurance. The results of a binary logistic regression analysis revealed that households WTP is positively correlated with IBLI training and significant at a 1% significant level. This means that the households who go access to the training are more likely to pay for the purchase of IBLI for all categories of livestock,

Drought shock: Another variable that turned out significant is the exposure of the drought. Drought is one of the shocks that affects the livelihoods of the pastoral communities in many ways. The outcome of binary logistic regression analysis showed that the exposure to drought have a positive and significant relationship with households WTP at a 1% significant level. This implies that exposure to the shocks like droughts related to high willingness of households to purchase IBLI products.

Received payout: The results of a binary logistic regression analysis revealed that households that received payout were positively correlated with households' willingness to pay and significant at a 1% significant level. It is believed that households that received payout are more likely to pay for the purchase of different categories of IBLI products than households who do not receive the payout.

5. Conclusions and Recommendations

5.1. Conclusions

The study was conducted on the pastoralist household's willingness to pay for index-based livestock insurance in the Moyale woredas of Borana zone. The study used mixed research design. Data was collected using desk reviews, key Informant Interview (KIIs), Focus Group Discussions (FGDs) and household survey. This study employed the Contingent Valuation Method (CVM) to determine the willingness to pay for the purchase of index-based livestock insurances. Data were analyzed by various descriptive statistics such as frequency distribution tables, graphs, charts, mean and standard deviations. Further logistic regression model was used to determine the factors that influence pastoralist household's willingness to pay for IBLI. The study found that pastoralism which is a complex interaction of people, natural resources, and livestock is predominantly practiced in the study woreda. In the study area climate risks pose significant threats to sustained pastoral development and livestock production. Drought is one the most common risks that often create disruptions of livelihoods, damages properties and life of people. The study revealed that among the problems that create multi-hazard situations in pastoral areas, drought is ranked first. The most recent drought have resulted in the death of millions of livestock and disruptions of livelihoods in the study woreda. Index-based livestock insurance is found to be the most promising methods to mitigate shocks posed by the co-variate of the climate shocks. The findings of this study suggest that livestock insurance uptake can reduce the adverse effects of these risks.

The study assessed the awareness and perceptions of pastoral households on index-based livestock insurance. The study found that significant proportion of households has already started benefiting from insurance payout. Largest proportions of respondents were aware of the existing livestock insurance policy. This indicates that the community is highly aware of index based livestock insurances. High awarness of community about livestock insurances is attributed to high awarness creation works creared through various means of communications by various development actors, radios, government extension workers, NGOs and insured households. This indicates the existence of various means of insurance information dissemination mechanisms.

The study also found the purchase of insurance policy is largest for cattle than other livestock categories. This implies that in the pastoral and agro-pastoral areas of study area, cattle are mostly affected by the impacts of shocks as compared to other livestock categories. This also

implies that other livestock species like goats and camels are more drought resistant. With regards of the price of one insurance for different categories of livestock, the study found that pastoralist propose lowest price options than previous pricing options. For instance, largest proportion of respondents prefer the price of one insurance to be less than 300 birr for cattle and about 100 birr for goat and 500 for camel. The study also found that though largest proportion of pastoralist insured their livestock still there are lack of adequate information and awareness on livestock insurance, and limited choices on livestock insurance products.

The results of a contingent valuation analysis revealed that, out of the total respondents that were participated in the study, about 76 percent of the households had a positive willing to pay for the purchase of livestock insurance for different categories of livestock. This implies that, if large awareness raising campaign is undertaken, the community will have high willingness to pay for insurance products. The study however, found that household's willingness to pay for the purchase of index-based livestock insurance was associated with various household demographic characteristics. From all explanatory variables of household WTP, age of households, family size, sex of household head, IBLI training, drought shock and receipt of payout are found to influence the households WTP for livestock insurance.

5.2. Recommendations

To increase the household's willingness to pay for index-based livestock insurances and raise the awareness of the community, this study has made the following recommendations.

- Multi-hazardous risks like drought which put pastoralists households in shocks should be recognized by stakeholders at the national and local levels
- National, zonal and local level disaster risk management stakeholders and non-state actors that work on disaster risk reductions should work on strengthening the drought early warning mechanisms to increase the preparedness of the community to shocks.
- The knowledge and awareness of the pastoralists households on the benefits of the index-based livestock insurances should be increased though various awareness creation campaigns by NGOs that work on livestock insurances, concerned government sectors and the insurance companies.
- National and international NGOs that works on insurance should establish sustainable mechanisms for raising of insurance awareness and dissemination of insurance

information through establishment of disaster risk management and early warning, and livestock insurance committees.

- Zonal and local government should also work on raising the awareness of the pastoralist households on livestock insurances through strengthening of its local structures like development agents and government extension workers.
- National and international NGOs operating in the area and local governments should make use of the local min-medias like radio to reach out the pastoralist community and disseminate information about index-based livestock insurances.
- The insurance companies and other stakeholders should work more on selling of the insurance premium for cattle categories to reduce the adverse impacts from the loss of cattle due to recurrent drought.
- To increase the purchase of insurance products, the insurance companies should reduce the price of one insurance for all categories of livestock and increase the payout amount. For instance, the insurance price should be less than 300 birr for cattle and about 100 birr for goat and 500 for camel.
- To increase the pastoral households' willingness to pay for index-based livestock insurance, NGOs, local and national government should work on improving the socioeconomic status of the pastoralist households, provisions of the continuous training on the adverse impact of drought shock and role of insurance.

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Appendices

Household Survey

Instruction: You are not required to write your name and Please put a **"✓"** mark in the box and fill the answer in blank space for other questions.

Questionnaire Number _____

Kebele Bokola ▲

Buladi ▲

Village _____

Date of Interview _____

I. Demographic and Socio-Economic Characteristics of the Respondent

[1]. Gender of household head 1. Male ☒ 2. Female ☒

[2]. How old are you? _____Years old.

[3]. Marital status

1. Single ☒ 4.Widowed ☒
2. Married (monogamous) ☒ 5.Divorced ☒
3. Married (polygamous) ☒

[4]. Household size _____

[5]. Literacy level of household head. 1.Non-literate ☒ 2.Read and write ☒

II. Knowledge and awareness of the Pastoralist Households on the livestock insurance policy

[1]. What are dominant livestock species in your area? **Multiple answers are possible**.

1. Cattle ☒ 4. Sheep ☒
2. Goat ☒ 5. Camel ☒
3. Others _____

[2]. How many numbers of livestock do you have?

1. Cattle _____ 4. Camel _____
2. Goat _____ 5. Others _____
3. Sheep _____

[3]. What are the dominant shocks you have experienced in last five years? **Multiple answers are possible**.

1. Prolonged drought ☒
2. Animal disease epidemic ☒
3. Human disease ☒
4. Heat stress ☒
5. Flooding ☒
6. Conflicts ☒

Others

(specify)_____

_____

_____

[4]. Do you think the drought is the most frequent shocks you have been experiencing?

1. Yes ☒ 2. No ☒

[5]. Have you been affected by drought? 1. Yes ☒ 2. No ☒

[6]. In which year did the last drought occur? _____

[7]. For how long the drought extended? _____(years)

[8]. If your answer for question **no. "5"** is "**Yes**", how many livestock your households have lost to the recent prolonged drought.

1. Cattle _____
2. Goat _____
3. Sheep _____
4. Camel _____
5. Others _____

[9]. Estimate the value of loss due to this drought in Ethiopian birr. _____

[10]. Do you know anything about livestock insurance in this district?

1. Yes ☒ 2. No ☒

[11]. How do you get information about index-based livestock insurance?

1. Radio ☒
2. Development Agent ☒
3. Insured Household ☒
4. NGOs ☒
5. Government extension workers ☒
6. Insurance company ☒

[12]. What do you know about index-based livestock insurance? (put a "✍" mark for your choice)

No.	**Statement**	Strongly Agree	agree	Neutral	Disagree	Strongly Disagree
1.	I have heard about index-based livestock insurance					
2.	I know it sold by Oromia insurance company (OIC)					
3.	I know how it is sold					
4.	I have attended training on IBLI					
5.	It is effective mechanisms to mitigate weather shocks					
6.	It can reduces adverse consequences of drought					
7.	I know benefits of insurance policy					
8.	I have insured all of my livestock					
9.	I have insured only cattle					
10.	I have received IBLI payout					

[13]. Have you insured your livestock? 1. Yes ☒ 2. No ☒

[14]. When you have adopted the insurance _____(year)

[15]. Which insurance company provided the services _____

[16]. If your answer for question **no. 13** is "**Yes**", what number of livestock species you have insured?

S/N	**Category**	**Price of one insurance per category**	**No. of livestock species insured**	**Payout received**
1	Cattle			

2	Camel			
3	Goat			
4	Sheep			
5	Equines			
Total amount of payout received				

[17]. If your answer for question **no. 13** is "**NO**", why you have not insured your livestock? 1. Not aware of the scheme ☒ 5. Scheme is too expensive ☒
2. I do not know the importance of the scheme ☒ 6. Not interested ☒
3. I do not trust the insurance companies ☒ 7. Lack of money ☒
4. Not enough government subsidy ☒

[18]. Have you encountered any challenges with the insurance providers?
1. Yes ☒ 2. No ☒

[19]. If your answer for question **no. 18** is "**Yes**", list the challenges you have faced?

_____
_____
_____
_____
_____
_____
_____

[20]. What are the constraint for livestock insurance? (put a **"✍"** mark for your choice)

Constraints of livestock insurance among livestock owner	Strongly agree	Agree	Disagree
Inadequate information about livestock insurance			
Complex procedure for attainment of livestock insurance			
Excessive wastage of time during procedure of livestock insurance			

Inadequate information about claim amount			
Post-mortem of animal was not done in due course of time			
Getting livestock insurance claim is a lengthy and time taking process			
Inability to pay insurance premium in one installment			
Less number of financial institution providing livestock insurance			
Less faith of livestock owner in getting adequate livestock insurance claim			
Financial institution providing less coverage against risk			
Inadequate awareness program by Government Animal Husbandry Department about livestock insurance			
Distantly located veterinary hospital for contacting veterinarian and conducting post-mortem of animal			
Less coverage by insurance policies			
Presence of limited choices in insurance product suitable to socio- economic condition of livestock owner			
Maintenance and preservation of documents for getting claim after loss of animal			

III. Pastoralist households willingness to pay for Index-Based Livestock Insurance

It is known that insurance companies have their own policies and mechanisms for calculating the price of the insurance. Suppose that you will be given a chance to determine the IBLI pricing and will be able to determine the maximum price for all categories of insurance. Having in mind the previous prices for one insurance pastoralist households are paying answer the following questions.

[1]. How is IBLI product price calculated in your area?

_____

_____

_____

_____

[2]. How many times you have received the IBLI payout?

1. Only once ☒ 2. Two times ☒ 3. Three times ☒ 4. Four times ☒

5. Others _____

[3]. During which season of the year do you buy the IBLI product?

1. Rainy season/Ganna/ ☒ 3. Short rainy season/Hagayya/ ☒

2. Interim cool dry season/Adoolessa/ ☒ 4. Dry season/Bona/ ☒

[4]. For how long does the insurance you bought one time serve you? _____

[5]. Are you satisfied with previous IBLI price for one livestock?

1. Yes ☒ 2. No ☒

[6]. What is the price of one IBLI product you were paying previously?

Category	**Price of one insurance**
Cattle	
Camel	
Goat	
Sheep	
Equines	

[7]. From your assessment are the pastoral communities in your areas area willing to pay for this IBLI pricing options?

1. Yes ☒ 2. No ☒ 3. I am not Sure ☒

[8]. Are you willing to pay for this index-based livestock insurance?

1. Yes ☒ 2. No ☒ 3. I am not Sure ☒

[9]. If your answer for question **no. 8** is **"Yes**", how much would your household be willing to pay for IBLI product now?

Category	**Price of one insurance**
Cattle	
Camel	
Goat	
Sheep	
Equines	

[10]. What are the motives behind for your willingness to pay for IBLI?

_____

_____

_____

_____

_____

_____

_____

[11]. If your answer for question **no. 8** is **"No**" or you are **not willing to pay** for IBLI product, could you tell me the reason why your household does not want to pay anything for IBLI?

1. I do not trust they pay me later during shock
2. I cannot afford to pay due to lack of income
3. I don't think it help me mitigate drought consequences
4. I don't want to ensure my livestock which is still alive
5. Don't know

Other reasons (specify) ----------

KII Guide for Community Representatives

1. What are major shocks that has been affecting pastoralist community in this area (drought, conflict, flood, pandemic livestock/human disease or other)?
2. Would you tell us, the most common disaster risk that often creates shocks in this area?
3. Tell us how climate change and associated prolonged drought have been affecting Borana pastoralist? Extent of drought, its impacts?
4. Have you ever heard of weather index-based livestock insurance? From whom? What do you know about index-based livestock insurance? Please tell us the details.
5. Have you bought the weather index yet? Tell us what motivated you to purchase the weather index?
6. What are the benefits of buying weather insurance?
7. Have you received payout yet? How IBLI payout help, you mitigate the shocks.
8. If you have not bought weather insurance, why didn't you buy whether index livestock insurance yet? Please explain?
9. Is it your decision not to buy livestock insurance or you lack awareness about it? Please explain the rationale behind your decision?
10. What is your view towards weather index livestock insurance? Do have plan to buy it in the future?
11. Have you ever seen anyone in your area benefited from livestock insurance and how?
12. Do you recommend other pastoralist household to buy weather insurance? Why?
13. Are you pastoralist household in your areas willing to pay for weather insurance? If yes, how you have assessed their willingness?
14. What is your general recommendation about the product?

FGD Guides for Communities

1. The major shocks that has been affecting pastoralist community (drought, conflict, flood, pandemic livestock/human disease or other)? Rank these shocks.
2. Impacts of prolonged drought? Extent of drought, its impacts?

3. What you know about index-based livestock insurance? From whom? What do you know about index-based livestock insurance? Please tell us the details.
4. What are the benefits of buying weather insurance?
5. Are pastoralist household in your areas willing to pay for weather insurance? If yes, how you have assessed their willingness?
6. What is your general recommendation about the product?

KII Guide for Government Representatives

1. What are major shocks that has been affecting pastoralist community in this area (drought, conflict, flood, pandemic livestock/human disease or other)? What are most common disaster risk that often creates shocks in this area?
2. Have you ever heard of weather index-based livestock insurance? From whom? What do you know about index-based livestock insurance? Please tell us the details.
3. How is weather insurance benefiting pastoralists households in your district?
4. Tell us about the status of insurance up-take in your area?
5. Are the community willing to purchase weather insurance?
6. What is your general recommendation about the product?

KII Guide for NGOs

1. As development actors operating in Borana area, what are major shocks that has been affecting pastoralist community in this area (drought, conflict, flood, pandemic livestock/human disease or other)?
2. From your assessment what are the most common disaster risk that often creates shocks in this area?
3. Is your organization currently working on weather insurance project?
4. What is your approach to sell weather insurance to the community?
5. How is weather insurance benefiting pastoralists households?
6. How you have been supporting pastoralist households in purchasing weather insurance?
7. From your assessment, are the community willing to purchase weather insurance?
8. What is your general recommendation about the product?

Result of binary logistics regression model

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Age	-.184	.049	14.232	1	.000	.832	.756	.915
Fam size	.828	.257	10.375	1	.001	2.288	1.383	3.785
Sex	-1.549	.818	3.590	1	.058	.212	.043	1.055
Literacy	1.849	1.296	2.036	1	.154	6.353	.501	80.551
Marital status	-.005	.017	.090	1	.764	.995	.962	1.029
IBLI training	2.759	.723	14.584	1	.000	15.787	3.831	65.056
Insured livestock	.606	.582	1.084	1	.298	1.832	.586	5.731
Drought shock	3.038	.916	10.994	1	.001	.048	.008	.289
Received payout	3.104	.728	18.176	1	.000	22.279	5.348	92.803
Constant	4.217	1.572	7.200	1	.007	67.819		

*P < 0.01

Goodness-of-fit test / Omnibus Test of Logistic Regression

		Chi-square	df	Sig.
	Step	199.329	9	.000

Step 1	Block	199.329	9	.000
	Model	199.329	9	.000

VIF (Variance Inflation Factor) For Test of Multicollinearity

Model		Collinearity Statistics	
		Tolerance	VIF
1	Age	.484	2.066
	Famsize	.560	1.784
	Sex	.670	1.492
	Literacy	.539	1.854
	Marital status	.837	1.195
	IBLI training	.881	1.135
	Insured livestock	.562	1.781
	Drought shock	.815	1.228
	Received payout	.780	1.281
a. Dependent Variable: HH WTP			

VIF is not greater than 10. Therefore, there is no problem of multicollinearity.