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***Agricultural Finance and Insurance in
Ethiopia: Challenges and Policy Options***

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Agricultural Finance and Insurance in Ethiopia: Challenges and Policy Options

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EXECUTIVE SUMMARY

Introduction

In the last two decades, there have been several initiatives to improve the provision of agricultural finance for smallholder farmers and there is a good progress in reaching out the rural poor through a variety of financial services. However, the supply of finance to smallholders still has gaps in quantity and quality of the services. Thus, this study attempts to assess feasible options of financing the Ethiopian agricultural sector and major subsectors. To this end, the existing schemes and gaps in demand and supply of major financial products (credit, saving, remittance and insurance) were thoroughly examined. Further, the major agricultural risks, their impact and prevalence by subsectors (crop and livestock) and agro-ecologies is also assessed.

Methodology

Both primary and secondary data were collected for this study and analyzed using qualitative and quantitative approaches. The qualitative analysis focuses on the review of relevant literature and qualitative information collected from key informants and focus group discussants. Both theoretical and empirical literature and policy documents related to rural finance in Ethiopia were reviewed to identify and address institutional constraints for expanding access to financial products and innovative approaches.

Key informants were selected from community leaders, elders, formal and informal financial service providers and experts and managers of various financial institutions including MFIs, banks, insurance companies and the National Bank of Ethiopia and were interviewed on pertinent policy issues in the provision of agricultural finance to smallholders. The Focus Group Discussion has been designed to get additional information about the problems, opportunities and remedies to ensure the supply of adequate finance for smallholder farmers.

The quantitative analysis comprises both primary and secondary data. The secondary data were collected from the National Bank of Ethiopia, commercial banks, insurance companies, Micro Finance Institutions, Association of Ethiopia Micro Finance Institutions (AEMFI), Federal Cooperatives Agency and the World

Bank financial index survey to measure the existing supply of major financial products and assess crucial indicators such as inclusiveness, access and adequacy.

This primary data comes from three rounds of household panel data collected to analyze households' demand and supply side aspects of credit access. The first-round survey was conducted in 2012 and it has an exhaustive information regarding access to credit and saving services of rural households. The second round was conducted in 2018 and third round survey was conducted as part of this project and a total of 300 households that were included in the previous two rounds were reached out with the sample size being proportionately distributed to the regions based on sampling weights in 2014.

In the quantitative analysis, various descriptive analysis tools and econometric approaches including correlated random effects probit and pooled probit models were used and the key findings of the study, conclusions and recommendations are summarized below.

Key findings

Credit:

1. Agricultural credit outstanding by MFIs in 2018/19 is ETB 27.28B which is more than two folds from the amount before five years (i.e ETB 10.65B in 2014/15). Outstanding agricultural credit was 57.9% of the total credit outstanding in 2014/15 and slightly diminished over five years to reach 49.8% in 2018/19.
2. In the past decade, the supply of agricultural credit by commercial banks nearly doubled. More specifically, in 2010/11, agricultural credit outstanding was Birr 10.58 Billion and this has grown on average by 10% to reach Birr 21.09 Billion in 2019/20. However, in relative terms, the share of agricultural loan was 13.61% in 2010/11, which shrunk to 2% in 2019/20.
3. In this study the potential demand for credit by smallholders is estimated to be about ETB 122 Billion for the year 2021/22.
4. Even though rural households have financial deficit, they show low appetite to apply for credit from formal financial institutions. According to the respondents, the reasons for not applying for credit include: fear of indebtedness (51%), high-interest rate (38%), high transaction cost (30.46%), fear of risk of default and its consequences (29.8%), lack of collateral (27.46%), pre-conception that there is less likelihood to get credit (26.5%), no information about sources of credit (17.9%) and already being indebted (17.21%).

5. Farm households in the study area tend to prefer informal sources of credit over formal ones due to ease of access, flexibility in the payback arrangement, and little or no collateral requirement.
6. The econometrics analysis shows that household income, prior knowledge, and proximity to formal financial institutions to have positive effect on the demand for credit while membership to various local institutions, living in the desert and woina-dega agro-ecologies reduces the demand for credit compared to those households living in the dega areas.
7. The above findings are also supported by key informants where on the supply side, lack of all-weather roads and lack of internet services in rural areas hinder MFIs and banks to expand their outreach. On the demand side, limited financial knowledge about the services and products of formal financial institutions (FFIs), high cost to reach the nearest FFIs, poor trust on the services and working procedures of FFIs, and availability of local and informal financial service providers such as Iqqub, money-lenders, 'Tsewa Mahber'...etc. found to have negative effect on the demand for the services from formal financial institutions.

Savings:

8. MFIs' saving has grown on average by 32.53% per annum for a decade (2010-2019). More importantly, the share of voluntary saving has continuously increased to reach 84.71% in 2019 of the total saving from 68% in 2010. However, for the same period, growth in saving per borrower was below the growth of loan per borrower which challenged the MFIs' capacity to meet the farm households' demand for credit.
9. Data at household level show that majority of the households in the study area (72.6%) save their resources either in kind or in cash. For those who save, the average value of in-kind saving amounted to Birr 11,728 while the cash saving was almost half of that amount (ETB 5,512). Moreover, we found that saving in kind was growing faster than saving in cash, reflecting households' response to the country's growing inflation rate over the recent years.
10. As far as the institutions for saving concerned, 22.6% were using only formal financial institutions, 27.8%, were using informal institutions and the remaining were using both formal and informal financial institutions. Among those respondents who used to save in informal institutions, 65% and 33.1% of them replied that proximity and ease of access respectively are the main drivers to save in informal institutions. Safety (78%), ease of access (13.9%) and motive

to get other services such as loan (4.3%) are the other factors behind visiting FFIs for deposits.

11. Our regression results indicate that cash saving by rural households is positively correlated with household income, participation in off-farm activities, and trust on formal financial institutions.
12. The results also show that household income, knowledge about financial services, land holding and livestock size to have a positive and statistically significant effect on in-kind savings whereas participation in off-farm activities, trust on formal financial institutions, and living in the desert area to have a negative effect.

Shocks and coping mechanisms:

13. The major risk factors for rural smallholders in the study area are adverse market prices (50%), livestock diseases (39%), drought (27.5%), illness of a household member (27%), crop diseases (25.5%) and death of livestock (25%).
14. The major coping mechanisms for these shocks are reduction of consumption, and selling productive assets including livestock. Few households use dis-saving and borrowing from relatives and friends as additional coping mechanisms.
15. The distribution of shocks across agro-ecologies shows that it is very low in the dega and very high in the desert agro-ecology and roughly equally distributed across Woina dega and Kolla agro-ecologies.
16. There is a limited knowledge about Index Based Insurance (IBI) as only 15.23% and 5% of respondents heard about index-based crop & livestock insurances respectively. Moreover, the coverage was limited as low as 4.3% of the households purchased crop IBI at least once in the last 5 years from an insurance company. The average annual premium payment was 213 ETB per policy. None of the respondents have purchased livestock IBI so far in the study area. However, if available, 21.5% and 15.56% of respondents have shown demand for index-based crop and livestock insurances respectively.
17. The main reasons for not buying index-based insurance (IBI) was that they do not need it (33%), or they do not know the institutions selling the insurance (28%), or do not have the money to pay for it (18%), or do not know the benefits of this insurance (10%).
18. Our regression result shows that household income, trust on formal financial institutions, size of land holding, membership to local institutions and time preference to have a positive effect on the probability of revealing demand for

IB crop insurance. On the other hand, demand for crop insurance is negatively correlated with age of the head, number of livestock and being risk averse.

19. Household income and trust on FFIs correlate with livestock insurance in a similar fashion as they are correlated with crop insurance. A striking difference in IBLI is the correlation between number of livestock and demand for Index-based crop insurance (IBCI) and Index-based livestock insurance (IBLI). Consistent with prior expectations, the number of livestock positively and significantly correlates with demand for IBLI whereas it has no significant effect on the demand for IBCI. In addition to the above variables, Prior knowledge of insurance products increases the demand for IBLI.
20. In our KII, we noted that the dissemination of modern insurance services is further hampered by:
 - Absence of clear and full-fledged agricultural insurance policy and regulatory framework to guide and control the efforts the existing few insurance companies that strive to introduce and improve uptake of agricultural insurance products as potential feasible option to overcome agricultural shocks.
 - Lack of complementary apparatuses (eg. rainfall gauges, satellite information...etc) in rural Ethiopia are also found to be some of the limiting factors to persuade and increase uptake of IBI since farmers lose trust on distantly located rainfall gauges.
 - Absence of market intermediary to sell insurance products, high costs of insurance relative to rural households' income and limited knowledge about IBI are also critical impediments.

Conclusions and recommendations

Credit:

1. In relative terms, the already small share of agricultural loan has also been further declining over the years and there is a big gap in the demand for and supply of credit and this calls for policy intervention to increase the supply of credit to agriculture since this sector is the back bone of the economy.
2. In relation to the demand for credit, the results of this study showed that households with better income succeed in securing credit from the formal and the semi-formal financial institutions while the poor obtain credit from informal sources. This may show a mission drift of the financial institutions (mainly rural financial institutions such as MFIs and SACCOs) which are

expected to be pro-poor. This requires policy intervention to allow the poor to have better access to credit.

3. Even though farm households have financial deficit, their appetite to apply for credit from formal financial institutions is low due to high-interest rates, high transaction cost, fear of risk of default and its consequences, lack of collateral, pre-conception that there is less likelihood to get credit, and due to lack of information about sources of credit. This calls for further work to create a conducive credit market environment for the rural poor.
4. Following the huge awareness campaign undertaken by formal financial institutions like banks, MFIs and SACCOs to increase their outreach, the financial literacy rate in Ethiopia is on the rise. However, Ethiopia is still one of the lowest performers in global adult financial literacy rate with only 34% and this implies the need for more effort to increase the knowledge about financial services as it has been found to be one of the key determinants for demand for credit in the study area.

Saving:

5. More than half of the households in the study area prefer in-kind saving than cash saving. Such big difference in the magnitude can be explained by the vivid shift of households from cash to in-kind savings due to the rising inflation in recent years. This has a clear message for policy and it calls for an extra effort to control the current inflation using various policy instruments the government has at hand.
6. The study also showed that trust on FFIs really matters. The probability of cash saving is higher for households with medium and high trust on FFIs while it is lower for those with low and no trust. This result signals that increasing the outreach and financial awareness alone will not result in the intended change on households' decision to save. But, more work is required in building trust between small holder farmers and the financial service providers.

Shocks and coping mechanisms:

7. Household income, trust on formal financial institutions, size of land holding, membership to local institutions and time preference were found to positively affect the probability of revealing demand for index-based crop insurance (IBCI). On the other hand, demand for crop insurance is negatively correlated with age of the head, number of livestock and being risk averse.

It is obvious that an increase in household income boosts the capacity of rural farmers to pay for insurance premiums.

8. Given the high poverty level in rural areas, most farmers cannot pay for crop and livestock insurance. In the context of rural Ethiopia, most pilot insurance products cease due to lack of enough demand from farmers, huge loss due to the area-wide (covariate) shocks and the small pool of households who buy the insurance products. This calls for designing innovative insurance products and government intervention to provide subsidized insurance products (premium subsidies) for poor farmers.
9. Lack of technical expertise particularly, in loss adjustment is the other major problem and most insurance products are designed by consultants from abroad who have little or no knowledge of the local context. This calls for building local technical skill/knowledge in the area of crop and livestock insurance products.
10. Knowledge of insurance products clearly matters and mechanisms have to be designed to disseminate information regarding crop and livestock index-based insurance services as an alternative to the existing traditional coping mechanisms.
11. Agricultural insurance involves severe losses and reinsurers are unwilling to provide cover for direct insurers. This needs appropriate intervention by relevant stakeholders to make the sector more attractive for re-insurers. For instance, investment on digital technology is crucial to reach out pastoral and agro-pastoral areas to increase the pool, linking credit with saving and insurance can serve as an enabler or loan portfolio protection mechanism for those who apply for credit since it enables them to be creditworthy and at the same time the financier uses it to protect the loan. It can also help to promote small holder farmers practicing both crop production and livestock rearing on sedentary basis in agro-pastoral and highland livelihood systems.
12. The government's commitment to creating fertile grounds for insurance companies to expand crop and livestock insurance products is crucial. So far, there is no clear and full-fledged agricultural insurance policy and regulatory framework to guide and control the efforts of handful of insurance companies which strive to introduce and improve uptake of agricultural insurance products as potential feasible option to overcome agricultural shocks. This calls for appropriate action to be taken by the government.

LIST OF ACRONYMS

ACSI	Amhara savings and credit Institution
AdSCI	Addis saving and credit institution
AEMFI	Association of Ethiopian microfinance institutions
CIMMYT	International maize and wheat improvement center
DECSI	Dedebit credit and saving institution
FGD	Focus group discussion
IBI	Index based insurance
IBCI	Index based crop insurance
IBLI	Index based livestock insurance
KII	Key informant interview
MFIs	Microfinance institutions
NBE	National Bank of Ethiopia
OCSSCo	Oromia credit and saving S. Co.
PSRC	Policy studies and research center
UNCTAD	United Nations conference on trade and development
WB	World Bank
WTP	Willingness to pay

1. Introduction

1.1. Background and Rationale

In the past decade, the Ethiopian government has been allocating 10% of its budget to the agricultural sector (WB, 2021). The lion's share of the budget was allocated to scale up agricultural extension and provide rural infrastructure, including rural finance. This effort has been translated to agricultural growth in output and productivity, where growth in the value of cereal production and productivity was the major driver in the improvement of agricultural GDP (Bachewe et al., 2019).

Despite the past effort to improve agricultural output and productivity, the country still faces a large yield gap (Bachewe et al., 2019; Amare et al., 2016; Cepheus R & A, 2021). One of the major explanations for this gap is low technological adoption rate and intensity of use among smallholder farmers. For instance, only 30–40% of Ethiopian smallholders apply fertilizer, and of those who do, the application rate is only 37–40 kgs per hectare, which is far below the recommended rates (Amare et al., 2016). Smallholder farmers who produce nearly 90% of the country's agricultural production are resource-poor, which limits their investment in productivity-enhancing inputs (Bachewe et al., 2019; Spielman et al., 2013; Belissa et al., 2019). The financial offerings to agricultural sector players face gaps in terms of financial access, quantity and quality of financial products (CIMMYT, 2015). Most financial institutions are concentrated in urban areas. As a result, only a few financial institutions serve nearly 80% of the country's rural population, limiting access to formal financial institutions. In terms of product quality, gaps exist for all major product categories, including credit, saving, insurance and payments for all major agricultural players, including farmers, traders, and manufacturers. In terms of product quantity, the supply of rural finance is far short of demand. For instance, CIMMYT (2015) shows that about 80% of the potential rural demand for loans are still unmet. Furthermore, rural households' saving culture in formal financial institutions is low (Mirach & Hailu, 2014; Temam & Feleke, 2018; PSI, 2018; Negeri, 2018; Addis et al., 2019) since they opt to save in kind or save cash under the mattress and informal institutions such as 'Equb'. Uptake of agricultural insurance fails to take off (Amare et al., 2019; Hill et al., 2013; Tadesse et al., 2016; Ahmed et al., 2020; Bishu et al., 2018) though it has a great potential to spread agricultural risks

efficiently across different actors. Rather, rural households resort to traditional risk management and coping methods such as the use of savings (Tadesse et al. 2016; Yilma et al. 2014), reliance on social networks such as iddir (Tadesse et al. 2016; Dercon et al. 2014), government social safety net programs (Tadesse et al. 2016), and reduction of non-food expenditure (Asfaw & Braun, 2004).

A sound financial sector with an adequate supply of services to the agricultural sector is essential for sustaining the sectoral economic growth and reducing poverty and food insecurity. More specifically, credit facilities in rural areas play a positive role in technology adoption among rural households (Abate et al., 2016; Njagi et al., 2017; Bedru et al., 2020), startup of new businesses (Bedru et al., 2020) and in turn promote diversification that generates employment, improvements in income and food security status of households. Cash Savings in formal financial institutions ensures the safe and productive storage of money and in turn, guarantee excess capital channeled to its most productive use (Karlán & Morduch, 2009). Furthermore, in light of widespread climate and related risks in the context of rain-fed agriculture in Ethiopia, agriculture insurance helps to spread risks of agricultural players efficiently (Bridle et al, 2020) and overcomes limitations inherent to traditional risk management and coping methods. The various demand and supply side factors of the financial services of credit, saving and insurance to farm and pastoral households have been investigated in an isolated manner without focusing on agro-ecologies and livelihoods. Since all these gaps require closer examination, this study gauges the demand for and the supply of financial services available in terms of credit, saving and insurance across agro-ecologies and livelihoods.

1.2. Objectives and research questions

This study aims to:

- Characterizing farm households by their perception of formal and informal financial institutions and their services;
- Measuring current demand for and supply of credit, saving and insurance for small holder farmers.
- Identifying the major demand and supply side constraints of access to finance by rural households
- Identifying the major agricultural risks and traditional risk management and coping mechanisms practiced by smallholder

farmers in crop and livestock sub-sectors and in the major agro-ecologies;

- Assess feasible options and models of financing and insuring the country's smallholder farming activities and production in crop and livestock sub-sectors and in the major agro-ecologies.

Accordingly, the research questions of this study are:

- How financial services are provided in agriculture and rural areas?
- What is the level of demand for financial services to farm households and businesses?
- What is the current supply of micro financial services in agriculture?
- Which rural and agricultural activities are bankable and non-bankable?
- Which financing models are suitable to farmers operating at different scales and
- What is the level of risk involved in agricultural activities?
- Which traditional risk management practices are adopted by farmers?
- Which agricultural risks are insurable and non-insurable?
- Which insurance products are relevant to smallholder farmers and businesses operating at different scales and settings?

2. Review of the literature

2.1 Theories on access to finance

There are several evidences that support strong and positive linkage between accesses to financial services economic welfare of smallholder farmers. Hence, the key challenge for governments and policy makers is how to improve access to financial services. Awunyo-vitor (2018) suggests that the attempt to overcome this challenge should start from sorting out the dimensions of access to finance. He claims that access to finance has two dimensions; demand and supply side dimensions. The demand side of access examines the choice made by individuals with regard to services provided by financial institutions, while the supply side of access relates to financial services provision or financial intermediation. Farmers' decision to enter the financial market by farmers to

access financial services depends on both supply and demand aspects (Stijn, 2005; Karlan & Morduch, 2009; Awunyo-vitor, 2018). In Economic literature, there are a number of theories related to decision making, such as rationality theory, bounded rationality theory, prospect theory, inter-temporal theory, delegated monitoring theory, information asymmetry theory, and transaction cost theory (Scholtens & Wensveen, 2003). To select the relevant demand and supply sides theories applicable to the current study, it is essential to understand the context of decision making by smallholder farmers. Accordingly, farmers operate farm activities in the shadow of potential risk threats, especially climate-related risks, since the country's agricultural activities depend on erratic rainfall as water source. In most cases, these risks and subsequent shocks are not adequately managed and withstood by existing mechanisms. Hence, farmers face uncertainty about their agricultural production, income, and consumption expenditure. As a result, rational choice theory which assumes a decision under certainty, cannot be taken as a candidate. Rather, expected utility theory (EUT), formally developed by Von Neumann & Morgensten (1944) provides very good starting point for explaining decision under uncertainty. In our context, EUT postulates that people maximize their expected utility in their decisions to participate in financial markets. This decision is driven by the curvature of their utility function, which determines the level of risk aversion. For instance, risk averse individuals who prefer outcomes that are certainly known to uncertain outcomes will have low demand for credit and high demand for insurance. However, recent studies by Clarke (2016) & Hill et al (2019) claim that sometimes there are inconsistencies in the above beliefs. For instance, the demand for index-based insurance by risk-averse individuals initially increases with risk aversion up to a point and starts declining thereafter. As a result, they recommend using prospect theory since it overcomes the above inconsistencies via emphasizing behavioral factors following the work of Kahneman & Tversky (1979). Loss and ambiguity aversions are the pool of behavioral factors that affect farmers' perception of the probability of shock happening, the valuation of losses by shocks, and difficulty to analyze the possible benefits and costs of various financial products (Nshakira-Rukundo et al., 2021). Therefore, at the core of prospect theory, it is necessary to account for these behavioral aspects and their impact on households' decision making. Hence, in this study, we rely on both expected utility and prospect theories to explain the demand aspect of access to finance by smallholder farmers.

In Ethiopia, the provision of agricultural finance requires covering dispersed geographical area and administering smaller loan transactions, potentially increasing transaction costs for service providers. As a result, formal financial institutions often lose the appetite for serving rural households, especially those located in remote areas (Gashayie & Singh, 2015; Amha & Peck, 2010). Moreover, lumpy cash flow that overlaps demand for funds by savers and borrowers at a time and high covariance across borrowers in rural areas (Amha & Peck, 2010) are among the impediments to the supply of adequate credit for the agricultural sector. These evidences guide us to anchor on information and transaction cost theories to explain the supply aspect of access to finance in Ethiopia. The information asymmetry theory postulates that imperfect information results in an information problem. The consequences of information problems within the financial market can be classified as either ex-ante or ex-post. The ex-ante problems associated with information within the financial market result in adverse selection, while information problems that relate to ex-post lead to assurance services or expensive compliance verifications and moral hazard risks. According to information and transaction cost theories, financial service provision attempts to overcome these problems, at least partially, through improved access to information and use of different schemes of installments, collateral requirements etc. (Awunyo-vitor, 2018).

2.2. Empirical literature review

2.2.1. Agricultural finance: The supply and demand for credit

A. Supply of agricultural credit: institutions, determinants and constrains

In Ethiopia, Financial cooperatives and microfinance institutions (MFIs) are the two major formal credit sources. The microfinance industry is mainly dominated by the top five government-owned MFIs (i.e ACSI, DECSI, OCSSCO¹, ADSCI and OMO) operating in the four major regions of the country and in Addis Ababa city. Financial cooperatives and microfinance institutions (MFIs) account for about 80% of the total credit provided to rural households (CIMMYT, 2015).

¹ Recently, some of these MFIs became banks.

A study by Dejene (2003) showed that informal sources of credit in Ethiopia include relatives and friends, moneylenders, neighbors, Iddir, Iqqub and Mahiber. Every year, over 20 percent of the total credit is supplied by the informal sector (Amha & Peck, 2010; CIMMYT, 2015) of which friends and relatives (66 percent), moneylenders (14 percent) and Iddir (7 percent) are the major suppliers. Informal credit has the advantage of flexible borrowing terms and screening techniques, and they impose little restriction on how the loan being used (Braverman & Guasch, 1986; Saqib et al., 2018). However, Bardhan & Udury (1999) and Tang et al (2010) argue that with rapid economic growth, informal credit supply may not be sufficient to meet the increased demand for relatively larger amounts of credit as farmers start to engage in more diversified and capital-intensive economic activities. But, according to Karlan & Morduch (2010), examining the mechanics of the informal market is crucial for two reasons. First, the strength of the informal market is important for measuring and predicting how effective specific formal sector interventions will be. Second, lessons learned in the informal markets can help shape policy in the formal markets. Group lending, for example, is based largely on lessons learned from observing risk-sharing, credit and savings associations in informal markets.

In addition to existing modalities of agricultural credit, in the past decade, new and innovative models of financing the Usury agricultural sector have been recommended by experts and implemented by governments and other stakeholders in various countries. These models aim to provide sufficient funds to the agricultural sector by overcoming some of the inherent characteristics of agriculture that impede efforts. Cognizant to this, CIMMYT (2015) has suggested four innovative financing models as potential and relevant options of financing rural households' credit demand in the context of Ethiopia; (a) direct smallholder lending with collateral of equipment finance and tight market value chain finance (VCF); (b) indirect lending through cooperative with leasing collateral and lose VCF with output buyer; (c) emerging farmers finance with collateral of infrastructure finance and VCF with input supplier; and (d) saving account linked input finance with collateral management and factoring. The new models of financing, which are brought from their record of promising performance in other sectors, have little scale of implementation so far, which is mainly challenged by lack of detailed assessment regarding the legal, economic (e.g. infrastructure ...etc.), and technological requirements that facilitate implementation (Gashayie& Singh, 2015). For example, warehouse receipt finance (i.e one of the

variants of value chain financing) requires a warehouse receipt system, a legal environment that ensures easy enforceability of the security, and makes warehouse receipts a title document; reliable and high-quality warehouses that are publicly available; a system of licensing, inspection, and monitoring of warehouses.

B. Demand for agricultural credit: determinants and constrains

Classic works by de Janvry (1991), Woutersen & Khandker (2013), and Adjognon et al (2017) ascertain that improving credit access through policies that mitigate supply-side constraints may not necessarily increase uptake and underlined the importance of overcoming demand side constraints. Credit access can potentially be impaired by lack of collateral, risk aversion behavior of a household, ill-suited financial products and high transaction costs associated with complex loan application procedures. For example, Berhane and Abay (2019) found that more than half of the respondents are not borrowing due to risk of default (i.e. fear of being in debt or distress of losing assets in case of default). Moreover, households may not demand credit because they have sufficient cash to expend. Cognizant of this, Mamuye (2021) reviewed several studies conducted in Ethiopia with the main aim of identifying the socio-economic determinants of credit demand and access by rural households. However, further policy inputs aim to improve credit demand and access by rural households through the inclusion of behavioral aspects (Karlan & Morduch, 2010; Zhao, 2021) such as loss and ambiguity aversion, where so far, empirical evidences in Ethiopia are rarely present.

2.2.2. Agricultural Finance: rural Savings

For Ethiopia, the saving rate was 14.1% in the year 2008/09, and it has been increasing at an average rate of 7.2% per annum in the last 10 years to reach 24.3% in 2018/19 (NBE, 2020). The contribution of new saving products such as GERD bonds, house savings and pension contributions was significant (MoFED, 2015; FDRE PSRC, 2018). Even though saving rate has increased in recent periods, most past studies on rural household savings in Ethiopia found that the saving culture, especially cash saving in formal financial institutions, is low (Mirach & Hailu, 2014; Temam & Feleke, 2018; PSI, 2018; Negeri, 2018; Addis et al, 2019). This is partly due to substantial saving in kind, cash saving under the mattress & informal institutions such as 'Equb'. Saving in kind and cash saved in

informal institutions may not be channeled to entrepreneurs or deficit units in the financial system with feasible business or project ideas and as a result, such types of savings are mostly less efficient compared to saving in cash and in formal financial institutions (UNCTAD, 2007). Hence, any effort aimed at elevating domestic savings in formal financial institutions by rural households in Ethiopia should address why the saving culture is low among rural households in Ethiopia and what can be done to help farm households to save more in cash and in formal financial institutions than saving in-kind and in informal methods.

In relation to the first issue, studies by Addis et al (2019), Fenta et al (2017) & Negeri (2018) and PSI (2018) have assessed saving culture (i.e decision to save) and the amount of saving among rural households in Ethiopia and they found that level of education of heads positively correlates with decision to save and/or amount of saving. Economic variables such as household income (PSI, 2018; Temam & Feleke, 2018; Mirach & Hailu, 2014; Teshome et al, 2013), amount of land holdings (Temam & Feleke, 2018; Addis et al., 2019) and remittance (Addis et al, 2019) found statistically and positively correlated with saving decision and/or amount of saving by rural households. Furthermore, almost all past studies showed that poor access to formal financial services negatively & statistically correlated with saving practices and/or amount of saving.

However, there is a lack of prior studies that address why farm households often save in-kind and in informal methods across agro-ecologies.

2.3. Agricultural risks, risk management and coping mechanisms

Duong et al (2019) have systematically reviewed more than 197 previous studies conducted in the area of agricultural risks and coping methods. They have classified agricultural risks in to price or market risk (output and input price fluctuation, market shocks), weather-related risk (drought, flood...etc), pests and diseases (biosecurity threats), institutional risk (regulations, legal environment and tax policy), human resource risk (physical and mental health), and political risks (unrest, crime...etc). Farmers in different geographies experience these agricultural risks in differing degrees, and more than half (55%) of the studies reviewed by Duong et al reported that farmers perceived weather and climate change as the main risk to their farm enterprises, followed by bio-security threats (48%), human risk (35%), and market risk (27%).

Risks can also be classified in to covariate and idiosyncratic based on the number of households affected. Accordingly, a shock is idiosyncratic if it is reported to have affected only that household and covariate if it affects at least some other households in the locality such as Kebele (Yilma et al, 2014).

Even though recent and holistic evidence is not sufficiently available, Tadesse et al. (2017) found that drought is the most binding risk in the south-central highlands of Ethiopia, followed by crop disease and pests. Dercon et al. (2005) using the Ethiopian rural household survey, a panel data survey covering about 1,450 households across the country, found that in the period spanning from 1999 to 2004, just under about half the households were affected by drought, but a large number of other shocks were also relevant. For example, 43 percent reported to have been affected by a death in the household, and 28 percent were affected by a serious illness in the household. Other shocks reported (by between 10 and 20 percent of households) were output price collapses, increases in input prices, crop pests and crime.

It is essential to have current and detailed evidence on the types, frequency, incidence and distribution of risks among rural households engaged in crop & livestock sub-sectors and residing in different agro-ecologies; Dega (highlands), Woyna Dega (midlands) and Kola (lowlands)-where there is a big research gap in Ethiopia in this area. We believe that assessment of agricultural risks in the context of different subs-sectors and agro-ecologies has merits for policy because the frequency, distribution and incidence of agricultural risks vary across different agro-ecologies, which in turn frames the relevant and feasible risk management option/s in a specific agro-ecology. For example, flood is more likely and common in highlands whereas drought and pests are more pervasive in lowlands.

Farmers do not passively accept the risks they encounter. Rather they apply wide range of traditional and/or modern risk management and shock coping mechanisms (Binswanger-Mkhize, 2012). A review of a large body of literatures by Duong et al. (2019) ascertained that the most frequent and important traditional risk management method is diversification of crops and livestock, followed by pest and disease monitoring and prevention and off-farm work. Moreover, rural farmers may resort to the utilization of savings either in cash or in-kind (Binswanger-Mkhize, 2012; Karlan & Morduch, 2010), cooperation with other farmers, migration (Bardhan & Udury, 1999; Binswanger-Mkhize, 2012), social protection through government handouts (VaRgas & Toremo, 2009), sharecropping (Bardhan & Udury, 1999; Carter et al. 2014), reduction in non-

food consumption expenditure, reliance on remittance (Binswanger-Mkhize, 2012). These are some traditional methods on board to manage and cope with agricultural risks and shocks.

In Ethiopia, the use of savings (Tadesse et al. 2016; Yilma et al. 2014), reliance on social networks such as iddir (Tadesse et al. 2016; Dercon et al.2014), government social safety net programs (Tadesse et al. 2016), and reduction of non-food expenditure (Asfaw& Braun, 2004) are mentioned by farmers either to reduce risk, ex-ante or to cope with shocks, ex-post.

Banerjee (2004) argues that the rural poor may quite well insure through the informal/traditional methods. However, Karlan & Morduch (2009) have reviewed a large body of studies and suggest that the view by Banerjee is too optimistic and that traditional methods are inadequate and the poor households remain substantially exposed to risks, especially for covariant risks. Furthermore, Bardhan & Udry (1999), and Karlan & Morduch (2009) argue that traditional methods are economically inefficient because they dispose of farming efforts (eg. off farm employment), reduce specialization (e.g. diversification), and provide poor incentive for producing profit maximization level of output (e.g. share cropping). Nonetheless, in a run to develop feasible options of financing, critical assessments of the nature & types of traditional methods applied by farmers have a number of merits. For example, we can use the existing social networks, such as Iddir to sell modern insurance, and integrate the traditional methods with modern agricultural insurance (e.g. R4 in Ethiopia and Senegal). R4 refers to the program's four risk management strategies, partnered by UN World Food Program (WFP) and Oxfam America and implemented in Ethiopia & Senegal (Hill et al., 2013). The first is Risk Reduction: access to improved climate risk management, for example, natural resource rehabilitation or new agricultural extension techniques. This is designed so that a drought year might have less of an impact on farmers. Second, Risk Reserves involve access to individual or group savings so that farmers can build a financial base for investing in their livelihoods. These two categories fall under traditional methods. Index-based (modern method) insurance falls under the third strategy, Risk Transfer, and aims to transfer the component of risk (e.g., a major regional drought) that cannot be reduced in any other way. Finally, Prudent Risk Taking involves access to microcredit. Microfinance Institutions are often reluctant to offer credit to farmers because of the perceived high risk of default in bad seasons. R4 allows farmers to have a stronger asset base and an ability to pay back a loan in a drought year,

thus improving access to credit to allow investment in productive assets such as seeds, fertilizers and new technologies.

2.4. Agricultural Insurance products

Insurance is a special line of property insurance applied to agricultural firms, and it involves the equitable transfer of a risk of loss from one entity to another in exchange for a premium or a guaranteed and small quantifiable loss to prevent a large and possibly devastating loss (Iturrioz, 2009). Insurance products can broadly be classified into two categories: indemnity-based and index-based insurances.

In case of indemnity-based insurance, payments are made based on assessment of actual losses incurred by the policy holder. More specifically, the insurer assesses losses on yield due to adverse events, and determines indemnity payment for every policy holder at individual level. There are two types of indemnity-based insurance: named peril and multiple peril (yield based) crop insurance. Named peril crop insurance involves payment of indemnity following losses due to adverse events explicitly mentioned in the policy where as in case of multiple perils crop insurance (MPCP) indemnity is paid against all perils that affect production unless specific perils have been explicitly excluded in the insurance contract (Iturrioz, 2009).

Even though indemnity-based insurance has very good precision in the estimation of damages caused by the peril as it requires on-site loss verification by the insurer, its applicability is constrained by high administrative costs and information asymmetry (Karlan & Morduch, 2009; Iturrioz, 2009; Carter et al., 2014; Nshakira-Rukundo et al., 2021). In the case of indemnity-based crop insurance, the insurer should inspect every plot of the insured to estimate damage (thereby increasing administrative costs), and asymmetries of information lead to the possibility of adverse selection and moral hazard. Without adequate technical expertise, underwriters cannot distinguish between high-risk and low-risk producers and, if they set premiums based on averages, they may attract only high-risk applicants. Additionally, this type of insurance may motivate producers to take additional risks such as using less fertilizer, planting out of season or planting in less fertile areas. The livestock variant of this indemnity-based insurance also suffers from the same problems (VaRgas & Toremo, 2009); the insurer should cover vast areas that increase costs to audit lost herds, ex-ante

moral hazard (herders failed to protect their livestock), and ex-post moral hazard (herders falsely reported animal deaths).

Index-based agricultural insurance involves writing contracts against specific perils defined and recorded at regional levels (usually at local weather stations). For such schemes, insurance payouts do not depend on the individual losses of policyholders but on the regionally recorded index, which serves as a proxy for the losses in a particular region. It is therefore a contingent claim contract for which an objective index determines payouts, most of the times weather-related parameters (Hochrainer-Stigler et al., 2014). Such parameters need to be highly correlated with farm-level yields. The index can be based on the amount of rainfall (lack of or excess), humidity levels, the arrival of locusts, water levels in a river, occurrence and strength of a hurricane, sea-surface temperature, frost, hailstones, etc. This requires highly capable and independent measurement tools, such as weather stations.

Compared to indemnity-based insurance, IBI has a number of superior qualities and merits, such as it substantially reduces administrative costs because the product pays out in events that are triggered by a publicly observable index, such as rainfall recorded on a local rain gauge, without the need for households to formally file a claim (Hochrainer-Stigler et al., 2014; Carter et al., 2014; Nshakira-Rukundoet al., 2021). The typical advantages of IBIs are that they tend to reduce significantly the problems of adverse selection (that is, since farmers know more about their risks than the insurer, the low-risk farmers may opt out, leaving the insurer with only high-risk customers) and moral hazard (that is, when farmers' behaviors can influence the extent of damage that qualifies for insurance payouts) that often plague insurance markets because payouts are based only on publicly-observed data rather than on private information reported by the person filing claims. Furthermore, IBIs are more efficient than indemnity-based insurance as the former reduces transaction costs significantly since loss assessment isn't made at level of every policy holder (VaRgas & Tomeri, 2009; Karlan & Morduch, 2009; Xavier, 2015; Nshakira-Rukundoet al., 2021).

Through IBI, it is possible to spread risks over large regions, which could decrease premium payments significantly (World Bank, 2007). IBI products can also be combined with other financial services thereby decreasing administrative costs (Nshakira-Rukundoet al., 2021).

Even though IBI has the aforementioned merits, ironically the uptake for this insurance product is low (Ali et al., 2020, 2020; Nshakira-Rukundoet al.,

2021), especially in Africa. For example, Hess & Hazzel (2016) have shown that from approximately 51 million small holder farmers in Africa, only 1.3% of them have agricultural insurance. Moreover, Nshakira-Rukundoet al., (2021) documented that uptake of agricultural insurance in Africa is 3.5% but still this figure is by far lower than Asia (46.2%) and Latin America (15.8%).

The facets of low uptake is demonstrated not only by small proportion of farmers buy the insurance offered but also the purchasers usually buy the smallest coverage offered, and the poor farmers who would benefit the most are not usually among the purchasers (Skees, 2010)

In Ethiopia, even though current data is not available about the total number of IBI contract holders, low uptake of thereof is well documented by different authors (Amare et al., 2019; Hill et al., 2013; Tadesse et al., 2016; Ahmed et al., 2020; Bishu et al., 2018).

Several studies aim to resolve the puzzle of low uptake by smallholder farmers in less developing countries. Accordingly, the most important limiting factor is basis risk (Carter et al., 2014; Ali et al., 2020; Nshakira-Rukundoet al., 2021). By ‘basis risk’ we mean the imperfect correlation between computed indexes and the actual losses that can jeopardize actual uptake of IBI (Jensen et al., 2014). According to Nshakira-Rukundoet al. (2021), there are three categories of basis risk. The first is the geographical/spatial basis risk, which measures the distance from a farmer’s plot to the measurement point. The second is design basis risk which emanates from the models and variables used to construct an index. The third is temporal basis risk which is related to the time frame in which the index is measured. Due to the presence of basis risk, significant portion of losses left unpaid. For example, simulation studies in Cameroon and Niger have indicated that basis risk might be as high as 50 percent in most indices (Leblois et al., 2014a, 2014b), implying that there is a 50 percent chance that an insured farmer’s risk might not be covered by their insurance due to such poor correlation. Among the three categories, spatial basis risk is the most pronounced type of basis risk.

In order to reduce basis risk, several strategies have been suggested by experts and these include; i) substantial investment by governments and other stakeholders on whether apparatus to ensure more proximity to farmers (Amare et al., 2019), ii) the insurance product can give more protection through insuring multiple crop and multiple perils rather than single crop and peril (Morsink et al., 2016), iii) insurance product development might consider using multiple sources and types of data to better explain both the production risk and multiple

dimensions of possible losses (Wang et al., 2013). However, Nshakira-Rukundo et al. (2021) has underlined that even though these technological improvements are valuable additions, their use should be weighted with their respective costs, time lag in triggering payments etc.

In addition to basis risk, cash-constrained smallholder farmers in developing countries have unveiled low demand for IBI since they don't have the resource to pay premiums (Cole et al., 2013). As a result, IBI should cost less because premium payments may involve high opportunity costs for the insured, causing other negative consequences such as a decrease in consumption and foregone opportunity to invest more in productive activities (Helgeson et al., 2013).

Furthermore, lack of trust on financial institutions and their products (VaRgas & Torero, 2009; Ali et al., 2020), and limited knowledge & information about index-based insurance (World Bank, 2007; VaRgas & Torero, 2009; Nshakira-Rukundoet al., 2021) are also binding constraints to uptake the insurance product.

Behavioral and cultural aspects of farmers may also limit the uptake of both crop and livestock index-based insurance. Risk and ambiguity aversions are the pool of behavioral factors that affect farmers' perception of the probability of shock happening, the valuation of losses by shocks, and difficulty to interpret the value of index-based insurances Cultural aspects of smallholder farmers, such as religion and gender are also important areas of considerations in a run to develop appealing and inclusive IBI (Nshakira-Rukundoet al., 2021).

Last but not least, the problem of insurance demand may be further confounded in developing countries because of the availability of self- insurance mechanisms and the presence of many tools that governments use to smooth farm incomes, such as direct cash or kind safety net programs, quotas & minimum price support systems, input subsidies, and low-interest agricultural loans (Mahul and Stutley, 2010).

With plenty of evidence about low crop and livestock demand in Ethiopia, several studies have been conducted with two main related emphases. Some of the studies have taken for granted the blue print of almost all problems of IBI discussed above as binding constraints in Ethiopia, and conducted various empirical & experimental studies that aim to develop the existing IBI. On the other hand, some of the efforts are spared on investigating the feasibility of existing index-based insurance.

In a recent pilot project, R4 has partnered with the International Food Policy Research Institute (IFPRI) to use smartphone pictures to improve its index insurance contracts for small-scale Teff growing farmers in Ethiopia. With picture-based insurance (PBI) audit, farmers or agents regularly send in geo-referenced smartphone pictures of the insured crops (i.e in this case Teff), from planting to post-damage. Then, loss assessments are based on damages visible from a time series of pictures taken by the farmers regularly using smartphones. In its pilot implementations, the project has increased uptake of index-based insurance by reducing basis risk through engaging farmers to participate directly, with one's own pictures being more tangible than other indices (Porter et al., 2020).

Tadesse et al (2016) use a choice experiment to elicit smallholders' willingness to pay for IBI either in cash or kind (i.e work for insurance program at daily wage rate to overcome cash shortages) in four districts of South-central Ethiopia. They found that farmers opt for premium payments with daily wage rate than cash. In another related study aim at increasing uptake in context of cash constrained smallholder farmers, Ahmed et al. (2017) shows that uptake of commercial rainfall index insurance in drought-plagued farming cooperatives in Amhara region is very low, ranges from 0.5% to 3% across different seasons. However, uptake has increased to 39% when small free insurances are provided.

To address the problems of low trust and knowledge of IBI, Dercon et al (2014) & Belissa et al (2019) test to what extent uptake can be enhanced via informal risk sharing institutions (i.e Iddirs). Both studies ascertained that promoting insurance through 'Iddirs' increases uptake more than standard IBI.

Belissa et al (2020) have provided experimental evidence on impacts of risk and ambiguity aversion behaviors of farmers on the uptake of index-based crop insurance. They found that an increase in risk aversion increases uptake, but an increase in ambiguity aversion lowers uptake.

In the second pool, studies by Clarke (2011), Bishu et al. (2018), and Amare et al. (2019) found that uptake of existing index-based crop insurance depends on basis risk, education level, trust and risk & ambiguity aversions.

One way or another, the above studies provide evidence to improve the existing insurance products and uptake of thereof. However, some of the studies are conducted with a due acceptance of almost all the reasons for low uptake in literatures as binding constraints in Ethiopia too. This approach may fire off efforts aim at increasing demand for IBI. Rather, the run to develop feasible insurance for small holder farmers has to start from the basics of identifying the major agricultural risks among farmers since it frames the relevant feasible options. For

example, suppose the numbers of dominant risks faced by smallholder farmers are more than one. In that case, the expert has to assess the feasibility of multi-peril insurance products rather than testing the feasibility of different marketing/promotion channels.

Furthermore, an important aspect that previous studies have overlooked is analysis of agricultural risks and design of distinct feasible insurance mechanisms applicable in different agroecologies. This is worthy of detailed assessment since rural livelihoods and related risks vary across different agroecologies.

3. Methodology

The conceptual framework guides the methodology that the reviewed literature and theories suggest as described below, and the econometric model incorporates variables that arise from the conceptual model and the ensuing mathematical relation derived from utility and profit maximization goals.

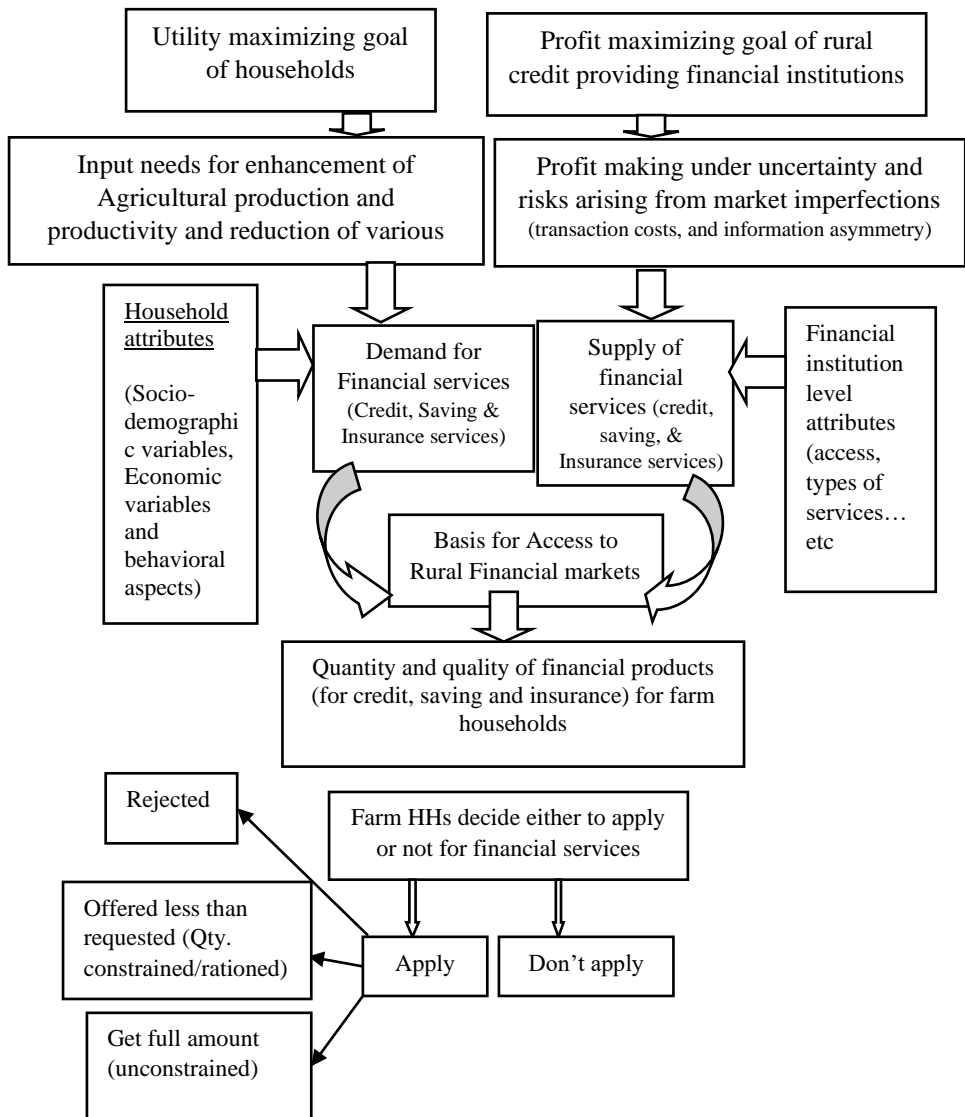
3.1. Conceptual Framework

Access to rural finance is framed in demand and supply framework of the market where rural households demand for financial services and rural financial institutions supply credit, saving and insurance services. Demand for credit of households emanates from assumed utility maximizing goals and rural supply of credit originates from profit maximization goal of financial institutions. Utility is derived from consumption and other factors and consumption is derived from part of profits made last period less saving. In their quest for increasing output and productivity farm households borrow funds from financial institutions to purchase inputs and technology on the one hand and insurance policies to withstand risks arising from weather and other factors. Insurance appears as a cost of production on the one hand and as enhancer of more use of factors in production, thereby enhancing profit. Thus, the schematic of the conceptual relationship of demand for credit and the supply of credit, saving and insurance services is shown as follows.

Farmers may not apply for financial services for the simple reason that they are not liquidity constrained. Furthermore, some farmers with positive demand may not apply for various reasons such as fear of default, lack of information where to apply, high transaction costs to get credit...etc. Farmers who apply for financial services may either be refused, or offered an amount less

than or equal to the amount applied. Those farmers who are refused and offered an amount less than their request are classified as quantity rationed. Farmers' decision to apply for financial services and subsequently rationing by financial intermediaries is assumed to be influenced by institutional attributes such as access, services rendered...etc and characteristics of farmers (Chivakul & Chen, 2008; Awunyo-vitor, 2018).

Figure 1: Schematic presentation of the conceptual model



3.2. Methodological Framework

Farm households may be assumed to maximize utility derived from the consumption and other factors represented by a vector X. Consumption is realized by the use of part of farm profit and a left over from a little saving at a rate of s, meaning the profit is partly saved and partly consumed.

$U = U(C; X)$ utility is as a function of consumption and a vector of other factors where

$C_t = (1-s)(\Pi_{t-1})$: Consumption today is part of the profit of the previous period less the saving and $(\Pi_{t-1}) = f(K_o, B_c, K_n, L)_{t-1} - (wL + r_o K_o + r_r K_n + r_c B_c)_{t-1} + (P_i)$ where $B_c = (P_i \mu (K_o + K_n))$.

Where K_o is own capital, B_c amount of credit the size of which is based on insurance premium P, risk aversion factor μ and the sum of own physical capital and land, L is own and hired labor, w is wage rate (opportunity cost of own labor), r_o, r_r, r_c , interest rates and r_r is land rental rate.

Under uncertainty, utility (U) becomes expected Utility (EU), hence utility maximization is expressed as:

$$\text{Max EU} = \text{Max EU} \{ (1-s)(f(K_o, B_c, K_n, L)_{t-1} - (wL + r_o K_o + r_r K_n + r_c B_c)_{t-1} + P_t); X \}$$

$$\text{Max EU} = \text{EU} ((1-s) f(K_o, B_c(P_i \mu (K_o + K_n)), K_n, L)_{t-1} - (wL + r_o K_o + r_r K_n + r_c(P_i \mu (K_o + K_n)))_{t-1} + P_t) X)$$

$$\frac{\delta \text{EU}}{\delta B_c} = (1-s)(\text{EU}'(f_{B_c}' * \mu f^{\mu-1} * (f_{K_o}' c + f_{K_n}')) - r_c (f_{B_c}' * \mu f^{\mu-1} * (f_{K_o} c + f_{K_n})) + f_{B_c}' x = 0$$

Expected marginal utility from borrowing or credit is a function of saving (S), marginal product of capital borrowed, marginal product of insurance, marginal effects of borrowing on marginal product of own capital and land, and interest rate of borrowing plus marginal effects of other factors affecting the marginal product of borrowing ($f_{B_c}' x$).

$$EUB' = F(s, fBc, \mu f p \mu^{-1}, fBKo', fBKn'rc, fBc'x) \quad (1)$$

On the other hand, the supply side of credit is derived from the assumption that financial institutions maximize profit; where profit (Π) = $f(Bf, L) - ((wL + rcBc + TtBc), Y)$ with Bf is being investable fund, Bc credit, T is unit transaction cost, Y any other factors affecting Bc or rc ,

Again, under uncertainty, Π becomes $E\Pi$, hence profit maximization is expressed as:

$$\begin{aligned} \text{Max } E\Pi &= \text{Max } E\Pi f(Bf, L) - ((wL + rcBc + TtBc), Y) \text{ and } Tt = \phi v Bc \\ \delta E\Pi / \delta Bc &= (E\Pi Bc' - rc - 2Bc\phi v \pm fBc'Y) = 0 \end{aligned}$$

Expected marginal profit from lending or providing credit is a function of marginal product of capital lent (interest rate), marginal cost of transaction, plus marginal effects of other factors affecting the lending interest ($fBc'Y$)

$$E\Pi B' = G(r, \phi v, fBc'Y) \rightarrow Bc = g(r, \phi v, fBc'Y) \quad (2)$$

The variables in this function interact with the demand side determinants of expected marginal utility of borrowing, including other factors X affecting equilibrium demand for credit of households. Based on marginal utility from borrowing we derive and conclude that the determinants of demand for credit being:

$$Bc = B(s, fBc, \mu f p \mu^{-1}, fBKo', fBKn'rc, fBc'x, \phi v, fBc'Y, \phi v) \quad (3)$$

Credit demand (Bc) is expressed as a function of the above variables.

4. Data Types, Sources and Sampling

This study mainly relies on three rounds of household panel data to analyze households' demand and supply side aspects of credit access. The first-round survey was conducted in 2012 by the Association of Ethiopian Micro Finance Institutions (AEMFI). In this survey, a total of 1,425 rural households from the entire country were selected and exhaustive information regarding access to credit and saving services of rural households were collected. In the second round, a total of 3,005 rural households were selected of which 1,580 were new households that were not included in the first round. It was conducted in 2018 by the then FDRE policy

studies & research center (PSRC) in collaboration with staff from the department of Economics of the Addis Ababa University. The third-round survey was conducted as part of this project and a total of 300² households that were included in the previous rounds were reached out.

Data collected from both crop and livestock producing areas, and for the ease of access to farm households, regions and enumeration areas in central Ethiopia (rural households from Oromia, Amhara, SNNPR and Afar) constitute our sample. The sample size for this study is 300 and it is proportionately distributed to the regions based on sampling weights in 2014³.

Table 1: Distribution of sample of rural households across regions

Region	Proportion in 2014	Sample size
Oromia	28.67%	86
Amhara	28.67%	86
SNNPR	28.33%	85
Afar	14.33%	43
Total	100%	300

We also conducted 4 focus group discussions, FGDs (one in each region) with selected community leaders, rural money lenders, and other relevant stakeholders in the rural finance value chain to get additional information about the problems, opportunities and remedies to ensure adequate finance for smallholder farmers.

We also collected secondary data from the National Bank of Ethiopia, Commercial banks and insurances, Micro Finance Institutions, association of Ethiopia Micro Finance Institutions (AEMFI), federal cooperatives agency, World Bank financial index survey etc. to measure the existing supply of major financial products, and assess thereof in terms of crucial indicators such as inclusiveness, access and adequacy.

² The sample size is determined by EEA (as per the ToR) and it may not be a representative sample size for more than 13 million rural households of the Country.

³ It is more or less consistent with sampling weight in ESS which is initially suggested by EEA

4.1. Method of data analysis

a. Descriptive approach

The measurement of current demand and supply is vital since the difference shows financial gap. Based on this gap, government and other stakeholders can anticipate the work ahead to ensure adequate supply of essential financial products for smallholder farmers in the country.

The financial market for credit and saving is more familiar to rural farmers than agricultural insurance. As a result, we can estimate the existing demand for these products based on responses by farmers for credit and saving demands within the past 12 months. More specifically, we multiply the average credit demand of sample households by the approximate number of entire rural households to arrive at total agricultural demand for the country. Nonetheless, we may resort to add credit and saving demands weighted by the proportion of regional rural household sizes if we observe significant variations of average demand among regions.

The modern insurance market is so underdeveloped and poorly understood by smallholder rural farmers (WB, 2018) that in turn left significant knowledge gap about the nature and importance of insurance products. Hence, households may face difficulty to explicitly state their demands (eg. lack of prior insurance market information, quality of insurance products...etc). As a result, we use non-market stated preference approach to estimate demand for modern agricultural insurance especially index-based crop and livestock insurances.

Contingent valuation method (CVM) and discrete choice experiment (DCE) are the popular methods to measure stated willingness to pay for a good or service. In contingent valuation methods, a detail description of the product should be given to the respondents and in turn they have to elicit their willingness to pay (WTP) for the product. We can ask information on WTP using one of the following methods; open-ended questions, bidding games, payment cards, or dichotomous or discrete choices. DCE are worthy to measure demand for the various attributes of a product.

On the oversight, it seems like that DCEs are better options for this study since at the end we have to provide suggestions to improve the existing IBIs, and meanwhile, we have to optimize in various attributes of IBI (eg. multi crop vs single crop IBI, multiple peril vs single peril, sale of IBI for groups vs individuals, sale of IBI by insurance companies or MFIs...etc). However, this exercise results in large number of scenarios to be considered which in turn pose two types of

difficulties. First, setting initial prices increases with the number of products considered, and this is hectic and tedious to pursue. Second, even if researchers overcome the first problem, confusion among farmers grow very much when the number of scenarios is large. Consequently, we use CVM to measure WTP for existing crop and livestock in this study. We allow farmers to elicit their WTP through dichotomous choices (i.e yes or no response about their WTP to purchase insurances at offered prices, and the amount of land or number of livestock the policy should cover at this price). The use of dichotomous choice methods help to reduce strategic biases of CVM. Moreover, this takes it or leave it question mimics the option consumers face in an insurance market (Hill et al., 2013).

The demand for insurance can be estimated by multiplying the average amount of land or number of livestock owned by the number of respondents willing to pay for the product. However, in this study suggestions to develop existing IBI come from critical assessments of the determinants of willingness to pay for IBI where we present an econometrics model in the next section.

As mentioned above, the amount of supply of major financial services can be estimated based on secondary data from various sources such as the National Bank of Ethiopia, Commercial banks and insurances, Micro Finance Institutions, Association of Ethiopian Micro Finance Institutions (AEMFI), federal cooperatives agency and World Bank financial index survey. We assess supply of credit, saving & insurance in terms of crucial indicators such as inclusiveness, access and adequacy.

In this study, various descriptive tools and methods were also used to provide current and detail evidence of the types, frequency, incidence, distribution of risks and coping methods among rural households engaged in crop & livestock sub-sectors and residing in different agro ecologies (Dega (highlands), Woyna Dega (midlands) and Kola (lowlands)). Assessment of agricultural risks and coping mechanisms in the context of different sub-sectors and agro-ecologies has merits for policy because the frequency, distribution and incidence of agricultural risks vary across different agro-ecologies, which in turn frames the relevant &feasible risk management options in a specific agro-ecology.

Finally, we resort to desk review of various literature and policy documents related to rural finance in Ethiopia, and data from FGDs to identify and address institutional constraints for expanding access to existing financial products and innovative approaches.

b. Econometrics models specification

Farmers as rational agents decide to apply for financial services only if the financial products (credit, saving, and insurance) increase their utilities and they do not go for these products in the opposite case. Let Y_1 & Y_0 be utilities expected by farmers from applying for financial services, and not to apply respectively. If $Y_1 > Y_0$, farmers apply for financial services and do not apply when $Y_1 \leq Y_0$.

However, we cannot directly observe the utilities but their decisions which take a binary value (i.e. 1 if the farmer applies for the services and 0 otherwise).

$$dd = 1 \text{ if } Y_1 > Y_0,$$

This can be further written in terms of probabilities as:

$$P(dd = 1/X) = P(Y_1 > Y_0).$$

In order to identify the major determinants of farmers' decision to apply or not, we estimate Chamberlian probit model from the class of binary models of panel data since it accounts for modeling of unobserved heterogeneity among households (Wooldridge,2010; Cameron &Trivedi,2009).

Let us start from the latent variable model which is specified as follows:

$$y_{it}^* = x_{it}\beta + c_i + e_{it} \quad (4)$$

$$y_{it} = 1 \text{ if } y_{it}^* > 0$$

$$y_{it} = 0 \text{ if } y_{it}^* \leq 0$$

The response probability for the above unobserved effects probit model for household i at time t is given by:

$$P(y_{it} = 1|x_{it}, c_i) = \Phi(x_{it}\beta + c_i) \quad (5)$$

Where x_{it} contains a vector of time variant and invariant variables depicted on the right-hand side of equation 3, c_i is unobserved random variable and e_{it} is the error term. Moreover, for each of the major financial products, the dependent variable is defined as:

For Credit and saving products:

$$Y_{it} = \begin{cases} 1 & \text{if a household decides to apply for credit or decides to save,} \\ 0 & \text{otherwise} \end{cases}$$

For Insurance products:

$$Y_{it} = \begin{cases} 1 & \text{if a household is willing to pay for IBI,} \\ 0 & \text{otherwise} \end{cases}$$

Since c_i is unobserved random variable drawn along with (x_i, y_i) . Chamberlain (1980) allowed for correlation between c_i and x_i by assuming a conditional normal distribution with linear expectation and constant variance. A common restriction is:

$$D(c_i | x_i) = D(c_i | \bar{x}_i);$$

where \bar{x}_i is the time average of continuous variables for every observation. Technically, this implies that there is no partial correlation between c_i and these dummy variables which may not necessarily hold. But, it is a step forward to model c_i using time average of continuous variables compared to other unrealistic distributional assumptions .

Mundlak's (1978) special case of Chamberlain approach can then be written as:

$$c_i = \gamma + \bar{x}_i \delta + \alpha_i \tag{6}$$

$$c_i | x_i \sim \text{Normal}(\gamma + \bar{x}_i \delta, \delta_a^2)$$

Where δ_a^2 is the conditional variance of α_i in the first equation and it is assumed that it doesn't depend on x_i .

Substituting equation 6 into 4, the revised latent variable model becomes:

$$y_{it}^* = x_{it} \beta + \gamma + \bar{x}_i \delta + \alpha_i + e_{it} y_{it} = 1 \text{ if } y_{it}^* > 0 \tag{4}$$

$$y_{it} = 0 \text{ if } y_{it}^* \leq 0$$

$$e_{it} | x_i, \alpha_i \sim \text{Normal}(0, 1)$$

$$\alpha_i | x_i, \sim \text{Normal}(0, \delta_a^2)$$

Then, the APE of the above model can be estimated using ASF as follow;

$$\begin{aligned}
 ASF(x_t) &= E_{c_i}[\Phi(x_t\beta + c_i)] = E_{\bar{x}_i}\{E[(\Phi(x_t\beta + c_i)|\bar{x}_i)]\} \\
 &= E_{\bar{x}_i}\{E[(\Phi(x_t\beta + \gamma + \bar{x}_i\delta + \alpha_i)|\bar{x}_i)]\} \\
 &= E_{\bar{x}_i}\left\{\left[\Phi(x_t\beta + \gamma + \bar{x}_i\delta)/(1 + \delta_a^2)^{\frac{1}{2}}\right]\right\} = E_{\bar{x}_i}[\Phi(x_t\beta_a + \gamma_a + \bar{x}_i\delta_a)] \quad (5)
 \end{aligned}$$

Where, for example, $\beta_a = \frac{\beta}{(1+\delta_a^2)^{\frac{1}{2}}}$ are scaled coefficients.

However, Barslund & Tarp (2008) argue that when we pool formal and informal demand together as depicted in equation 1 above, we risk blurring the picture of demand for financial services (saving and credit). Consequently, more concrete evidence on rural financial demand can be obtained if we apply a bivariate probit model for demand from formal and informal sources as follows:⁴

$$\begin{aligned}
 z_{1ti} &= 1 \text{ if } z_{1ti}^* = \beta_1 q_{1ti} + e_{1ti} > 0, \\
 &\text{or } 0 \text{ otherwise (demand for services of formal institutions)} \quad (6)
 \end{aligned}$$

$$\begin{aligned}
 z_{2ti} &= 1 \text{ if } z_{2ti}^* = \beta_2 q_{2ti} + e_{2i} > \\
 &0, \text{ or } 0 \text{ otherwise (demand for services of informal } \frac{\text{institutions}}{\text{methods}}) \\
 &\quad (7)
 \end{aligned}$$

Where, q_{jti} is vector of explanatory variables and β_j is vector of coefficients to be estimated, and our main intention is to check whether factors determining credit demand differ between formal and informal sources.

Especially for credit, we should go beyond the horizon of identifying factors that determine thereof to those factors that limit this demand (i.e credit constraints). A household is credit constrained if they have applied for loan and has the application rejected or get smaller loan than applied for. Even though it is possible to get information about households' demand for credit from their responses, it is difficult to know what would have been the lender's decision if the households who demand credit but didn't apply for it had actually applied. To limit our analysis only to those relevant households and subsequently to address

⁴ In case of access from both sources, households are assigned to sources in which they access more.

the sample selectivity problem, Wooldridge (2010) recommends a bivariate version of Heckman's selection model as specified below:

$$w_{1ti} = 1 \text{ if } w_{1ti}^* = \gamma_1 w_{1ti} + u_{1ti} > 0, \text{ or } 0 \text{ otherwise (constrained)} \quad (8)$$

$$w_{2ti} = 1 \text{ if } w_{2ti}^* = \gamma_2 w_{2ti} + u_{2ti} > 0, \text{ or } 0 \text{ otherwise (applied)} \quad (9)$$

Where, w_{jti} is vector of explanatory variables, γ_j is vector of coefficients to be estimated and equation 9 is the selection equation that explains the households' decision to apply for a loan ($i.e. ek_{2ti} = 1$).

5. Results and Discussion

5.1. Descriptive analysis

i. Rural saving practice

A. Rural savings: The big picture

As depicted in the following table, MFIs' saving has grown on average by 32.53% per annum for a decade (column-7 of Table 2). More importantly, the share of voluntary saving has continuously increased to reach 84.71% in 2019 (column-6). The growth in total saving was higher than the growth in the number of active borrowers, which improved saving per borrower significantly. However, this remarkable growth in saving per borrower was far below the growth of loan per borrower. As a result, capacity of MFIs to meet loan demand from savings has reduced through time especially in recent years (column-11). The growth of overall financial gap of MFIs is also evident in the last decade as the difference between total loan (Column D times by column E) and total saving (column E) has been growing continuously except in 2014.

Table 2: Ethiopian MFIs Saving Trend, Saving & Loan per Borrower (in Million Birr)

Year	Compulsory Saving-in million ETB (A)	Voluntary Saving-million ETB (B)	Total Saving-million ETB (C)	No of Active Borrowers (D)	Voluntary/ Total Saving (%)	Growth of T. Saving (%)	Saving per Borrowers (ETB)-E=C/D	Loan per Borrowers (ETB)-F	Gap per borrower =F-E	Growth of gap per client
2010	817.13	1,738.60	2,555.73	2.33	68.03	-	1,098.81	2,453.39	1,354.58	-
2011	931.25	2,764.77	3,696.02	2.48	74.80	44.62	1,489.84	2,882.96	1,393.11	2.84
2012	1,407.29	4,067.06	5,474.35	2.64	74.29	48.11	2,075.48	3,635.71	1,560.22	12.00
2013	2,164.47	5,853.83	8,018.31	3.15	73.01	46.47	2,545.70	4,117.37	1,571.67	0.73
2014	2,934.57	8,584.04	11,518.61	3.37	74.52	43.65	3,422.10	4,672.81	1,250.71	(20.42)
2015	3,165.79	11,699.09	14,864.88	3.81	78.70	29.05	3,904.45	5,374.17	1,469.71	17.51
2016	3,384.16	13,600.69	16,984.85	3.86	80.08	14.26	4,397.34	5,867.59	1,470.25	0.04
2017	4,622.97	20,563.27	25,186.25	4.82	81.64	48.29	5,226.97	7,166.67	1,939.70	31.93
2018	5,234.12	23,730.05	28,964.16	5.11	81.93	15.00	5,672.91	8,491.62	2,818.71	45.32
2019	6,014.12	33,330.10	39,344.22	5.00	84.71	35.84	7,869.74	11,001.80	3,132.06	11.12
Average	3,067.59	12,593.15	15,660.74	3.66	77.17	32.53	3,770.33	5,566.41	1,796.07	10.11

Source: AEMFIs and own computation

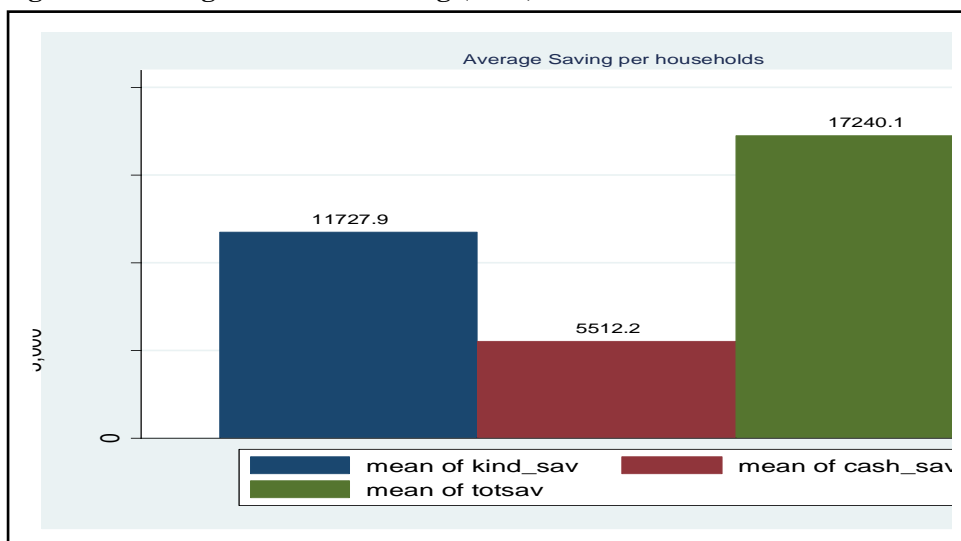
B. Rural savings: in the study area

Majority of the households in the study area (72.6%) save their resources either in kind or in cash. For those who save, the average value of in-kind saving amounted to Birr 11,728 while the cash saving was almost half of that amount (ETB 5,512). The total average saving was, therefore, Birr 17,240 (Figure 2)

Table 3: Saving status/practice

Saving Status	Freq.	Percent
Practice saving	658	72.63
Don't practice saving	248	27.37
Total	906	100

Figure 2: Average amount of saving (ETB)



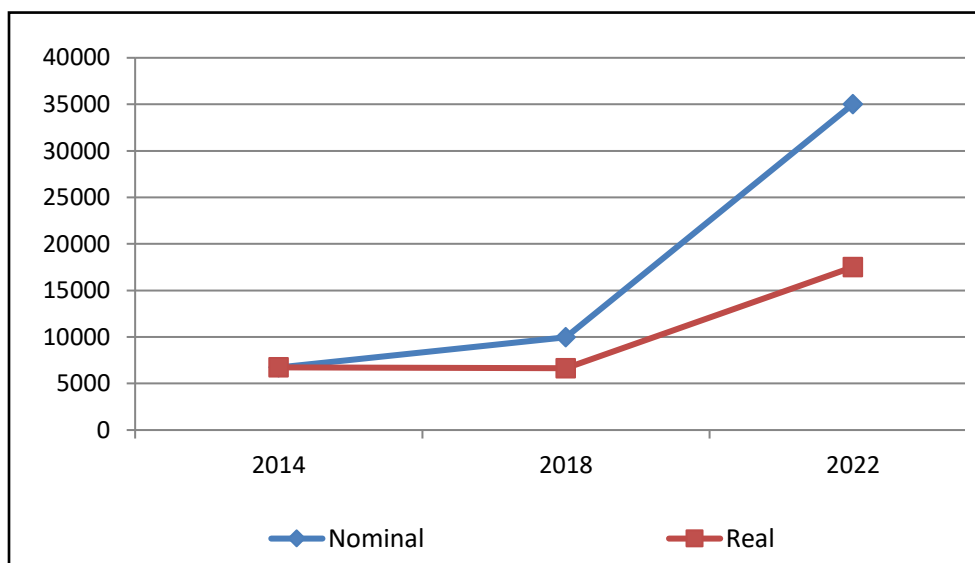
The nominal value of saving has been increasing over the years. The average saving amounted to Birr 6,725 in 2014; grew to 9,968 in 2018 and to Birr 35,027.5 in 2022 where the average growth rate was about 20.6%. In real terms, assuming a 25% annual inflation, growth of saving was about 11.9%, which was nearly half of the growth in nominal saving. On the other hand, saving in kind was growing faster than saving in cash, reflecting households' response to the country's growing inflation rate over the years. As complement to this, in 2022, 35% of those who practice saving responded that the previous years' inflation have forced them to reduce their saving

in cash and resort to in-kind saving where these figures were 21.6% and 16% in 2018 and 2014 respectively.

Table 4: Nominal Vs. real saving over the years

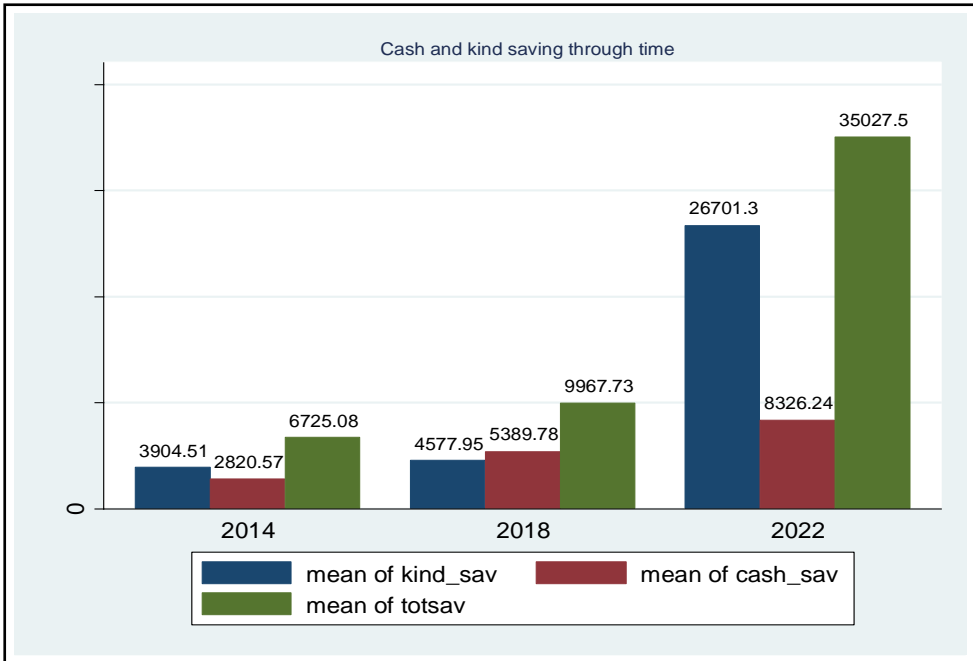
Years	Nominal saving value	Ln Nominal saving value	Real saving value	Ln real saving value
2014	6725	8.814	6725	8.814
2018	9967.7	9.207	6645.133	8.802
2022	35027.5	10.464	17513.75	9.771
Growth rate		20.63%		11.96%

Figure 3: Nominal Vs. real saving over the years



Those households who saved in-kind mentioned that their main motives to save in this form are the expectation of higher returns (62.5%) and protecting their wealth from inflation (15%) where as cash saving decision by rural households are mainly driven by safety issues (49.5%) and high value for liquidity (47.3%).

Figure 4: Saving in cash and in-kind over time



The comparison of the mean characteristics of respondents who practiced and did not practice saving indicates that age and income differences between those saving and not saving is significant at 5% while the difference in distance to the nearest formal financial institutions, and the difference in the amount of land holding were significant at 1%. The difference in livestock holding between savers and non-savers was significant at 10% (Table 5). The results for mean differences are pretty much consistent with theory and empirics. More specifically, rural households with higher income, land and livestock holdings, and more proximity to formal financial institutions are more likely to practice savings.

Among 234 households who practiced saving in the year 2022, 53 or 22.6% were using only formal financial institutions, 65 or 27.8%, were using informal institutions and the remaining were using both formal and informal financial institutions. Among those respondents who used to save in informal institutions, 65% and 33.1% of them replied that proximity and easy access respectively are the main drivers to save in informal institutions. Safety (78%), easy access (13.9%) and motive to get other services such as loan (4.3%) are the other factors behind visiting FFIs for deposits.

Table 5: Comparison of means for those who practice/not practice saving

Variables	Sample Size	Practice saving (1)	Don't practice Saving (0)	Difference (1)-(0)	significance
Age	302	52.85	57.01	-4.16	**
Years of education	302	2.84	2.88	-0.04	-
Family Size	302	8.003	7.68	0.323	-
Distance to the nearest formal FI	302	5.13	6.14	-1.01	*
Amount of landholding	302	1.28	1.05	0.23	*
Amount of livestock	302	19.5	7.79	11.71	***
Total income	302	36,293.36	23,476.26	12,817.1	**
Food consumption expenditure	302	1274.04	1160	114.04	-

***, ** & * show statistical significance at 1%, 5% & 10% respectively

5.1.1. The Supply and Demand for credit

A. Supply of agricultural credit

It is estimated that the supply of credit by formal and semi-formal financial institutions accounts for approximately 80% of the total amount channeled to the sector. In the past decade, the supply of agricultural credit by commercial banks nearly doubled. More specifically, in 2010/11, agricultural credit outstanding was Birr 10.58 billion and this has grown on average by 10% p.a to reach Birr 21.09B in 2019/20. However, in relative terms, the share of agricultural sector was 13.61% in 2010/11, which shrunk to 2% in 2019/20.

Table 6: Total credit outstanding of CBs by economic sectors (in billion birr)

Economic sectors	Years					
	2010/11		2014/15		2019/20	
	Amount	% share from total credit outstanding	Amount	% share from total credit outstanding	Amount	% share from total credit outstanding
Agriculture	10.58	13.61	18.58	8.0	21.09	2.0
Non-agriculture	67.12	86.39	213.19	92.0	1,011.12	98.0
Total	77.69	100.0	231.77	100.0	1,032.20	100.0

Source: NBE annual reports of 2010/11, 2014/15 & 2019/20 and own computations

Even though the above illustration gives an overview of the trend and share of agricultural credit in the last decade, it is less relevant to demonstrate credit channeled to smallholder farmers because the banking sub-sector seldom entertains credit requests by smallholder farmers since they fail to meet collateral and other requirements. As a result, we resort to agricultural credit supply by MFIs (i.e provide credit based on group liability) as better indicator⁷ since smallholders often visit these institutions to get credit without pledging collateral.

Table 7: Total credit outstanding of MFIs by economic sectors (in billion birr)

Economic sectors	Years				Growth (B-A/A)*100
	2014/15		2018/19		
	Amount (A)	% share from total credit outstanding	Amount (B)	% share from total credit outstanding	
Agriculture	10.65	57.9	27.29	49.8	156
Non-agriculture	7.75	42.1	27.56	50.2	256
Total	18.39	100.00	54.86	100.0	198

Source: AEMFI & own computation

⁷ It should be noted that though this is a better approach, it may underestimate supply as it doesn't account for supply of thereof by other semi-formal FIs.

Agricultural credit outstanding in 2018/19⁸ is 156% higher than the amount in 2014/15 which leaves a tremendous average annual growth rate of above 31.2% p.a for five years. The share of outstanding agricultural credit was 57.9% in 2014/15 and slightly diminished over five years to reach 49.8% in 2018/19.

B. Demand for Agricultural credit

The demand for credit was low as only 24.1% of respondents have visited the doors of both formal/informal lenders to get credit. The average amount of loan requested was ETB 10,084.9 while the approved amount was ETB 9,201.4 with 91% success in securing the loan. The sources of credit were both formal and informal. The major sources of credit were friends and relatives⁹ (42.5%) and the MFIs¹⁰ (30%). Formal FIs rejected only 2% of the applications for loan due to incomplete information and doubts on business feasibility.

The fact that the success in securing the requested loan is high while the demand for credit is so low is intriguing¹¹. The main reasons expressed in a multiple response format as to why they did not apply for loan were that they fear indebtedness (51%), high-interest rate (38%), no liquidity constraint (31.8%), high transaction cost (30.46%), fear of risk of default and its consequences (29.8%), lack of collateral (27.46), pre-conception that there is less likelihood to get credit (26.5), no clue about credit sources (17.9%) and already being indebted (17.21%) (Figure 4).

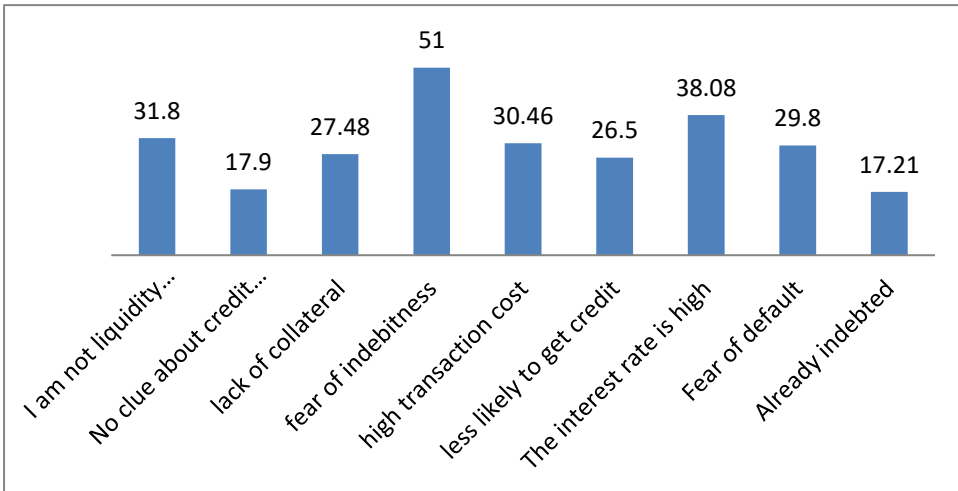
⁸ Latest year for which we got data

⁹ NB. Informal source

¹⁰ NB. Formal source

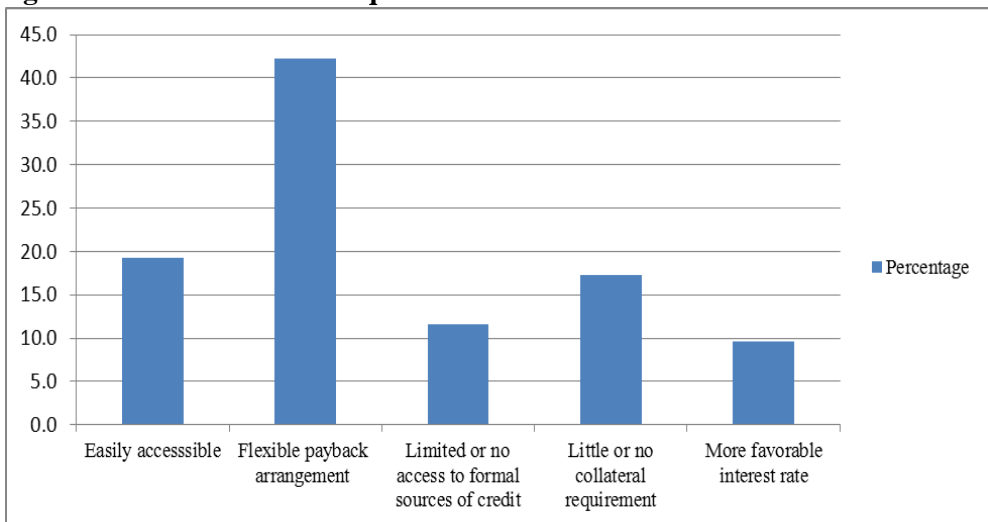
¹¹ However, the demand for credit will be astonishingly high if any of the relevant constraints to apply for credit are improved (i.e except those who aren't liquidity constrained, the rest can be potential demanders for credit).

Figure 5: Reasons for not applying loan



As shown in Figure 6 below, the major reasons for rural households to visit informal sources are its flexible payback arrangement, ease of access and little or no collateral requirement.

Figure 6: Reasons for loan request from informal sources



5.1.2. Remittance

About 9% of the surveyed households received remittance while 85% of the remittance was received in cash and 12% was in kind. The remaining has been received both in cash and in kind. The average amount received was 5,700 ETB and 50% of the money was spent for smoothening consumption. About 54% of the households receive the remittance through formal institutions while the rest receive and informal methods, including individuals.

5.1.3. Financial Knowledge

The financial knowledge of respondents about financial products was assessed along with the main sources of information for their knowledge. The financial components were saving account, compulsory and voluntary saving, children saving account, Loan from commercial banks, chequing account, interest on own saving, interest on loan and lease. Of all products, awareness about saving account is better (56.6%) followed by loan from commercial banks (45.4%). The main sources of information are friends, relatives, neighbors, CBs & MFIs (Table 8)

Table 8: Sources of financial knowledge

Types Of Financial Products	Financial Knowledge			Main Source of Information
	I Knew It Before (%)	I Heard About It (%)	I Don't Know About It (%)	
Saving Account	56.6	25.8	17.5	Friends, Relatives, Neighbors & Cbs, Mfis
Compulsory & Voluntary Saving	29.5	20.9	49.7	Friends, Relatives, Neighbors & Mfis
Children Saving Account	25.5	20.2	54.3	Friends, Relatives, Neighbors & Radio
Loan From Cbs	45.4	21.9	32.8	Friends, Relatives, Neighbors & Cbs
Cheque	15.9	14.9	69.2	Friends, Relatives, Neighbors & Cbs, Mfis
Interest From Saving	38.7	21.5	39.7	Friends, Relatives, Neighbors & Cbs, Mfis
Interest For Loan	36.1	23.5	40.4	Friends, Relatives, Neighbors & Cbs, Mfis
Lease	5.0	17.5	77.5	Friends, Relatives, Neighbors

5.1.4. Agricultural Risks and Insurance

Households' risks/shocks mainly arise from adverse market prices (50%), livestock diseases (39%), drought (27.5%), illness of a household member (27%) crop diseases (25.5%), livestock death (25%), Theft (11%), death of a family member (10%), unemployment (9%), unrest (6%) (Figure 6). Among the 50% of the households that suffered the risk of adverse market prices 92.7% described the loss in income following this shock was either very high or high. In case of livestock disease, 30.2% of the respondents face either very high/high reduction in income. Moreover, a significant share of those who experience livestock disease (46.6%) labeled the loss income due to this shock as medium (Table 9).

Even though in terms of incidence, drought (27.2%), illness of member of a household head (26.8%) and crop disease (25.5%) and livestock death (24.2%) stood third, fourth, fifth and sixth, compared to livestock disease (i.e. second) a notably higher percentage of respondents reported that the loss in income was either very high or high (Table 9) due to these shocks.

Figure 7: Incidence of various agricultural shocks

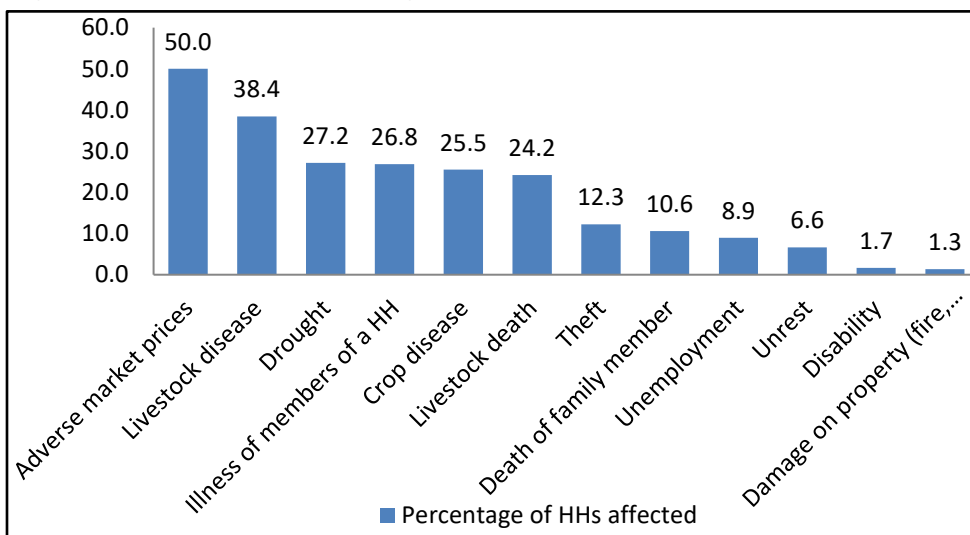


Table 9: Risks/shocks and loss in income

Types of risks/shocks	Percent age of HHs affected	Loss in income due to the shock (% calculated based on affected HHs)			Major coping mechanism
		very high & high	Medium	Low & very low	
Adverse market prices	50.0	92.7	6.6	0.7	Reduce consumption
Livestock disease	38.4	30.2	46.6	23.3	Selling prod. Assets
Drought	27.2	39.0	35.4	25.6	Selling prod. Assets
Illness of members of a HH	26.8	39.4	54.9	5.6	Selling prod. Assets
Crop disease	25.5	36.4	35.1	28.6	Selling prod. Assets
Livestock death	24.2	54.8	17.8	27.4	Reduce consumption
Theft	12.3	56.8	40.5	2.7	Use own funds (savings)
Death of family member	10.6	64.5	12.9	22.6	Selling prod. Assets
Unemployment	8.9	70.4	22.2	7.4	Get loan from relatives, friends, etc
Unrest	6.6	20.0	65.0	15.0	Reduce consumption
Disability	1.7	66.7	33.3	0.0	Reduce consumption
Damage on property (fire, flood...etc)	1.3	66.6	33.3	0.0	Reduce consumption

Source: Own computation

The major coping mechanisms for the shocks are largely reduction of consumption, and selling production assets. Few use de-saving and borrowing from relatives, friends as coping mechanisms. Shocks of adverse market prices and death of livestock are mainly addressed by reducing consumption. Shocks of livestock disease, drought, and illness of household member, crop diseases and death of family member are addressed by selling production assets. (Table 10). Almost all the shock coping mechanisms practiced by the respondents are traditional and hence inherit the limitations of these pools of options as risk management and shock coping methods which is discussed in section 3.4.

The distribution of the shocks across agro-ecologies indicates that Dega agro-ecological zone has the least percentage of occurrences of shocks. For most of the shocks the percentage of household facing the shocks are largely in desert agro-ecology and roughly equally distributed across Woina dega and Kolla agro ecologies (Table 10).

Table 10: Major shocks in different agro ecologies

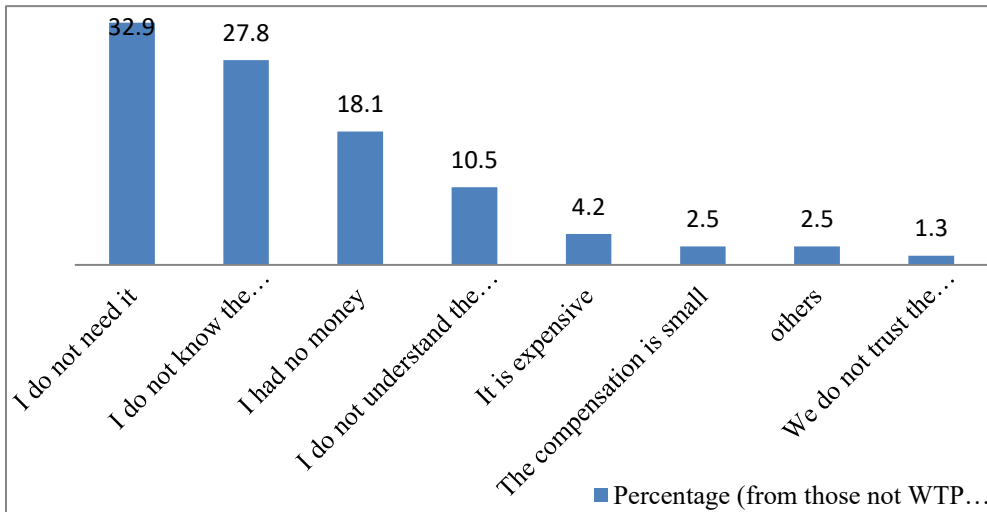
Types of risks	Percentage of HHs affected	Main agroecology			
		Dega	Woina Dega	Kola	Desert
Adverse market prices	50.0	11.9	29.1	24.5	34.4
Livestock disease	38.4	10.3	24.1	24.1	41.4
Drought	27.2	1.2	6.1	39.0	53.7
Illness of members of a HH	26.8	12.3	42.0	29.6	16.0
Crop disease	25.5	6.5	46.8	32.5	14.3
Livestock death	24.2	8.2	19.2	15.1	57.5
Theft	12.3	5.4	59.5	5.4	29.7
Death of family member	10.6	6.3	53.1	28.1	12.5
Unemployment	8.9	11.1	7.4	70.4	11.1
Unrest	6.6	0.0	0.0	5.0	95.0
Disability	1.7	0.0	50.0	50.0	0.0
Damage on property (fire, flood...etc)	1.3	0.0	33.3	0.0	66.7

5.1.5. Access to crop and Livestock insurance services

The major source of Information about crop insurance for respondents was development agents. Some 15.23% of respondents heard about crop insurance of which more than 90% of them got the information from development agents. Those who purchased crop insurance were 4.3% of the respondents and they purchased it at least once in the last 5 years from an insurance company. The average annual premium payment was 213 ETB per policy. If available, 21.5% of respondents have shown demand for index-based crop insurance.

Only 5% of the respondents heard about Livestock insurance; among those who heard about this insurance, 60% of them got the information from development agents and the remaining from Radio. None of the respondents have purchased livestock insurance so far although 15.56% of the respondents have shown demand for livestock insurance. The main reasons for not buying index-based insurance (IBI) were that they do not need it (33%), or they do not know the institutions selling the insurance (28%), do not have the money to pay for it (18%), or do not know the benefits of insurance (10%).

Figure 8: Main reasons not buying index-based insurances (IBI)



Source: Own computation

5.2. Econometric Analysis

5.2.1. Determinants of household saving

To understand the determinants of saving behavior of farm households in the study area, initially we run a correlated random effects probit model using surveys of 2014, 2018 & 2022. However, we found that the coefficients of the average values of the continuous variables which are added in the model to control for unobserved heterogeneity are not jointly different from zero. Moreover, we couldn't reject the null hypothesis that $\rho = 0$ and as a result, the panel-level variance component became unimportant, and the panel estimator is not different from the pooled estimator (See appendix A for details). Hence, we run a pooled probit model and estimated the average marginal effects which are presented in Table 11 below.

Table 11: Average marginal effect after probit regression

dependant var.: Savdum	dy/dx	Delta-method Std. Err.	Z	P>z	[95% Conf. interval]	
family_size	0.010	0.006	1.720	0.086*	-0.001	0.022
Sexdum	0.003	0.041	0.070	0.941	-0.078	0.084
Age	0.000	0.006	0.070	0.943	-0.012	0.013
age_sq	0.000	0.000	-0.510	0.607	0.000	0.000
Offfarmdum	0.019	0.038	0.500	0.618	-0.055	0.093
remit_dum	-0.127	0.045	-2.830	0.005***	-0.215	-0.039
Lny	0.024	0.005	5.230	0.000***	0.015	0.034
knowlefs_dum	0.130	0.032	4.080	0.000***	0.068	0.193
trustfi_dum	0.015	0.031	0.480	0.635	-0.046	0.075
distance_ffi	-0.006	0.002	-2.310	0.021**	-0.011	-0.001
Numlivestock	0.001	0.001	1.090	0.277	-0.001	0.002
Landsize	0.025	0.016	1.560	0.119	-0.006	0.056
localmeb_dum	0.003	0.041	0.070	0.941	-0.076	0.082
ecology_n						
Desert	-0.162	0.059	-2.73	0.006***	-0.279	-0.046
Kola	-0.021	0.052	-0.41	0.684	-0.124	0.081
Woyina dega	-0.009	0.048	-0.19	0.853	-0.102	0.085
Number of obs	906.00					
LR chi2(16)	96.700					
Prob > chi2	0.000					

***, ** & * shows statistical significance at 1%, 5% & 10% respectively

The probit regression result in Table 11 above shows that households' income, family size, and knowledge about financial services have significant and positive effect on households' propensity to save while receiving remittance, distance (measured in KM) to formal financial institutions and living in the desert agro-ecological zone to have significant negative effect on the probability of households to save.

A key factor that is found to have a significant effect on household's decision to save is household income. A one percent increase in household's income increases the probability of saving by 2.4% and this result is in line with the findings of Teshome et al (2013), Mirach and Hailu (2014), Fenta et al, (2017), and Temam and Feleke (2018). In relation to households' awareness about financial services, the recent boom in the number of branches of financial institutions across regions in recent years increased access to financial services and played a huge role in increasing awareness of households. Our regression results also show that compared to those households who do not have knowledge about financial services, the probability of saving increases by about 13 percent for those who have better knowledge about financial services. However, as shown in Table 7, about 50 percent of farm the households in our study area still have no idea about compulsory and voluntary saving products indicating the need to work more on raising awareness about different saving products.

From the results, the reader can also note that distance matters. As households go far and far away from formal financial institutions, the transaction cost to save also increases and hence more likely to reduce the probability of saving. Moreover, those households whose residence is far away from such institutions are less aware of the services of formal financial institutions (FFIs) and as a result, they have a relatively lower commitment to save. The regression result also shows that the probability to save to decline by 0.6 percent as distance from formal financial institutions increases by one more kilometer and this result is significant at 5%. This result is consistent with previous findings of Teman & Feleke (2018); and Negeri (2018) & Addis et al (2019).

Based on nature, frequency and behavior of the receivers of remittance, receipt of remittance affects probability of saving either positively or negatively. In our case, a receiver of remittance is estimated to reduce the probability of saving by 12.7% compared to those who didn't receive and this result is statistically significant at 1%. This may be due to two reasons. First, the remittances are sent occasionally and mostly for emergency purposes to be spent right away and may not be saved. Second, even though it was sent on constant basis, households may develop a dependency syndrome which reduces the probability to save. The

receiver usually becomes more or less certain about the next remittance cycle to smoothen the consumption (see our finding in section 5.1.3). This result is consistent with the finding of Addis et al (2019).

Determinants of saving in cash and kind

According to the 2022 global Findex report saving in formal financial institutions is on the rise, and even though the saving rate in developing countries is lower than the amount in developed countries, a positive progress is being observed (Demirguc-Kunt et al, 2022). The average saving rate in these countries is 42%, and among those who save, 25% of them make their savings in formal financial institutions. Achew et al, (2021) on their report also indicated that 47.4% of sampled households undertake formal saving which is much higher than the 18.1% informal saving. Below, we have present discussions on the results of regression on the determinants of cash (mostly in the formal financial institutions) and savings in kind in the study area.

As illustrated in the table, household income, participation in off-farm activities, trust on formal financial institutions and agro-ecology (i.e desert) affect both cash and in-kind savings significantly. In addition to these variables, saving in kind is significantly affected by family size, knowledge about financial services, distance from formal financial institutions, number of livestock and land holding size. The following discussion is based on these findings.

Table 12: Average marginal effect of cash and kind savings after probit regression

	Dependant var.: Cash_dum				Dependant var.: Kind_dum			
	dy/dx	Delta- method Std. Err.	Z	P>z	dy/dx	Delta- method Std. Err.	Z	P>z
family_size	0.007	0.006	1.160	0.245	0.012	0.006	1.910	0.056*
Sexdum	0.046	0.046	1.000	0.316	0.031	0.047	0.660	0.510
Age	0.003	0.007	0.410	0.680	0.000	0.007	0.020	0.986
age_sq	0.000	0.000	-0.970	0.334	0.000	0.000	-0.020	0.981
Offfarmdum	0.077	0.041	1.860	0.063*	-0.084	0.040	-2.110	0.035**
remit_dum	-0.072	0.051	-1.420	0.156	-0.082	0.051	-1.610	0.107
Lny	0.012	0.005	2.190	0.029**	0.034	0.006	6.040	0.000***
knowlefs_dum	0.056	0.036	1.580	0.115	0.212	0.034	6.250	0.000***
trustfi_dum	0.072	0.034	2.130	0.033**	-0.059	0.035	-1.720	0.086*
distance_ffi	-0.004	0.003	-1.500	0.135	-0.007	0.003	-2.610	0.009***
Numlivestock	0.000	0.001	-0.440	0.662	0.002	0.001	2.270	0.023**
Landsize	0.004	0.016	0.240	0.811	0.038	0.016	2.420	0.016**
localmeb_dum	0.011	0.043	0.250	0.801	0.012	0.041	0.300	0.765
ecology_n								
Desert	-0.28	0.065	-4.290	0.00**	-0.21	0.063	-3.260	0.001***
Kola	-.013	0.059	-0.220	0.824	-.102	0.059	-1.720	0.086*
Woyina dega	-.024	0.054	-0.440	0.656	-.194	0.054	-3.600	0.000***
Number of obs			906				906	
LR chi2(16)			100.48				137.68	
Prob > chi2			0.000				0.000	

***, ** & * show statistical significance at 1%, 5% & 10% respectively

Logarithm of household income measured in ETB

An increase in household income tends to increase the probability of cash and in-kind saving, with a more pronounced impact on the latter. More specifically, a 1% rise in household income results in increment of the probability of cash and in-kind savings by 1.2% and 3.4% respectively. This difference in

magnitude can be explained by the vivid shift from cash to in-kind savings following the rising inflations in recent periods. As evidence to this, we have asked the respondents a hypothetical question about the use of additional income if their current income doubled and 57.4% of the respondents replied that they keep it in the form of in-kind savings where as 24.18% prefer to deposit the additional income in MFIs and the remaining eye on boosting their current consumption level.

Participation in off-farm activities

Participation in off-farm activities increases the probability of cash saving by 7.7% whereas the impact of same on the probability of in-kind saving is negative (i.e participation in off farm activities reduces the probability of in-kind saving by 8.7%). A possible reason for this may be that petty trade is the main form of rural households' off-farm participation which forces traders to deposit their income mainly in cash to replenish their stock of goods or services quite often.

Trust on ¹²formal financial institutions

We expect higher tendency to save in cash/mainly in formal financial institutions by those households who trust the services of FFIs. In the contrary, low or absence of trust will corner households to in-kind savings. Consistent to this, we found that rural households with medium and high trust on FFIs have 7.2% higher probability of cash saving compared to those households with low and no trust. Furthermore, better trust of FFIs results in reduction of in-kind saving by 5.6%. This result signals that increasing the outreach and financial awareness alone will not result in the intended change on households' decision to save. But more work is required in building trust between small holder farmers and the service providers.

In addition to the above socio-economic factors, in-kind saving is also affected by financial knowledge, distance to FFIs, number of livestock and land holdings.

¹² It is qualitative measurement (no trust, low, medium and high trust)- we have assigned 0 for those who responded no/low trust and 1 for those who replied medium and high trust on FFIs

Size of livestock and land holding

Many households in rural areas are engaged in animal husbandry and farming. Household's income from such activities is determined by the size of livestock and land holding, respectively. These most important determinants of households on farm income can also have a consequence on household's decision to save. Income from such activities is usually collected in-kind, thus if households decide to save, the probability of saving in-kind will be high. Teshome (2013) shows the significant and positive relationship between the size of livestock and household's decision to save and the amount of saving. Our regression results also comply with such findings, and we found that when size of livestock increases by one, the probability of household's decision to save in-kind increases by about 0.2 percent. When land holding of the household increases by one hectare, the probability of household's decision to save in-kind increases by 3.8 percent.

Financial knowledge and distance to save in FFIs

Even though the results of livestock and land holdings are consistent with theory, the impacts of financial knowledge and distance to FFIs on kind savings are at odds with prior expectations. More specifically, knowledge of services of FFIs increases the probability of in-kind savings by 21.2%. This may be due to the fact that stock of financial knowledge help rural households not only to save but also to save in the form of those portfolios with higher return (i.e save in kind).

5.2.2. Determinants of household demand for credit

To understand the key determinants of the demand for credit, we run a probit regression and estimated the marginal effects (Table 13) and the results are discussed hereunder.

Logarithm of household income

The regression result shows that household's income (measured in ETB) has a positive and statistically significant effect on household demand for credit. In fact, when household's income increases by one percent, the probability of applying for credit services increases by 1.6%. Prior studies also show that income level of households is one of the major determinants of the demand for credit (Baba et al, 2015; Balana et al, 2020; Barslund& Tarp, 2008; Gray, 2006 Mamuye, 2021; etc). Using it as an indicator for household's wealth level, wealthier individuals are expected to succeed in securing credit from the formal

and the semi-formal financial institutions while the less wealthy individuals obtain credit from informal sources (Mpuga, 2010).

Knowledge about financial services

Following the huge campaign undertaken by formal financial institutions like banks, MFIs and SACCOs to increase their outreach, and the huge awareness creation made by governmental and non-governmental institutions, financial literacy rate in Ethiopia is on the rise. But, according to Faulkner (2022), Ethiopia is still one of the lowest performers in global adult financial literacy rate with only 34%. Financial literacy has been found to be one of the key determinants for demand for credit in developing countries (Barslund and Tarp, 2008 etc). Being significant at 1%, compared to those households who do not have knowledge about financial services, the probability of applying for credit increases by 29 percent for those households with better knowledge about financial services.

Distance in KM from the nearest formal FI

The results of our analysis shows that there is a negative relation between demand for credit and distance to financial institutions as distance from the nearest financial institution increases by 1 km, the probability of households applying for credit falls by about 1 percent.

In Ethiopia, most formal financial institutions are concentrated in urban areas. Achew et al., (2021) on their survey briefing on fourth round of Ethiopia's Socio-Economic Survey (ESS) indicated the existing wide gap between rural and urban areas in access to modern financial institutions. While residents of urban areas are expected to travel on average one kilometer to the nearest modern financial center, those in rural areas are expected to travel up to 15 kms on average, increasing the transaction cost of credit. Other prior studies have also shown the negative effect of this gap on households' demand for credit (example: Barslund& Tarp, 2008; Mamuye, 2021).

Furthermore, there is a difference in distance to formal and informal institutions. But through time, the competence of the informal sector to keep up with the rising demand of the rural households is declining, and this increases the need to improve the accessibility of modern financial institutions even more (Barslund& Tarp, 2008; Bardhan & Udury, 1999; Tang et al, 2010).

Table 13: Average marginal effect of demand for credit after probit regression

Dependant Var.: credit_dum	dy/dx	Delta-method Std. Err.	Z	P>z	[95% Conf. Interval]	
family_size	-0.010	0.005	-1.750	0.08*	-0.020	0.001
Age	0.006	0.007	0.950	0.344	-0.007	0.019
age_sq	0.000	0.000	-1.360	0.173	0.000	0.000
Offfarmdum	-0.023	0.036	-0.650	0.517	-0.093	0.047
Sexdum	0.021	0.042	0.510	0.610	-0.061	0.104
remit_dum	0.035	0.044	0.790	0.431	-0.052	0.121
Lny	0.016	0.005	3.030	0.002***	0.006	0.026
access_dum	0.037	0.033	1.140	0.254	-0.027	0.102
knowlefs_dum	0.268	0.029	9.170	0.000***	0.211	0.326
distance_ffi	-0.010	0.003	-3.990	0.000***	-0.015	-0.005
Numlivestock	-0.004	0.001	-3.590	0.000***	-0.007	-0.002
Landsize	0.001	0.014	0.070	0.944	-0.027	0.028
localmeb_dum	-0.073	0.035	-2.090	0.037**	-0.142	-0.004
ecology_n						
Desert	-0.174	0.058	-3.010	0.003***	-0.287	-0.061
Kola	0.107	0.057	1.880	0.06**	-0.005	0.218
Woyina dega	-0.122	0.049	-2.510	0.012**	-0.218	-0.027
Number of obs		906				
LR chi2(16)		204.55				
Prob > chi2		0.000				

***, ** & * shows statistical significance at 1%, 5% & 10% respectively

Membership to local organizations

Most of the rural communities of Ethiopia live in remote areas where modern financial services are not available. As a result, they tend to be members of established local organizations like 'Iqub' and 'Idir' to meet their demand for finance and cope with idiosyncratic risks. Despite the emergence of modern financial service providers in these areas, households might still incline towards local organizations. The findings of our analysis also show the inverse relation between membership to local organizations and demand for credit as the

probability of applying for credit falls by 7.3 percent for those households that are members of established local traditional organizations.

Agro ecological zone

After categorizing the -ecological zones of the study area into four, and making living in Dega agro ecological zone a reference category, we tried to investigate how living in the other three agro ecological zones impact household's demand for credit. The result shows that compared to households living in Dega agro ecology, the probability of demand for credit declines by 17.4 percent for those households living in desert areas. Again, compared to households in the Dega agro ecological zone, we found that the probability of demand for credit to decline by about 12 percent for those households living in Woyna dega areas. The driving forces for households' demand for credit include the need for technology adoption and both on- and off-farm livelihood diversification.

5.2.3. *Determinants of household demand for Insurance Services*

In section 5.1.6, we have discussed that the existing coverage of both crop and livestock insurance is highly limited. But, we also found that if available, 21.5% and 15.56% of respondents have shown demand for index based crop and livestock insurance with existing market price. In the following section, we examine the determinants of demand for both crop and livestock insurance based on data collected in 2022 alone since the previous surveys do not have questions related to agricultural insurance.

Determinants of demand for index-based (rainfall) crop insurance (IBCI)

Table 14 below, shows that the log of household income, trust on formal financial institutions, size of land holding, membership to local institutions and time preference are positively correlated with the probability of revealing demand for IB crop insurance. On the other hand, demand for crop insurance is negatively correlated with age of the head, number of livestock and being risk averse.

Log of rural household income measured in ETB

Higher household income surely boosts the capacity of rural farmers to pay for insurance premiums, binding constraints to hold the policy by poor rural farmers (Cai, 2016). In support of this, we found that when income of a household increases by 1%, the probability to demand IB crop insurance increases by 3.8%. This result is consistent with Tadesse et al (2017) and Belissa et al. (2019).

Trust on formal financial institutions

When farmers have doubts about either the insurance product design itself or the likelihood of receiving payment when they incur losses, they tend to be hesitant in taking up insurance products (Ali et al., 2020). Similarly, Carter et al (2014) argue that trust in the insurance provider is a major issue in contracting insurance, especially in the developing country context where there is little legal recourse in reclaiming insurance payments.

Our finding is also pretty much consistent with the above arguments. More specifically, the demand for IB crop insurance for rural households with high and medium trust (dummy=1) of FFIs is 12.6% higher than those households who have low/no trust on the FFIs. This result is consistent with the findings of Karlan et al (2014), Linhoff, Mubhoff and Parlasca, (2022), and Belissa et al. (2019) where the latter study used a randomized control trial in Ethiopia and observed that uptake of index-based insurance doubled when leaders of an “Iddir” who have higher trust on the insurance product are engaged in sale of the policy.

Table 14: Average marginal effect of crop and livestock insurances after probit regression

Exp. variables	Dependant var.: cropins_dum				Dependant var.: livestockins_dum			
	dy/dx	Delta-method Std. Err.	Z	P>z	dy/dx	Delta-method Std. Err.	Z	P>z
Sexdum	0.023	0.064	0.350	0.723	-0.043	0.057	-0.750	0.453
Age	-0.003	0.002	-1.870	0.061*	0.000	0.002	-0.170	0.864
offfarm_dum	-0.012	0.056	-0.220	0.829	0.053	0.060	0.880	0.379
Educllevel	0.001	0.006	0.130	0.895	-0.003	0.007	-0.380	0.706
remit_dum	-0.075	0.075	-0.990	0.321	-0.116	0.084	-1.390	0.165
Lny	0.038	0.010	3.940	0.00***	0.013	0.008	1.600	0.1*
trust_dum	0.126	0.039	3.220	0.001***	0.137	0.042	3.220	0.001***
distance_to_fffi	-0.003	0.005	-0.630	0.529	-0.008	0.005	-1.550	0.122
Numlivestock	-0.007	0.003	-2.230	0.026**	0.002	0.001	2.340	0.02**
Landsize	0.048	0.022	2.170	0.03**	0.020	0.024	0.840	0.402
localmem_dum	0.103	0.054	1.930	0.05**	0.093	0.055	1.700	0.089*
Knowinsu	0.065	0.043	1.520	0.129	0.143	0.042	3.370	0.001***
riskav_dummy	-0.083	0.046	-1.790	0.073*	0.008	0.051	0.160	0.870
ambig_dum	0.011	0.043	0.250	0.803	0.027	0.042	0.640	0.525
timepref_dum	0.175	0.040	4.310	0.00***	0.021	0.044	0.490	0.623
ecology_n								
Desert	-0.080	0.085	-0.930	0.350	0.024	0.103	0.230	0.819
Kola	0.018	0.083	0.220	0.823	0.028	0.097	0.290	0.774
Woyina dega	0.020	0.070	0.290	0.775	-0.068	0.078	-0.870	0.382
Riskdum	0.127	0.066	1.930	0.054*	-0.008	0.057	-0.150	0.883
Number of obs			302				302	
LR chi2(19)			102.49				42.17	
Prob > chi2			0				0.001	

***, ** & * shows statistical significance at 1%, 5% & 10% respectively

Size of land holding in Ha and number of livestock

The size of land holding is positively correlated with the demand for index-based crop insurance. An increase in land holding by 1 ha raises the demand for index-based crop insurance by about 4.8% and the result is statistically significant at 5%. The amount of land size approximates the level of agricultural yield; hence, it is not surprising if farmers; hence, it is not surprising if farmers mainly rely on crop production demand IBCI. This is also more supported by our finding that the number of livestock owned by the household is negatively correlated with demand for IBCI.

Membership to local traditional institutions

In Ethiopia, households have long tradition of using local organization like 'Idir', 'Iqub' etc. in order to cope with the consequences of risk and uncertainties. Mostly used as an indicator for the social capital that households possess, membership to local organizations can help internalize economic externalities resulting from climate variability and help to spread awareness about insurance products (Amare and Simane, 2017). Amare et al. (2019) shows how social capital can play a role to increase the uptake of index-based insurance products. Significant at 5%, the regression result indicates that the probability to apply for index-based insurance will increase by 0.103 for members of local traditional institutions. This complies with the works of Abugri, Amikuzuno, and Daadi, (2017), Amare et al., (2019) etc. which show that social capital to have significant and positive impact on households' uptake of index-based insurance.

Time preference of household heads

When households have time preference for the future over the present time (dummy =1 in our case), it is an indicator for households' perception that the future is less uncertain, making them less risk averse (Yesuf & Bluffstone, 2008). But, living under constant threats of climate change, most small holder households' perception about future uncertainties is expected be high and index-based insurance products, which according to Hochrainer-Stigler et al., (2014) are objective indexes, usually are determined by weather related parameters and they will give an opportunity for households to be less risk averse (Russo, Caracciolo & Salvioni, 2022). In our analysis, we have also found time preference of households to be a significant determinant of households' demand for index-based insurance, and the results show that significant at 1%, when a household

gives more weight for tomorrow than for today, on average, the probability of the household to apply for index-based insurance increases by about 18 percent.

Risk behavior of households

Basis risk is the most binding constraints for index-based insurances as it creates additional risk for contract holders (Clarke, 2016). As a result, Clarke concluded that the disutility from this additional risk dominates for individuals with higher risk aversion, resulting in risk aversion decreasing the demand for index insurance. However, in a recent study by Hill et al (2019), the demand for index-based insurance by risk-averse individuals initially increases with risk aversion up to a point and starts declining thereafter.

Our finding shows that the demand for IBCI reduces by 8.3% for at-risk rural households compared to non-risk averse rural households. But, this has to be taken cautiously since we must move up to 10% significance level so as to establish the aforementioned relationship.

Prior experience of risks

As expected, priory, those households who experienced crop related risks in the previous one year have higher probability to demand for crop insurance. More specifically, demand for crop insurance increases by 12.7% for those households with risk experience in the past one year compared those without such risks.

Demand for index-based livestock insurance (IBLI)

Household income and trust on FFIs variables correlate with livestock insurance in a similar fashion as they are correlated with crop insurance. A striking difference for IBLI is the correlation between number of livestock and demand for IBCI and IBLI. Consistent with prior expectations, the number of livestock positively correlates with demand for IBLI because the amount of land holding positively correlates with IBCI. Another relevant point here is the role of prior knowledge of insurance services on the demand for IBLI. Prior knowledge of insurance products increases the demand for IBLI by about 14.3 percent and this variable turned out to be significantly affecting the demand for IBLI at 1% while it is not significant in the case of the demand for IBCI. This has important implication for awareness creation and building trust on insurance services.

Discussion of results from the KIIs and FGDs

We conducted focus group discussions (FGDs) with selected rural households and key informant interviews (KIIs) with managers and senior financial sector experts to assess the existing institutional challenges to expand financial services, mainly credit, saving and insurance for small-holder farmers in Ethiopia. The results are summarized as follows.

5.2.4. Institutional challenges to expand credit and mobilize saving

Even though promising results have been achieved, especially through microfinance institutions, to reach bankable smallholder farmers in the last two decades, the road to further heights is limited by several supply and demand side institutional challenges. On the supply side, inadequate all-weather roads and lack of internet services in rural areas hinder MFIs and banks to expand their outreach. Moreover, in some areas, the existing financial products do not fit with the demand by the respective farmers. On the demand side, limited financial knowledge about the services and products of formal financial institutions (FFIs), high cost to reach the nearest FFIs, poor trust on the services and working of FFIs, and availability of local and informal financial service providers such as Iqqub, money-lenders, ‘Tsewa Mahber’ ...etc. have negatively impacted the opportunity to exploit the services of formal financial institutions.

5.2.5. Institutional challenges to provide crop and livestock insurance services

Insurance companies render a number of agricultural insurance products. Index based insurances (IBI), Multi-Peril Crop Insurance (MPCI), Area-based yield insurance and Indemnity-based livestock insurance are the major products of insurance companies to hedge farmers from single or/and multiple sources of agricultural risks. The interviewees pointed out that crop and livestock insurances, especially, the index-based insurance products are more recent phenomenon and the practices compared to credit and saving, and hence the nature and depth of challenges of the former are different from the latter cases.

Policy challenges

Key informant interviewees from various insurance companies expressed that the government's commitment to create fertile grounds for insurance companies to expand crop and livestock insurance products is limited. As evident to this, the government didn't articulate clear and full-fledged agricultural

insurance policy and regulatory framework to guide and control the efforts of handful of insurance companies which strive to introduce and improve uptake of agricultural insurance products as potential feasible option to overcome agricultural shocks.

Inadequate infrastructure

Rainfall gauges and satellite information are core for index-based insurance products to function. Lack of these complementary apparatuses in rural Ethiopia are one of the limiting factors to persuade and increase uptake of IBI since farmers lose trust on distantly located gauges. Indemnity and area yield index insurances which rely on field level data to determine extent of loss by the insurer are found be costly for insurance companies.

Gaps in Marketing channel

In the case of agricultural insurance, the transaction cost per policy holder is higher since insurance companies are forced to manage a large number of transactions but smaller in size. Middlemen who can work with better proximity and in turn efficiency with farmers are almost scant in rural Ethiopia.

Absence/limited knowledge of crop and livestock insurance products by farmers.

Most of the participants of our focus group discussions told us that they do not know about crop and livestock insurance services so far. Furthermore, KIIs pointed that this lack of awareness of insurance products by farmers is a binding constraint to improve uptake of the products.

Poor capacity to pay premiums

In their effort to sale crop and livestock insurance products to small holder farmers, poor capacity of farmers to pay premiums for crop and/or livestock insurances hinder the aspiration of insurance companies to function at larger scale to reduce cost. Here, it is important to note that the responses we got from the FGDs and KIIs agree with the results from the quantitative analysis.

6. Conclusion and Recommendations

Sound financial sector with adequate supply of services to the agricultural sector is essential for sustaining the sectoral economic growth and in turn reducing poverty and food insecurity. More specifically, credit facilities in rural areas play positive role in technology adoption among rural households and in turn promote diversification that generates employment, improvements in income and food security status of households. Cash Savings in formal financial institutions ensures safe and productive storage of money, and in turn, guarantee excess capital channeled to its most productive use. Furthermore, in light of widespread climate and related risks in the context of rain-fed agriculture in Ethiopia, agriculture insurance helps to spread risks of agricultural players efficiently and overcomes limitations inherent to traditional risk management and coping methods. The various demand and supply side factors of the financial services of credit, saving and insurance to farm and pastoral households have been investigated in isolated manner without focus on agro ecologies and livelihoods. Since all these gaps require closer examination, this study tried to identify the major demand and supply side constraints of access to finance by rural households in the study area.

To this end, we reviewed both the theoretical and empirical literature to establish a mathematical relation derived from utility and profit maximization goals and developed a conceptual framework to hypothesize the relation between the demand for and the supply of financial services in the context of rural Ethiopia. Both qualitative and quantitative methods were used to analyze the effect of various socio-economic and policy variables on the demand for financial services and the results are discussed in the previous sections. This section will provide a brief conclusion and tentative recommendations based on the study's key results.

A key factor that is found to have a significant effect on a household's decision to save is household income. A one percent increase in household income increases the probability of saving by 2.4%. However, the effect is not the same for cash and in-kind savings where a 1% rise in household income results in increment of the probability of cash and in-kind savings by 1.2% and 3.4% respectively. More than half of the households in the study area prefer in-kind savings than cash saving. Such big difference in magnitude can be explained by the vivid shift from cash to in-kind savings due to the rising inflation in recent

years. This has a clear message for policy and it calls for an extra effort to control the current inflation using various policy instruments the government has at hand.

The study also showed that trust on FFIs really matters. The probability of cash saving increases by 7.2% for households with medium and high trust on FFIs compared to those households with low and no trust. Furthermore, better trust of FFIs results in reduction of in-kind saving by 5.6%. This result signals that increasing the outreach and financial awareness alone will not result in the intended change on households' decision to save. But, more work is required in building trust between small holder farmers and the financial service providers.

In relation to the demand for credit, the results of this study showed that households with better income succeed in securing credit from the formal and the semi-formal financial institutions while the poor obtain credit from informal sources. This may show a mission drift of the financial institutions (mainly rural financial institutions such as MFIs and SACCOs) which are expected to be pro-poor. This requires policy intervention to allow the poor to have access to credit.

Following the huge awareness campaign undertaken by formal financial institutions like banks, MFIs and SACCOs to increase their outreach, the financial literacy rate in Ethiopia is on the rise. But Ethiopia is still one of the lowest performers in global adult financial literacy rate with only 34% and this implies the need for more effort to increase knowledge about financial services as it has been found to be one of the key determinants for demand for credit in the study area.

The result also showed a difference in demand for credit across agro-ecological zones, implying that a blanket recommendation cannot solve the problem and that policy recommendations should consider variations across agro-ecological and living conditions of farm households.

Household income, trust on formal financial institutions, size of land holding, membership to local institutions and time preference were found to positively affect the probability of revealing demand for index-based crop insurance (IBCI). On the other hand, demand for crop insurance is negatively correlated with age of the head, number of livestock and being risk averse. It is obvious that an increase in household income boosts the capacity of rural farmers to pay for insurance premiums. However, given the high poverty level in rural areas, most farmers cannot pay for crop and livestock insurance. In the context of rural Ethiopia, most pilot insurance products cease due to financial problem, huge loss due to the area-wide climate change impacts and the small pool of households who buy the insurance products. This calls for designing innovative insurance

products and government intervention to provide subsidized insurance products (premium subsidies) for poor farmers.

Our key informants noted that lack of technical expertise particularly in loss adjustment is the other major problem and most insurance products are designed by consultants from abroad who have little or no knowledge of the local context. This calls for building local technical skill/knowledge in the area of crop and livestock insurance products.

Household income and trust variables also similarly correlate with livestock insurance as they are correlated with crop insurance. Consistent with our prior expectations, the number of livestock positively correlates with demand for IBLI because the amount of land holding positively correlates with IBCI. Another relevant point here is the role of prior knowledge of insurance services on demand for IBLI. Prior knowledge of insurance increases the demand for IBLI and this has important implication for awareness creation and building trust on insurance services.

Agricultural insurance involves severe losses and reinsurers are unwilling to provide cover for direct insurers. This needs appropriate intervention by relevant stakeholders to make the sector more attractive for re-insurers. For instance, investment on digital technology is crucial to reach out pastoral and agro-pastoral areas to increase the pool, linking credit with saving and insurance can serve as an enabler or loan portfolio protection mechanism for those who apply for credit since it enables them to be creditworthy and at the same time the financier uses it to protect the loan. It can also help to promote small holder farmers practicing both crop production and livestock rearing on sedentary basis in agro-pastoral and highland livelihood systems.

Generally, the government's commitment to creating fertile grounds for insurance companies to expand crop and livestock insurance products is crucial. So far, there is no clear and full-fledged agricultural insurance policy and regulatory framework to guide and control the efforts of handful of insurance companies which strive to introduce and improve uptake of agricultural insurance products as potential feasible option to overcome agricultural shocks. This calls for appropriate action to be taken by the government.

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Appendix A

Moreover, we can't reject the null of $\rho=0$ as a result the panel version the panel-level variance component is unimportant, and the panel estimator is not different from the pooled estimator

```

Random-effects probit regression                Number of obs   =       906
Group variable: unique_id2                    Number of groups =       302

Random effects u_i ~ Gaussian                  Obs per group:
                                                min   =           3
                                                avg   =          3.0
                                                max   =           3

Integration method: mvaghermite                Integration pts. =        12

Log likelihood = -479.32212                    Wald chi2(21)    =       95.38
                                                Prob > chi2     =       0.0000

```

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
family_size	.0161209	.0228289	0.71	0.480	-.028623 .0608648
sexdum	-.0180325	.1396809	-0.13	0.897	-.2918019 .255737
age	-.0032676	.021392	-0.15	0.879	-.0451951 .0386599
age_sq	-.0000595	.0002081	-0.29	0.775	-.0004674 .0003484
offfarmdum	.035066	.1286905	0.27	0.785	-.2171628 .2872948
remit_dum	-.426161	.1518688	-2.81	0.005	-.7238183 -.1285037
lny	.0766857	.0191015	4.01	0.000	.0392475 .1141238
knowlefs_dum	.4922141	.1122404	4.39	0.000	.2722269 .7122013
trustffi_dum	.0645023	.1036098	0.62	0.534	-.1385692 .2675739
distance_ffi	-.0047259	.010596	-0.45	0.656	-.0254936 .0160418
numlivestock	.0031868	.0040675	0.78	0.433	-.0047853 .0111159
landsize	.0170612	.0654017	0.26	0.794	-.1111239 .1452462
localmeb_dum	-.0254412	.1385339	-0.18	0.854	-.2969626 .2460802
ecology_n					
Desert	-.4158807	.2117966	-1.96	0.050	-.8309944 -.0007671
Kola	.0710109	.1970819	0.36	0.719	-.3152625 .4572843
Woyina dega	.0336503	.1770325	0.19	0.849	-.3133271 .3806277
avfmsize	.0395143	.043998	0.90	0.369	-.0467202 .1257487
avlny	.0083268	.0388568	0.21	0.830	-.067831 .0844846
avdisffi	-.0377773	.0187699	-2.01	0.044	-.0745656 -.000989
avlivestock	-.0008784	.0050194	-0.18	0.861	-.0107163 .0089594
avland	.183227	.1117907	1.64	0.101	-.0358787 .4023327
_cons	-.2240357	.645821	-0.35	0.729	-1.489822 1.04175
/lnsig2u	-14.10994	30.04023			-72.98771 44.76784
sigma_u	.0008631	.012964			1.42e-16 5.26e+09
rho	7.45e-07	.0000224			2.00e-32 1

```

LR test of rho=0:   chibar2(01) = 0.00                Prob >= chibar2 = 1.000

. test avfmsize avlny avdisffi avlivestock avland

( 1)  [savdum]avfmsize = 0
( 2)  [savdum]avlny = 0
( 3)  [savdum]avdisffi = 0
( 4)  [savdum]avlivestock = 0
( 5)  [savdum]avland = 0

      chi2( 5) =      8.03
      Prob > chi2 =     0.1545

```

Appendix B

Demand for credit by small holder farmers of Ethiopia (an approximation)

Assumptions

Rural population projection for the year 2022	81,287,000 (CSA, 2013)
Average number of members per household	4.6 (DHS, 2016) ¹³
Percentage of small holder farmers in Ethiopia	90% (Gebeyanesh et al, 2021; Fantu & Alemayehu, 2022) ¹⁴
Percentage of small holder farmers actually requested for loan (our finding)	24.1%
Percentage of small holder farmers with potential demand for loan	76% ¹⁵
Average loan size	Br.
10,084.9 (our finding)	

Estimation

Actual demand: This approximates the current demand in 2021/22 (i.e demand for credit by smallholder rural households in Ethiopia who apply for loan for a year prior to the date of data collection). This is equal to

$$\begin{aligned} \text{Demanda} &= (1 / 2) * 3 * 4 * 6 \\ &= \text{ETB } 38.65\text{B} \end{aligned}$$

Potential demand: This measure what would have been the demand for credit if all liquidity constrained rural smallholder farmers apply for loan. This is equal to

$$\begin{aligned} \text{Demandp} &= (1 / 2) * 3 * 5 * 6 \\ &= \text{ETB } 121.9\text{B} \end{aligned}$$

¹³ We rely on this as it is the most recent figure to date

¹⁴ Both mentioned that the proportion of smallholder is more than 90%

¹⁵ We have taken rural households except those who are not credit constraints