



Determinants of credit access and demand among small-holder farmers in Tigray region, Ethiopia.

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“Most of the people in the world are poor, so if we knew the economics of being poor, we would know much of the economics that really matters. Most of the world’s poor people earn their living from agriculture, so if we knew the economics of agriculture, we would know much of the economics of being poor. People who are rich.....”

Theodore W. Shultz

1979 Nobel Prize for Economics speech

Dedication

I (Doreen) dedicate this work to my lovely family Nancy, Michael and Samuel for their patience and encouragement throughout my academic journey.

I (Philip) dedicate this work to my beloved mother, Abena Nyarko and dearest wife, Louisa Opoku for their love and prayers for this long journey.

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List of Acronyms

AIDB	Agricultural and Industrial Development Bank
ADLI	Agricultural Development Led Industrialization
ACSI	Amhara Credit and Saving Institution
CSA	Central Statistical Authority
CBE	Commercial Bank of Ethiopia
DECSI	Dedebit Credit and Saving Institution
DAs	Development Agents
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
FTCs	Farmer Training Centers
FHP	Freedom from Hunger Program
GOE	Government of Ethiopia
MDGs	Millennium Development Goals
MFIs	Micro Finance Institutions
NBE	National Bank of Ethiopia
NGOs	Non-Governmental Organizations
REST	Relief Society of Tigray
USD	United States Dollar

Abstract

In this paper, the researchers investigated the determinants that affect access to and demand for credit in Tigray, Ethiopia.

A cross sectional panel data collected in 2003 and 2010 were used in the analysis. A bivariate probit model was employed on cross sectional data of 2010, which had 519 households, to examine factors that determine access to and demand for credit. Access to and demand for credit was mostly explained by family size, livestock endowment, value of assets, farm size, and religion and off-farm income.

A panel data for the years 2003 and 2010, with 694 observations, was used to assess whether fertilizer adoption stimulates (crowds in) or reduces (crowds out) manure application in the presence of credit. Logit models were run with dependent variables being amount demanded of credit and fertilizer use intensity. An error term from the credit demand model was included as explanatory in the fertilizer use logit model to cater for selection bias. Consequently the error term from the fertilizer use logit model was included in the probit model (with control function approach) for the manure adoption. A positive correlation between fertilizer and manure adoption was found and this seemed to point in the direction that these two inputs are complements.

Key words: credit access, credit demand, fertilizer and manure adoption, Tigray, Ethiopia.

1. Introduction

1.1 Background

Ethiopia is one of the largest countries in Africa and second most populous country in Sub-Saharan Africa, with population of 91 million and growing at 2.9% per year (World Bank Report 2012). The agriculture sector is important to the Ethiopian economy; contributing 46.4% to Gross Domestic Product (GDP), at an annual rate of 7%, and employing roughly 85% of the labour force (Ministry of Agriculture Report, 2012). The sector generates 90% percent of export (foreign currency) earnings and accounts for 85 percent of rural employment. Hence, agriculture is the backbone of the economy from which 80 percent of the population devices its livelihood (Haile and Assefa, 2006).

Even though farmers produce 96% of the national agricultural output, agriculture is unable to feed the fast growing population and reduce the dependence on food aid. Small-scale subsistence farmers characterize agriculture with average land holding of one (1)¹ hectare per household, yet using backward farming system, which ultimately results in low productivity (Kahsay and Kugbei, 2000, Gebreselassie, 2006). The low level of households' farm income is a corollary of both the small size of landholding and the low level of productivity in agriculture (FAO, 2003). Overall, the low level of productivity and hence the inability of the agricultural output to improve the livelihoods of the rural poor is due to various factors. These include: limited access to credit services, poor infrastructure, (Ogato et al., 2009) and the nature of land tenure systems which does not allow selling or using of land as collateral for loans (Devereux and Sussex, 2000).

It is obvious that if the problem of poverty is to be tackled among the rural households in Ethiopia, there has to be fundamental transformation of small-scale production system to a more modernized agriculture, which would make use of improved farm inputs and modern technology. Provision of credit services to the poor has been considered as one of the strategies carved to reduce poverty and promote rural entrepreneurship. Increasing access to financial services hold the promise to help reduce poverty and improve development outcomes by enabling the

¹ jarts.info/index.php/jarts/article/viewFile/55/49

poor to smooth consumption (in cases of adverse shocks such as poor rain, plant diseases, increase food price), start or expand businesses, cope with risk and increase/diversify household income. Having access to and acquiring financial services by the rural poor farmers is one way of improving productivity in the agricultural sector (Irz et al., 2002). Credit has been increasingly accepted as a powerful instrument to lift the rural poor out of abject poverty. It plays a crucial role in increasing agricultural productivity via building up production assets (Amha, 2000). It also enables smallholder farmers to invest in land improvements and thereby adopt new agricultural technologies such as high yielding seeds and fertilizers that increase their efficiency and income (Zeller and Sharma, 2000). Moreover, Microcredit stands to benefit poor individuals who lack collateral, steady employment, verifiable credit history, or other requirements necessary to gain access to formal credit (Bauchet et al., 2011).

However, even when new technologies appear to be very profitable to crop scientists and economists, farmers may not adopt them (Feder et al., 1985, Crépon et al., 2008). One of major constraints for small-scale farmers to adopt agricultural technologies is credit (Croppenstedt and Demeke, 1997) since cash resources are generally insufficient to cover high-yielding variety seeds and chemical fertilizer purchase for small-scale farmers at the planting season. Limited access to credit has been implicated as a hindrance to the growth and productivity of the agricultural sector (Bashir et al., 2010). In developing countries, lack of credit constitutes a critical constraint to adoption and use of improved inputs and modern technologies of farming (Mpuga, 2010). Most poor families in developing countries have limited access to formal financial services, including credit, savings and insurance (Bauchet et al., 2011). They, therefore, rely on a variety of informal credits such as local moneylenders, relatives, friends, or merchants. These options are, however, not ideal as they tend to be expensive and unreliable. This is largely because banks and other formal financial service providers, such as insurance companies, traditionally have not considered the poor as a viable market and penetration rates for formal financial services in developing countries are extremely low. The inability to acquire formal credit support has constrained poor farmers' capability to expand their production and improve their living condition, technology adoption, nutrition and health (Bauchet et al., 2011).

As a result, the Ethiopian government and other non-governmental organizations devised means to address this issue, by introducing credit institutions such as microcredit, which have targeted mostly the provision of credit to the poor households (rural poor farmers). In addition, the government established special financial institutions such as co-operative and rural banks, which were encourage by commercial banks. Despite these attempts by the government to provide credit to the rural poor, still outreach in Ethiopia is low and has not satisfied demand of the rural poor. For example, in Ethiopia, out of the estimated six (6) million farmers who demand credit, only 900,000² clients were able to get access to microfinance institutions in 1996. This paper looked at some of the factors that are determining demand for and access to credit among farmers in Tigray region, Ethiopia.

1.2 Problem statement

A sound financial sector is critical for sustainable economic growth and therefore poverty reduction and food security. Credit has become increasingly accepted as a powerful tool to lift the rural poor out of abject poverty. It plays crucial role in providing relief of distress for farmer for the purchasing of seeds, fertilizer, cattle and farm implements (Perkins and Yusuf, 1984). It also enables smallholders to buy inputs they need to increase their agricultural productivity (Nosiru, 2010). Moreover, credit improves the welfare of the rural poor through financing consumption and reducing the opportunity cost of highly valued assets and adopting labor saving technologies (Zeller et al., 1998). Also, credit helps to insure the rural poor against the vulnerability of shocks (flood, drought and others) by reducing the cost of the farmers to cope up with these shocks. Though this can also be looked at as risky and source of default by the financial institutions. Credit in general is essential to attain rapid and sustainable development.

These impacts of the credit on the poor show the crucial role credit can play in the reduction of poverty and improving the livelihood of rural households. According to Diagne (1999), rural poor suffer from lack of access to formal credit. Formal institutions such as commercial banks and/or development banks, however, still cannot reach the poor smallholder farmers in Ethiopia. Some crucial factors contributing to the inability to get banking services on the part of the rural poor

² Meklit Microfinance Institution, 2004

include the poor incentives created for smallholders in providing loans, unaffordable cost of delivering services or high transaction costs associated with small loans to target households and inability to enforce contracts and avoiding asymmetry of information (Nguyen, 2007). Also, institutions' selection criteria such as income, gender, credibility in community, age (active age group), permanent residence, character assessment, willingness to join credit group of self-selected members to co-guarantee the loan of fellow group members, prior experience of saving and loan repayment, support letter from their respective peasant association turn out to be the key challenges that small holder farmers face, limiting their access to and demand for credit (Kereta, 2007). Even when they (formal banks) provide, they direct the credit to the specific production activities, ignoring part of the demand side. To deal with these problems, the government of Ethiopia and other Non-governmental organizations (NGOs) established microfinance institutions(MFIs) to reach out to a large number of rural poor. However, the MFIs have no clear criteria for targeting the poorest of the poor, which shows that MFIs are drifting away from their original mission of reaching the poor (Ejigu, 2009). There is evidence which shows that a large number of rural farmers are marginalized, and thereby do not have access to micro credit (due to high transaction cost associated with small size of the loan and different requirements imposed by the lenders). Besides, due to high default and lack of effective enforcing mechanisms lenders restrict supplying credit to borrowers (Stiglitz and Weiss, 1981). For instance, in rural Ethiopia, only 34% of the credit demand of the poor is reached by MFIs (Ejigu, 2009). This means that the rural poor are faced with many factors that influence their demand for credit. Moreover, determinants of demand for household's credit are issues that need to be investigated. The purpose of the study is to investigate factors that influence rural households' demand for credit in Tigray State- Ethiopia.

1.3 Objectives of the study

The study aims at:

- I. Identifying the socio-economic characteristics of farmers in Tigray
- II. Identifying the factors that determine rural households' access to and demand for credit in Tigray.
- III. Establish whether fertilizer and manure are independent, substitutes or compliments as farm inputs in the presence of credit.

2 RELATED LITERATURE

There is no standard definition for microcredit, it refers to the provision of loans to very small businesses-in an increasingly common weapon in the fight to reduce poverty and promote economic growth (Karlan and Zinman, 2009). Also, it is defined as a small loans made to low-income individuals to sustain self-employment or to start up very small businesses (Kirchgeorg and Winn, 2006). Banks and other institutions can grant Microcredit.

2.1 Factors Affecting Credit-Demand

Factors affecting demand for credit can be categorized into two: the household/individual characteristics and the attributes of the financial institution. Among the individual/household characteristics includes the level of income, sex, age, education and the attributes of the financial institution that may affect an individual's/household's decision to demand for credit from that source includes interest rate, terms of the credit and distance from the provider.

2.1.1 Individual Characteristics

Mpuga (2008) found that age of an individual positively related to the decision to apply for credit and the amount of credit applied for. Mpuga further stated that the young might tend to save and/or borrow more for various activities while the old are less. Also, Zeller (1994) has found age to positively affect the decision to demand for credit. This means that the young and the energetic individuals, with an ambition to earn higher incomes and expand investment or engaged in different activities are expected to be more active in terms of saving so as to accumulate enough capital. Those at the medium age have positive and significant demand while the old are less inclined to demand for credit. However, contrary to these findings, the study result by Tang et al. (2010) proved that old farmers are more likely to borrow than the younger farmers. This is because older farmers have more social network or social capital and thus, have more access to credit market. Also, a study in Nigeria found the same result and concluded that age of the individual does not have effect on credit demand (Nwaru, 2011).

In developing societies like Ethiopia, men and women engage in different economic activities, which have different implications on the demand for credit. Social roles and norms dictate the segregation of activities by gender where women mostly

concentrate on farm activities and household chores while men undertake income-earning activities because those are largely that society prescribes for them (Ilahi, 2001a; 20001b). This is exacerbated by the differential power relations between men and women where women have virtually no control of assets such as land, animals and buildings that could be used as collateral. Omboi (2011), study found that major reason for not seeking credit was lack of required security and being pessimistic on their ability to repay the credit. Moreover, Women who step outside traditional gender roles by taking a more independent and entrepreneurial approach in their economic lives will be blamed with the traditional construction of gender and activity-regulating social norms. If these norms are strong enough, such women may express no demand for credit even when they have profitable investment opportunities. If they do, the society will object them thinking that women who actively engage in market-oriented activities are not able to take adequate care of their home responsibilities (Fletschner and Carter, 2008). As a consequence the probability of demanding credit is negatively correlated with being female-headed household (Bendig et al., 2009; Nwaru, 2011). Single-headed (for instance widowed) households are often considered 'less lucky' or disadvantaged and thus have difficulties in social networks. Old headed households have less ability to smooth consumption by themselves if they face adverse shocks, as they do not have enough working household members to increase income by increasing labour working hours. Thus, they are forced to borrow from informal institutions (Kochar, 1997). Married couples could be given more credit because they are less mobile and loan may be jointly underwritten and his report proved that singles are 3.4 percent more likely to be constrained than married couples (Jappelli, 1990).

Tang et al. (2010) indicated education as one of important variables that affect households' demand for farm credit. In their finding it was possible to show that one additional year of education would increase the probability of borrowing by another 2.5 percent and doubling land endowment would increase the probability by 5.6 percent. On the other hand, the impact of these factors was not the same rather it varied considerably by kind of financial institutions (formal or informal). For example, while education increases households' probability to borrow from formal credit markets, it decreases or does not affect the informal credit demand at all. But this is not always true. Chen and Chiivakul, (2008) found that, education, at primary

and secondary level may affect positively, but at four-year university level, education has negatively and insignificant effect. Also, Tin et al. (2010), found that most of the poor household heads in Vietnam work in unskilled sectors, where education is not rewarded well, education does not influence credit demand.

Bendig et al. (2009) uses a comprehensive survey in Ghana to identify the possible drives that affect the different types of households' demand for financial services. The results found from a multivariate probit regression method showed in contrast to their expectations. Household size was expected to negatively affect the demand for credit. This is due to the fact that the larger households (assumed to contain more children and elderly people and not households with more economically active adults) are likely to consume a large share of their income and thus have less collateral in form of accumulated assets (Tang et al., 2010). The result, however, revealed positive influence of household size on demand for microcredit as larger households are more exposed to shocks (like illness) from higher number of household members. This was seconded by our findings where total consumption expenditure of the households was positive and significant.

Moreover the level of income is an important factor that would determine the demand for credit. Individuals may desire a higher debt while they are in a higher current income level and this may be the individual's rational decision as these individuals have higher future income expectations (Chen and Chiivakul 2008). This means that at low levels of income, the household has limited resources to save and less demand for credit than at higher level of income. However, another explanation shows that, when individual's income is very low, the marginal utility of consumption is very high, leading to high demand of credit.

Also, Magri (2002) argued that net wealth, as an indicator of household's current and future endowment is major determinant of credit demand. Whenever households' endowment grows, households can automatically finance a greater share of their desired consumption and their demand for credit may reduce. At the intermediate level of individual's wealth, an increase in endowment can increase the consumption need and therefore the demand for credit increases. According to the study, it was found that, the values of assets have significant and positive effect on the desired

debt. But at maximum level, the relation between demand for credit and the value of asset and desired debt was found negative (Chen and Chiivakul 2008).

Household assets are important elements households consider when borrowing decisions are made. According to a study by Duflo et al. (2008) it indicated that the amount of livestock owned has a negative influence on demand for credit as households need no more capital. However, the findings of Mpuga (2004) and Mpuga(2008) contend that it is not the number of the assets rather the value of assets (e.g., building, land) and how easily these assets can be liquidated that strongly influence demand for credit.

The study by Bendig et al. (2009) argued that asset endowment and regular (formal) employment status enhance financial service uptake. Households, who receive remittances, also do not show demand for microcredit. This supports the widespread assumption that poorer households are more likely to be excluded from the formal financial institutions than better-off households who characterized by high and steady incomes and assets (Mohieldin & Wright, 2000;Nguyen, 2007). Furthermore, assets of the households have also been seen as important factors that households take into consideration when borrowing decisions are made.

A study by Nwaru (2011) indicates that there is no relationship between dependency ratio and demand for credit. But found that migration, death of a family member, bad harvest has positive effect on demand for credit. However, the intensity of these influences differs depending on the source of the credit. For example, salary income worker, sick days and distance from the village positively affect demand for credit from the informal source. A study in India showed that skill, opportunities from off farm investments and occupation of the individuals are key factors influencing borrower to get a loan from the microfinance (Chaudhuri, 2011).

The type of household's activity affects their ability in obtaining credit. Majority of rural farmers in poor countries engaged in agricultural production. But, in this sector, due to unreliable rainfall and other factors, there is high degree of uncertainty and risk, which can result in high default (Tan et al., 2010). On the other hand, lenders may be less inclined to accept and prefer to be away from borrowers in risk-

conditions because of the high probability of loan default (Zeller et al., 1997). The study by Anyiro & Oriaku (2011) in China and Anyiro & Oriaku (2011) in Nigeria found that occupation affects significantly to farmers in demand for credit from formal financial institutions.

2.1.2 Institutional Characteristics

Like any other service or product, the demand for financial services is likely to be affected by their own price. In the case of financial services, the price for saving/credit is the interest rate offered/charged. In particular in the analysis of demand for credit, holding other factor constant, the higher the interest rate charged, the lower the demand for credit. This is a plausible assumption because at high interest rates, the returns from an activity must be high enough to enable the investor to retain a profit after paying the loan plus the interest. In addition to the interest, there are other charges such as commitment fee that may be imposed on the loan recipient.

2.2 Hypotheses

From the above review of previous literature by different researchers, we formulated the following hypotheses;

- a) Male headed households have more access to and demand for credit than female headed households
- b) Farming households have more access to and demand for credit
- c) Large farms demand more credit

3 ETHIOPIAN ECONOMY

Situated in the Horn of Africa, the Federal Democratic Republic of Ethiopia is Africa's oldest independent country. Bordered by Eritrea to the North, Sudan and South Sudan to the West, Djibouti and Somalia to the East and Kenya to the South, Ethiopia is a landlocked country of 91 million people – the second most populous country in Africa. The majority of Ethiopia's population (83%) lives in rural areas, concentrated mainly in the highlands of the country. Due to recent economic changes, demographic factors and incidences of drought in some regions, migration among the working age groups to the major cities is on the rise.

As a recap from above, Ethiopia is engaged in various economic activities like trade and agriculture (which is a key driver of Ethiopia's long-term growth and food security). Agriculture directly supports 85 percent of the population, constitutes 46.4 percent of Gross Domestic Product (GDP), and 90 percent of export value³. The Ethiopian government has in particular focused on improving the livelihood of the poor rural agricultural people. The key development strategy of the government as it is stated on its Sustainable Development and Poverty Reduction Program (2002)⁴ is Agricultural Development Led Industrialization (ADLI). Taking into consideration that agriculture is the main means of livelihood for 85 per cent of the population of the country, who are primarily poor and who live in rural areas, ADLI is designed as a core development program. The extensive utilization of the relatively abundant cultivable land resource coupled with the intensive utilization of human labor is believed to help improve productivity. The growth of agrarian economy is assumed to help the expansion of related industrial activity in the country. For the realization of these objectives, the roles of the expansion of financial services are given fundamental importance. The government has in particular been supporting MFIs that are primarily aimed at providing their services to rural agricultural people.

Administratively, Ethiopia is divided into nine regional states and two city

³ <http://www.ata.gov.et/wp-content/uploads/Ethiopia-Agriculture-Diagnostic-Integrated-Report-July-2010.pdf>

⁴ See the SDPRP (2002) document on the world Bank website, that is http://siteresources.worldbank.org/INTETHIOPIA/Overview/20207639/2002_07_prsp.pdf

administrations, below which are zones and the ‘*Woredas*’⁵. *Woredas* are further sub divided into ‘*Tabias*’⁶ in Tigray and ‘*Kebeles*’ in other regions. Each *Tabia* or *kebele* is further divided into several villages, which are not clearly delimited as the homesteads are scattered over the landscape(Edwards et al., 2010). Tigray region, whose capital city is Mekele, is found in the northern Ethiopia, bordered by Eritrea to the north, Sudan to the west, the Afar region to the east and the Amhara region to the south as it can be seen in **Figure 1** below

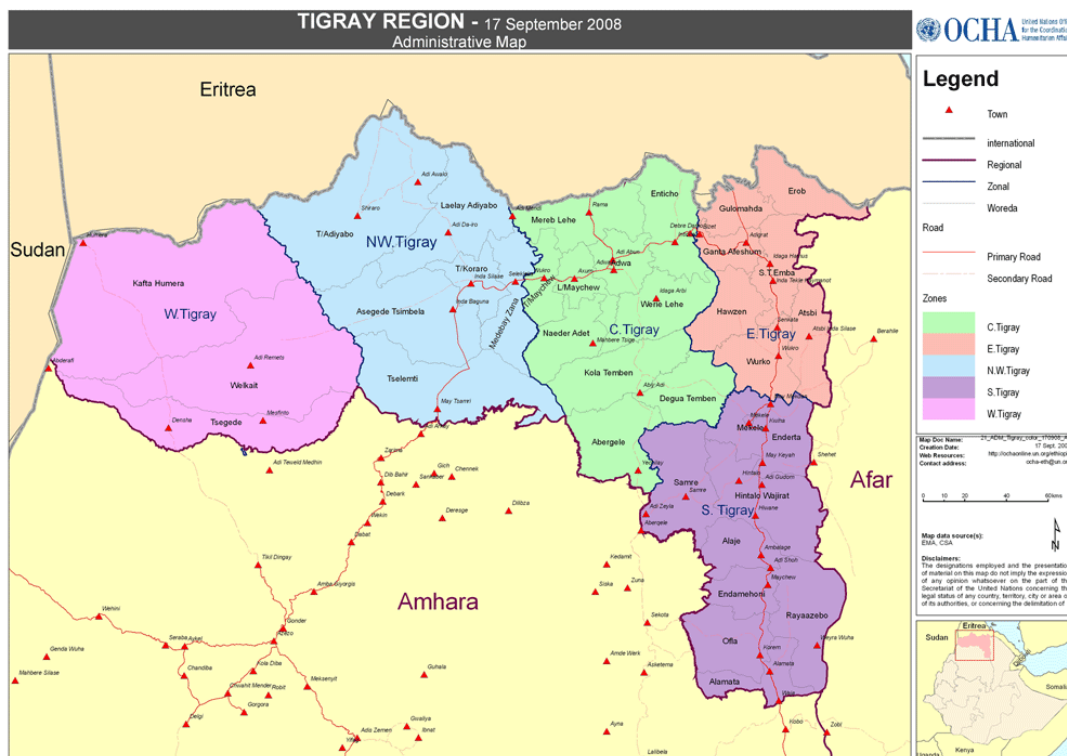


Figure 1: Map of Tigray region

According to the 2007 national census⁷ conducted by the Central Statistical Agency of Ethiopia (CSA), Tigray region has an estimated total population of about 4,314,456, of whom 2,124,853 are men and 2,189,603 are women. Tigray is predominately agricultural state with about 83% of the population being farmers. Teff, wheat, and barley are the main crops⁸. Other agricultural products include beans,

⁵ *Woreda* is an equivalent of a district

⁶ *Tabias* are the smallest administrative units in Ethiopia.

⁷ http://en.wikipedia.org/wiki/Tigray_Region

⁸ <https://web.archive.org/web/20070926215018/http://www.ethiopar.net/English/basinfo/infotgry.htm>

lentils, onions, and potatoes. Irrigation and terrace farming are used on the steep slopes. The region is also known for its export items of cotton, incense, sesame and minerals. 1.5 million hectares of land in the region is cultivable, of which one million hectares is being cultivated, while 420,877 hectares of land is terraced. Handicraft (gold smith, painting and wood sculptures) is another area of activity observed in the historic cities of the state.

3.1 Financial Sector in Ethiopia

Financial markets in developing countries and particularly the Sub-Saharan African (SSA) region are largely underdeveloped, lacking in depth, highly inefficient, concentrated in the urban areas and dominated by a few, often foreign-owned commercial banks. In particular, credit, savings and insurance markets in the rural areas are generally non-existent, and of those that do, many work imperfectly (Morduch, 1995).

“The financial market in Ethiopia includes conventional Banks (Commercial Bank of Ethiopia and Agricultural and industrial Development Bank (AIDB)), Microfinance Institutions, Cooperatives, Government projects, Semi-formal & Informal lenders, Trade credit as well as Private Bank” (Jemaneh, 2002). In spite of their high excess liquidity and the low yield on safe assets, these institutions are highly criticized for being unable to satisfy the various credit needs of the poor farmers in the country.

Never the less, major economic reforms have been taken by the Ethiopian government after the fall of the socialist government in 1991. Consequently, the Ethiopian Financial System has passed through significant reform process since 1992 as a part of transition from a planned to a market economy. Prior to this reform process, there had not been any competition within the financial sector due to the fact that all of the formal financial institutions were state owned and private financial institutions were not allowed to operate. After the implementation of the reform process starting from 1992, there have been significant measures undertaken by the government. The major reform measures taken include: Liberalizing and reforming the financial sector, relaxing foreign exchange controls, dismantling the administered interest rate regime, establishing a new regulatory framework for banks, insurance companies, microfinance institutions and cooperatives (Kassa, 2010). The sector is categorized

into formal, semi-formal and informal sub-sectors⁹. According to National bank of Ethiopia annual bullet in 2011/2012, the formal sector comprises of 17 commercial banks, 15 insurance companies and 33 MFIs. Semi-formal system comprises of registered but unregulated financial institutions including SACCOs, multi-purpose cooperatives and funeral funds. The informal system has unregistered institutions like Iqud, Idir and moneylenders.

Though with the above statistics of financial institutions in Ethiopia, a significant portion of Ethiopia's population lives without access to basic, affordable and sustainable financial services¹⁰. This is largely due to the perception by commercial banks of the unattractive risk-return outlook of serving the low-income rural population. The commercial banks prefer high-income clients who borrow large loans. These banks are urban. Because of the inability to secure the loan with fixed assets, the poor are considered as "high risk" borrower and credit was only accessible to large commercial farmers and industrial business activities. Due to bureaucratic and length procedures, high administrative costs, long distance, the unstable interest rate and the demand of small loans, rural poor households in Ethiopia are out of the reach of the formal financial institutions (Belay, 1998). Specific institutions like cooperatives are used as political tools and member's willingness was not given priority. These institutions have been hampered by poor infrastructure of the country and their size to outreach the rural poor is very limited. Shortage of skilled manpower and financial management take greater contribution in this regard (Coles et al., 2006). Even though institutions are availing themselves, those who need to borrow will not apply fearing that they do not have the capacity to repay and hence losing their collateral. These credit constraints were most severe among poorer farm households than the richer (Hoddinott & Dercon, 2005).

This, together with the high demand for bank loans in the mainstream economic sectors of the country, has created a comfort zone for the existing commercial banks, leading Ethiopia to be one of the least banked countries in the world. Data from the National Bank of Ethiopia¹¹ suggests that the country has a ratio of total population

⁸ http://www.mftransparency.org/wp-content/uploads/2012/05/MFT-RPT-101-EN-Country_Survey-Ethiopia.pdf

¹¹ http://www.mftransparency.org/wp-content/uploads/2012/05/MFT-RPT-101-EN-Country_Survey-Ethiopia.pdf

per bank branch of 112 thousand. Thus, the limitations of financial institutions in providing the rural poor with credit have become the driving forces behind the emergence of MFIs in Ethiopia.

3.2 Ethiopian Agriculture and Microfinance

Agriculture is the core driver for Ethiopia's growth and long-term food security. The stakes are high: 15 to 17 percent of the Government of Ethiopia's (GOE) expenditures are committed to the sector (Dercon et al., 2009), agriculture directly supports 85 percent of the population's livelihoods, 46.4 percent of gross domestic product (GDP), and over 90 percent of export value (Deressa, 2007). Thirteen million smallholder farmers account for 96 percent of total production, and five to seven million households are chronically food insecure. Ethiopia's agricultural sector has witnessed consistent growth since 2003: maize production has expanded at 6 percent per year, and the aggregate export value across all commodities has grown at 9 percent¹², underpinning an 8 percent annual growth rate in GDP. Public investment has expanded access to productive inputs, like hybrid maize seed and fertilizer. Concerted government spending in extension has also established nearly 10,000 Farmer Training Centers (FTCs) and trained over 63,000 Development Agents (DAs) from 2002 to 2008. The GOE has made marked progress in agriculture over the past decade. However, the sector continues to face a set of constraints: markets are underdeveloped, federal and regional governments lack capacities to implement, safety nets account for a large proportion of agricultural spending, irrigation is below its potential, shortages of improved inputs hinder growth, and key areas of the enabling environment require improvement¹³. From financial sector's point of view, agriculture is considered a less attractive field of business than other sectors of the economy such as construction, tourism and other activities. One cited reason for this is the sector's risk-return profile.

In order to improve credit accessibility, in 1994/95 Ethiopia opened doors for microfinance institutions to operate as government's poverty alleviation strategy to achieve the Millennium Development Goals (MDGs) (Zaid, 2008, Gobezie and

¹²http://siteresources.worldbank.org/INTETHIOPIA/Overview/20207639/2002_07_p_rsp.pdf

¹³ <http://www.ata.gov.et/wp-content/uploads/Ethiopia-Agricultural-Finance-Diagnostic-July-2010.pdf>

Gumuz, 2009). Following policy prescriptions by the government of Ethiopia and various NGO initiatives more than a decade ago, microfinance institutions have come into the picture, filling the gap in access to credit. These institutions are also slowly moving towards solving issues of access to sustainable and affordable saving, and access to insurance and remittance services at the bottom end of the market. Importantly, microfinance institutions, with the support of NGOs and other stakeholders, are working at various levels to provide financial education and create financial awareness amongst poor households. These institutions are spread all over the country and are legally licensed by government to take deposits from the general public (one tactic of mobilizing funds), draw drafts and provide credit to income generating activities(2005). Though operations of microfinance institutions (MFIs) started recently, their outreach and coverage of clients in Ethiopia is reasonably noticeable. There are over 30 licensed MFIs reaching over 2.2 million active borrowers with an outstanding loan portfolio of approximately 4.6 billion birr (Malepati and Gowri, 2011, Amha and Narayana, 2000, Tesfay, 2009).

Since 1996, Ethiopian microfinance is regulated under Proclamation No. 40/1996 (Licensing and Supervision of Microfinance Institutions). The National Bank of Ethiopia (NBE) is authorized to license, regulate and supervise MFIs, which are required to be incorporated as ‘for-profit’ companies, wholly owned by Ethiopian nationals or organizations owned by Ethiopian nationals (Micro Ned 2007, p. 10). The Ethiopian microfinance sector is characterized by its rapid growth, an aggressive drive to achieve scale, a broad geographic coverage, a dominance of government-backed microfinance institutions (MFIs), an emphasis on rural households, the promotion of both credit and savings products, a strong focus on sustainability and by the fact that the sector is Ethiopian owned and driven. The regional state governments and many local NGOs are shareholders in many of the MFIs. The three largest micro finance institutions; Amhara credit and savings institute-ACSI, Dedit credit and savings institute-DECSI and Oromia credit and savings-OCSSCO account for 65 per cent of the market share in terms of borrowing clients, and 74 per cent by loan provision(Deribe and Deribe, 2013). By having emphasis on the rural households, poor farmers are being targeted since the main activity in the rural Ethiopia is agriculture.

3.3 Fertilizer in Ethiopia

Enhancing agricultural productivity is one of the main challenges to achieving food security and poverty reduction in Sub-Saharan Africa. Looking at the very low level of inorganic fertilizer use on the continent, an obvious policy choice in addressing this challenge is to increase its use to increase crop productivity.

As result the Agricultural productivity growth has been the center of Ethiopia's development strategies since the country began the Agricultural Development led industrialization program in the early 1990s. The country has consistently allocated more than ten (10) percent of public spending on agriculture in the past ten (10) years (Fan et al., 2009, Byerlee, 2011), has invested heavily in rural infrastructure (Mogues, Ayele, and Paulos 2008), has made concerted efforts toward agricultural intensification with special attention to the promotion of extension services and fertilizer use (Byerlee et al 2007). This is reflected in both the economic growth and the poverty reduction strategies that the country has pursued over the past two decades. From table 1 it can be seen to large extent these policy initiatives have paid off. Following the introduction of fertilizer to smallholder farming in the country under Freedom from Hunger program in late 1960s, national annual fertilizer use grew from 3500 tons to about 140 thousand tons by the early 1990s when the central planning regime collapsed. Thereafter, fertilizer use increased from about 200 thousand tons by in 1994, to 400 thousand tons in 2005 and to 500 thousand tons in 2010. Table 1 below gives regional distribution of fertilizer consumption in Ethiopia.

Table 1: Regional Distribution of Fertilizer use in Ethiopia (percentage of the total fertilizer use)

year region	2005	2006	2007	2008	2009	2010	Weighted Average
Amhara	25	27	33	34	28	36	31
Tigray	3	2	4	3	4	4	3
SNNPR	7	10	7	9	10	15	10
Oromia	41	39	47	39	31	37	39
Other regions	24	22	9	15	27	8	18
Total fertilizer use(000mt)	425	433	388	442	510	554

Source: Central Statistical Authority 2010

From Table 1, it indicates that Amhara region has the highest percentage use of fertilizer in the year 2005(25%) but from 2006 to 2010 Oromia became the highest consumption region of fertilizer in Ethiopia. Examination of the distribution of fertilizer use across regions revealed that fertilizer use is concentrated in regions of the country that are close to Addis Ababa and therefore have relatively higher levels of infrastructure. Fertilizer use is primarily consumed in the high-potential agro-ecological areas in the central highlands of Ethiopia with relatively higher level of infrastructure.

In spite of the efforts by the government of Ethiopia and other donors to develop the agricultural sector, agricultural productivity growth remains low and the majority of farmers practice low-input, even subsistence agriculture. Inorganic fertilizers in Ethiopia are used by approximately 30 percent of an estimated six (6) million farm households and cover 37 percent of the cultivated area (Demeke et al.,1998).

3.4 Tigray in context

Historically, Tigray is one of hardest hit regions in Ethiopia by recurrent droughts. Of the 39 major recorded droughts in the last 200 years in the country that are characterized by food shortages, famines and excess mortality, more than half of them occurred in parts of the country that include this region (Webb, 1992). Moreover, many of Ethiopia's historical cross-border wars (like the 1896 and 1935 Italian invasion), recent civil wars (the protracted civil war that ended in 1991) and border conflicts (the 1998-2000 with Eritrea) took place in this region. Coupled with decades of poor governance, all of this resulted in environmental and ecological imbalances in the region, which are manifested in degraded lands, poor resource bases, and population pressure, which led to further land fragmentations and mismanagement and hence to an even poorer performance of agriculture, also relative to the national average (Woldenhanna and Oskam, 2001)

To reverse this situation and help the poor in Tigray, the Relief Society of Tigray (REST) was established in 1978 and has been engaged in development programs principally in environmental rehabilitation, agricultural development, aid, social development, rural water supply and credit and saving services (Borchgrevink et al., 2003). The pillar objectives of these programs are to improve the economic situation

of the low income and poorest people in the Tigray Region. Besides, to accomplish independence based on bona fide participation of the people by embarking upon and surmounting the core grounds and consequences of poverty through advancing sustainable rural development.

In 1993, **REST** (Relief Society of Tigray), the main NGO in the region, launched a socio- economic poverty survey in rural areas. Lack of access to credit appeared as one of the major obstacles to the rehabilitation of the region and its development. This marked the birth of Dedit Credit and Saving Institution (DECSI), which dominates the area and is considered as one of the largest MFIs in Africa. This program of credit is created to help increase agricultural production by providing regular, Agricultural Input and Agricultural Package Loans.

Although microfinance has been in operation in Ethiopia for 20 years, it has achieved less than three¹⁴ percent penetration, thus 2.4 million borrowers (Deribe and Deribie, 2013) in a population of over 90 million. While the economy is improving by 10 per cent each year, the number of people living in poverty has reduced by a mere 10 per cent in 10 years. Given these facts clearly something is not working!

3.5 Why the Agricultural sector is less financed and challenges faced

Despite the success stories of microfinance in Ethiopia, the agricultural sector is still less financed due to its characteristics, which include among others;

- ✓ Small transaction sizes. Transaction sizes in the agricultural sector are usually small, at least with regard to smallholder farmers. The average size of agricultural loans of an Ethiopian MFI in 2007 was ETB 1,250 (equivalent to less than USD 100) (Kassaye and Dejene, 2008). This increases the share of the – mostly fixed – costs of loan origination, monitoring, and collection of financial institutions relative to other sectors with higher average transaction sizes.
- ✓ "Lumpy" cash flows. Typical cash flows in the sector consist of one large cash outflow/loan (say for fertilizer), followed by one large cash inflow/repayment several months later (harvest)(Bierlen and Featherstone, 1998). Because the

¹⁴ <http://www.tradingeconomics.com/ethiopia/rural-population-percent-of-total-population-wb-data.html>

ease of monitoring individual customers increases for financial institutions with the frequency of repayments (since each individual repayment provides a monitoring opportunity), agricultural customers are more difficult to monitor compared with businesses with multiple cash inflows and outflows (Amha, 2010). Apart from complicating monitoring, "lumpy" cash flow patterns also complicate financial intermediation for financial institutions where agriculture is the primary economic activity. In this case, the savings and investment patterns of customers match and savers are likely to withdraw their savings at the time of greatest demand from borrowers (like when inputs need to be purchased).

- ✓ Illiquid and perishable collateral. Typical collateral in the agricultural sector is agricultural output, farming equipment, land or buildings (Miller, 1975). Agricultural output is typically perishable, which limits its use as collateral. The limited amount of standardization of agricultural output in Ethiopia and the availability of few "neutral" storage facilities further complicate the use of agricultural output as collateral. While a legal framework for moveable collateral such as farming equipment exists, practical considerations limit this type of collateral to large, standardized machinery that is mostly in use by a relatively limited number of commercial farmers. Since farmers generally cannot own land titles, land is also not acceptable collateral in this business. This also complicates the use of buildings as collateral. A lack of risk management skills among most financial institutions and the strong focus on highly collateralized lending (further details in the next section) further exacerbate the collateral issue in Ethiopia.

- ✓ High covariance across borrowers. The variance of cash flows compared with alternative businesses is high, making lending relatively more risky. Also, all borrowers are similarly affected by the same macro-risks, especially climate, which increases the individual and portfolio risk of lenders. The fact that about 95 percent of agricultural production in Ethiopia is rain fed

- ✓ Diverse sub-businesses with distinct dynamics. Agriculture consists of many different sub-industries with significantly varying investment and risk patterns. This causes high specialization costs in monitoring within a cash-

flow-based lending model, providing incentives to financial institutions to lend based on collateral or limit activities to easy-to-understand, homogenous parts of the business such as input credit.

Besides the characteristics of the agricultural sector limiting its financing attempts, there are some challenges faced by both the MFIs and the natives in Ethiopia. In Ethiopia women are disproportionately under-represented in the formal economy and are therefore the most poor, particularly female-headed households. Research has shown that current microfinance programs in Ethiopia are mainly designed and implemented by men with little or no participation of women (Bekele and Worku, 2013). Women's high involvement in domestic labor (cooking food and general caring of the families) also gives them limited access to credit. Therefore gender is an important factor that influences demand and supply of credit.

Religion and cultural taboos also influence access and participation in microcredit in Ethiopia. For example Muslims who are over 30 percent of the population do not participate in loan and savings activities. They believe that earning money through loans is 'haram'. Other reason why microfinance institutions have not achieved good penetration in Ethiopia is that the products they offer to the very poor are not well suited to their needs. Ethiopian microfinance institutions enter the marketplace offering credit, even though those living at subsistence levels often just want a safe place to save and manage their risk.

Other challenges facing microfinance in Ethiopia include the fact that the microfinance institutions themselves are under-funded. The loans they offer are inflexible and are given without adequate support services such as training in such basic skills as marketing, management and financial literacy training to the borrowers. Not surprisingly, there is a high failure rate of small business in Ethiopia(Worku). The MFIs also have limited success in accessing the poorest of the poor, particularly women, and their underdeveloped infrastructure makes the provision of services to rural areas difficult (Kereta, 2007). In addition to poor infrastructure are the long distances between the clients and the respective microfinance branches. This gives rise to high transactions (transportation and communication) costs. (Gobezie, 2005) noted that only 57 percent of the farmers are within 2 hours walk to any road.

Ethiopia has a very low rural banking density and consequently one of the lowest financial inclusion ratios in Sub-Saharan Africa, with only 14 per cent of adults having access to credit¹⁵. Most of the bank branches are situated in urban areas, leaving the rural areas under serviced. The ratio of the rural population to a bank or microfinance branch is 125,158 people per bank/branch.

Like many developing countries, Ethiopia's infrastructure is not well developed especially in the rural areas where the poor farmers are concentrated. This limits the outreach of the formal sector and leaves the poor with limited access to financial services. Generally, limited access to credit has been implicated as a hindrance to the growth and productivity of the agricultural sector (Bashir et al., 2010).

¹⁵ http://siteresources.worldbank.org/EXTGLOBALFIN/Resources/8519638-1332259343991/N4ssaEN_08202012.pdf

4 EMPIRICAL FRAMEWORK

In order to identify households who have or have no demand for agricultural credit, there are two methods: consumption smoothing method (indirect approach) and analysis of determining factors approach (the direct approach) (Diagne, 1999).

4.1 Consumption Smoothing and determining factors approaches

Life-cycle model and permanent income hypothesis (indirect approach) are the starting point when studying household demand for debt and credit constraint (Chivakul and Chen, 2008). This approach assumes that, under perfect capital market, households' demand for credit arises for consumption smoothing. Households maximize their utility over their life cycle by borrowing during low transitory income and saving during high transitory income. Accordingly, current consumption should be independent of current income. Unluckily, due to information asymmetry and contract enforcement problems, households in developing countries like Ethiopia are credit constrained and might not smooth their income (Diagne et al., 2000) and this eventually undermines this approach. This approach has some limitations according to findings of various scholars: Households can smooth their income by use of savings, remittances or accumulated assets (Doan et al., 2010). Secondly, most developing countries do not have insurance and therefore demand credit for health care.

Due to the shortcomings of the indirect approach, the direct approach becomes appropriate as it captures more information directly from the household members (Zeller, 1994, Bendig et al., 2009, Balogun and Yusuf, 2011). Under this approach, households can be categorized as either credit constrained or unconstrained and information regarding socio-economic characteristics affecting credit demand can be captured. There is one limitation with this approach as it fails to measure the extent to which households are constrained and the impact of credit on their welfare, which is outside the scope of this study.

4.2 Theoretical Model

From the literature and empirical framework plus the direct approach above, two frameworks are developed, the multistage credit demand decision tree, Figure 2 and determinants for credit, Figure 3

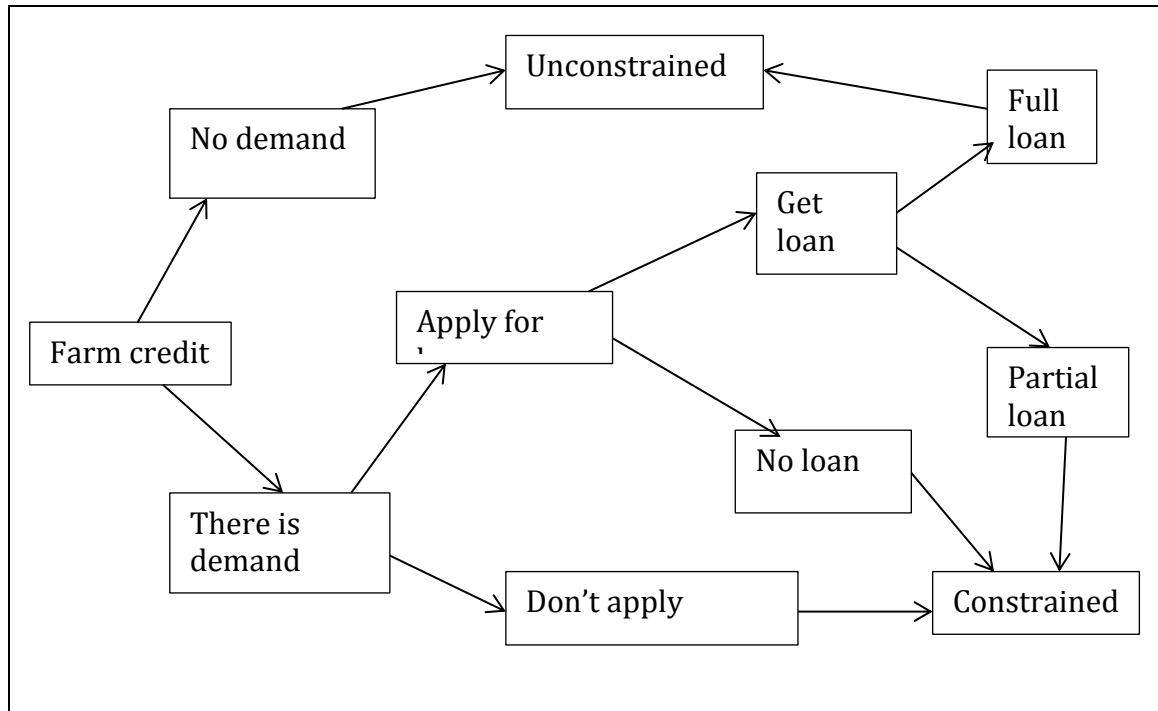


Figure 2: Multistage credit access and demand decision tree

The Figure 2 above indicates that farm households decide whether or not to demand credit for agricultural purposes. If the household demands for farm credit, he may or may not apply for the loan, as he might be discouraged. If he applies then there is a possibility that he may or may not get the full amount that he applied for. If he gets the full amount he applied for, then he is credit unconstrained otherwise if they get partial or is rejected, then they are credit constrained.

On the other hand, for a farm household to be successful in the credit market, there are various factors that influence their decision and hence demand for farm credit. Figure 3 below shows empirical factors that determine farm household demand for credit.

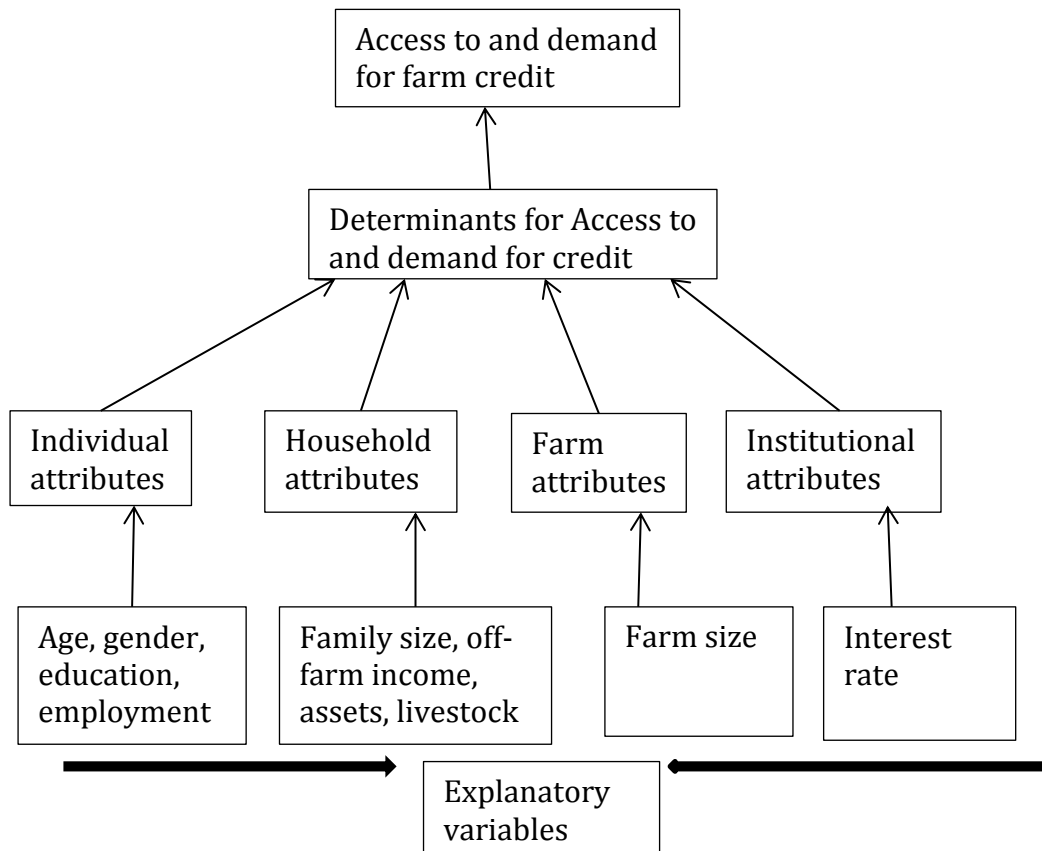


Figure 3: Determinants of farm credit demand

As stated in the literature there are several independent variables that influence farm credit in the rural Ethiopian region of Tigray. These include age of household head(HHH), education of household head (HHH), gender of household head(HHH), religion of household head(HHH), total household assets, family size, marital status of household head(HHH), household consumption expenditure, total farm expenditure (individual/household and farm attributes) and interest rate which is an institutional attribute. Below is the summary framework of the explained and explanatory variables.

4.3 Variables and their measurements

In this study five dependent variables were considered together with other various independent variables.

Access to farm credit was obtained from the responses of the participants to the question “are you able to obtain credit for farm input expenditure?” It is a binary variable with 1 for yes and 0 otherwise.

Demand for farm credit was obtained from the responses of the participants to the question “have you got credit?” It is a binary variable with 1 for yes and 0 otherwise. These two variables were used to achieve objectives I and II which were to assess the socioeconomic characteristics of farmers and to evaluate the factors that determine access to and demand for farm credit in Tigray region.

Amount of credit demanded was obtained from the actual amount, in Birr, of loan obtained by the household.

Fertilizer use intensity was obtained by dividing the total quantity of fertilizer in kilograms by the plot area in hectares on which fertilizer was applied. It is a continuous variable in kg/ha.

Manure adoption is a dummy variable that was constructed depending on whether a household applied manure or not. It is 1 for households that applied manure and 0 otherwise. Fertilizer use intensity and manure application were used to achieve objective III; assessing whether fertilizer and manure are used as complements, substitutes or independently.

Table 2 summarizes explanatory variables and their measurements. The expected signs are drawn from the literature review above where different researchers had different outcomes for same variables.

Table 2: Variables and their measurements

variable	indicator	Expected sign
Gender	Sex of HHH. 1 for male and 0 otherwise	+/-
Age	Age in years of the household head	+/-
Marital status	1 for married HHH and 0 otherwise	+/-
Religion	1 for Muslims and 0 otherwise	+/-
Education	1 for HHH who completed at least junior (9 Or more years of	+/-

education), 0 otherwise

Employment	Formal vs informal occupation	+/-
Other income	Income from sources other than farming	+/-
Consumption expenditure	Total amount of money spent on home expenses (birr)	+/-
Family size	Total number of people in the HH	+
Purpose	What the credit is used for. 1 for farming activities and 0 otherwise	+/-
Farm expenditure	Total amount of money spent on inputs (birr)	+
Durable farm assets	Current value (birr)	+/-
Durable house assets	Current value (birr)	+/-

Sources: reviewed literature

5 DATA SOURCES AND METHODOLOGY

5.1 Data sources and sample techniques

This study used secondary data obtained from Stein Terje Holden (professor at NMBU), who supervised and guided students of Norwegian University for Life Science (now known as NMBU) together with those from Mekelle University (Ethiopia) in 2003 and 2010 under the NOMA program. This household survey data was collected from sixteen (16) communities¹⁶ from Tigray Region, Northern Ethiopia.

The household surveys include household basic characteristics, household consumption, credit information, durable assets, sales of crops and livestock, and plot level information.

The household surveys were conducted to understand factors determining demand for credit in Tigray and present facts to the attention of policymakers in their attempts to improve access to credit to the people of Tigray Region.

5.2 Empirical Models

This section comprises of the different statistical models that we employed to achieve the three study objectives.

5.2.1 Bivariate probit model (Maximum Likelihood)

In this study, we used the bivariate probit model, one of the econometric models that use Maximum likelihood (ML), to estimate the parameters of demand for and access to credit (Gujarati, 2004). Demand for and access to credit are binary variables where demand for and access to credit take a value of one (1) or zero (0). Binary choice models assume that individuals are faced with a choice between alternatives and that the choice depends on identifiable characteristics. This gives the relationship between a set of attributes describing an individual and the probability that the individual make a given choice (Pindyck and Rubinfeld, 1998). When the dependent variable is dummy, the aim of the researcher is to find out the probability of an event occurring.

Estimating the parameters of credit demand and access assuming that the two variables are independent of each other could result in biased estimates (Lee, 1979).

¹⁶ The names of the 16 selected communities and the number of households sampled from each communities is available in Appendix

In this research, demand for and access to credit were interrelated. That is the two decisions are dependent on each other. As result of this, it is appropriate to use bivariate probit model instead of a normal probit model for this study. The two equations can be represented as follows:

$$Y_{1i} = \beta_1 X_{1i} + \varepsilon_{1i} \dots \dots \dots (1)$$

$$Y_{2i} = \alpha_1 X_{2i} + \varepsilon_{2i} \dots \dots \dots (2)$$

Where:

Y_{1i} is a binary variable for the probability of farm household i demand for credit in Tigray

X_{1i} are explanatory variables that affect household's demand for credit.

β_1 the unknown parameter that reflects that impact of the change in variable X on Y which are being estimated

ε_{1i} is the error term

Y_{2i} is a binary variable that represents the probability of farm household i having access to credit in Tigray

X_{2i} are explanatory variables that determine the dependent variable access to credit

α_1 the unknown parameter that reflects the impact of the change in variable X and to be estimated

ε_{2i} is the error term

To achieve the third objective of assessing whether fertilizer and manure are used as either compliments, substitutes or independently in the presence of credit, we used farm household and plot level panel data for 2003 and 2010 to analyze and achieve this objective. A total of 347 households were found to have participated in both two rounds thus giving rise to a balanced panel data with a total of 694 observations.

We used a two-stage approach to estimate demand for manure at farm level and an input demand model was used to find out factors which influence the use of these inputs at farm level. The following probit model was estimated for probability of manure adoption.

$$I_{mpit} = a_{ko} + a_{kf} I_{fpit} + a_{kl} I_{opit} + a_{k2} C_{it} + a_{fp} F_{pit} + a_{khm} H_i + a_{k3} R_i + a_{k4} P_{pit} + \hat{\varepsilon}_{fpit} + \mu_{kpit} \dots (3)$$

I_{mpit} is the use of input m (manure) on farm p by household i in period t and is a dummy variable having one if input was used and zero otherwise. The main objective was to analyze factors that affect manure use to find out if manure and fertilizers are used as compliments or substitutes by those farmers who have access to and are participating in credit schemes. I_{fpit} is the use of input f (fertilizer) and is also a dummy having one if fertilizer was adopted or applied and zero if application was not done. I_{opit} is the set of (log of) other inputs other than manure and fertilizer. In this analysis we considered log of (seeds, herbicides and pesticides) expenditures per hectare. We measured these other inputs by their cost due to their more heterogeneous nature. C_{it} is a dummy associated with whether a household i obtained credit in period t . This was determined by whether a particular household answered yes or no to the question “have you obtained credit?” One for yes and zero otherwise. F_{pit} is the log of average fertilizer price paid for the fertilizer applied on the farm. This variable (average fertilizer price) was constructed by dividing the fertilizer cost by the quantity of the fertilizer used. Average fertilizer price for 2010 was corrected for inflation by using formula;

$$\text{correctedPrice2010} = \text{price2010} (\text{CPI}_{2003}/\text{CPI}_{2010}) \dots\dots\dots (4)$$

Where CPI_t is Consumer Price Index in year t .

H_i is set of farm household characteristics including family size, livestock endowments (Oxen and Tropical Livestock Units-TLU), value of assets and others. In this research the TLU was calculated by multiplying total number of animals with the corresponding conversion factors. The table of the conversion factors is in appendix. R_i is a vector of regional dummy variables that control for variation in agro-ecological and socioeconomic characteristics such as zone-wise variations in market prices of inputs. P_{pit} is a set of farm plot characteristics like farm size. Access to credit is not random and may be influenced by various factors both from supply and demand sides such as poverty targeting objectives of the institutions and the social capital of the households. Karlan (2001) noted that microfinance institutions have annual strategies for which communities to serve and why. This makes it hard to obtain unbiased estimates for the credit program and as such we employed an instrumental variable approach using a control function method. We identified exogenous variables that are correlated with access to credit but do not directly influence fertilizer use intensity. Variables like sex of household head, age (as we assumed that social influence of the household head is strengthened by his age), and square of age of

household head as his/her social influence may weaken with old age, source and purpose of credit. The error term predicted from credit demand model was included in the fertilizer use intensity logit model to cater for selection bias of the credit program.

$\hat{\epsilon}_{fjit}$ is the predicted error term from the fertilizer demand equation in which credit demand was instrumented for. In the logit fertilizer demand equation we specified a dependent variable as fertilizer intensity in kilograms per hectare obtained by dividing the total quantity of fertilizer (kg) used by farm size (ha). The inclusion of the error term (control function approach) helps control for endogeneity of fertilizer use and access to credit.

6 Descriptive analysis of variables

This study used secondary data collected in 2003 and 2010 in Tigray Region, northern Ethiopia. A total of 519 households, including both borrowers and non-borrowers, were considered in the study. The summaries of all the variables considered in the study are given in Table 3 and Table 4 below.

Table 3: Summary of general descriptive statistics of the dependent variables (Total households)

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	519	54.8	14.7	19	100
Total income (Off-farm)	519	3542.8	13171.7	0	283500
Assets value	519	11621.1	29622.9	0	335222
Seeds (Expenditure)	519	581.4	603.5	0	4581
Total consumption (Expenditure)	519	9573.5	6244.3	407.5	60271
Family size	519	5.0	2.4	1	11
Crop income	519	1298.6	3917.7	0	40000
Livestock income	519	1845.5	4812.7	0	61900
Herbicide (Expenditure)	519	9.7	48.5	0	800
Pesticide (Expenditure)	519	10.4	140.7	0	2880
Equipment (Expenditure)	519	8.3	60.9	0	1200
Manure (Expenditure)	519	41.3	266.9	0	3500
Fertilizer (Expenditure)	519	283.9	370.6	0	2960
Farm size	519	3.7	3.5	0	24
<u>Oxen Expenditure</u>	<u>519</u>	<u>3.7</u>	<u>82.2</u>	<u>0</u>	<u>1875</u>

Source: Noma 2010

From Table 3 above, Household or family size ranged between 1 and 11 members. The mean family size of borrowing households is approximately 6 persons. This number is very high which creates high dependency of farmers on a small piece of land, which is the main source of income. Off farm income which is an income generated by a household working off the farm also serves as a means of income smoothing when the income from the on farm activities couldn't be as expected. Accordingly, result on off farm income indicates that the overall annual average income of the households in the study area was 3542 ETB¹⁷ and 4529ETB for total and borrowing households respectively. While household average consumption expenditure is 9573ETB, which increase to 11154ETB with borrowed households. Farm size was approximated by area planted in hectares. The Average cultivated land holding size for the sample was 3.6 tsimdi (0.9hectare), which is almost the same as the estimated national average of around 1 hectare ((Bewket and Sterk, 2002).

Data on income from livestock and crops showed an annual average 1804 ETB and 1298 ETB with maximum of 32220 ETB and 33700 ETB and minimum of 0 respectively among borrowers. Farm expenditures included among others seed, herbicides, pesticides, and equipment, salt, oxen, fertilizer, and manure purchases. Results on fertilizer and manure expenses gave 454 ETB and 33 ETB respectively.

Table 4: Percentage and frequency distribution of the dependent variables among both total and borrowing households

variables	Total households		Accessing households		Borrowing households	
	frequency	percentage	frequency	percentage	frequency	percentage
Sex						
Male	363	69.8	122	70.9	144	77.01
Female	156	30.2	50	29.1	43	22.9
Marital status						
Married	330	63.5	113	65.7	137	73.3
Not married	189	36.5	59	34.3	50	26.8
Education						
Illiterate	382	73.7	118	68.6	131	70.1
Literate	137	26.3	54	31.4	56	29.0
Religion						
Non-moslem	455	87.5	156	90.7	177	99.7
Moslem	64	12.5	16	9.3	10	5.4

¹⁷ Ethiopian Birr (currency)

Occupation						
Non-farming	34	6.7	9	5.2	7	3.7
Farming	485	93.3	163	94.8	180	96.3
Sources						
Dedebit	117	22.5	61	35.5	117	62.6
Formal	52	10.0	27	15.7	51	27.3
Informal	10	1.9	7	4.1	10	5.4
R.E.S.T	7	1.4	7	4.1	7	3.7
own	1	0.2	-	-	1	0.5
N/A	332	64	70	40.7	1	0.5
Zones						
Southern	78	15.0	23	13.4	15	8.0
Eastern	96	18.5	20	11.6	27	14.4
Central	97	18.7	31	18.0	39	20.9
Western	88	16.9	33	19.2	45	24.1
North-west	160	30.9	65	37.8	61	32.6
Fertilizer use						
No use	233	44.8	60	34.9	39	20.9
Used	287	55.2	112	65.1	148	79.1
Manure use						
No use	375	72.3	153	89.0	114	61.0
used	144	27.8	19	11.0	73	39.0
Purpose						
N/A	335	64.6	70	40.7	3	1.6
On-farm	177	34.1	100	58.1	177	94.7
Off-farm	7	1.4	2	1.2	7	3.7
Total	519		172		187	
observations						

Source: NOMA 2010

Note: N/A for purpose and source variables means that respondents did not get credit

From Table 4 above, out of the total sample of 519 households, 156(30.2%) households were female headed as compared to 363 (69.8%) households that were male headed. The gender composition of the respondents indicates more male-headed households than female-headed households. This result reflected the social and cultural system of the African society where men are the heads of their households. It also showed that for male-headed households, 122 (70.9%) and 144 (77.0%) accessed and demanded credit respectively as compared to female-headed households with 50 (29.1%) and 43(22.9%) accessing and demanding credit respectively.

Regarding marital status, 189 (36.61%) household heads were not married, 329 (63.39%) household heads were married. There was a visible big difference between

married household heads 113 (65.7%) and 137 (73.3%) accessing and demanding credit respectively as compared to unmarried household heads 59 (34.3%) and 50 (26.7%) accessing and demanding credit respectively. It can be concluded that majority of the respondents who accessed and demanded credit were married household heads.

The number of Muslim household heads (5.4%) who demand for credit is less than non-Muslim household heads (94.7%). This is due to the fact that, their religion prohibits them from demanding for credit. Illiterate household heads accessed and demanded more credit; 118 (68.6%) and 131(70.1%) respectively. than literate household heads who had 54 (31.4%) and 56 (29.9%) for access and demand respectively. 94.8% and 96.3% of the household that accessed and demanded for credit respectively were involved in agricultural activity (farming). This seems to indicate that primary occupation in the Tigray region is farming.

The respondents had an average age of 54.1 years, with minimum and maximum age of 19 and 100 years respectively. The borrowing households have an average age of 54.1years.This means that the younger households who are economically active are not demanding credit from financial institutions in the area. There were various sources from which households acquired credit and these included Dedebit, formal, informal, R.E.S.T and own financing, with Dedebit having the highest percentage of households who demand for credit 117 (62.6%).This is because Dedebit is financial institution which covers most areas and has the aim of reducing poverty in the Tigray region(the target is on the poor dominated rural farmers).

The purpose of acquiring loans was categorized into on-farm and off- farm activities, with on-farm activities taking the largest percentage (94.6%) against off-farm (3.7%). This was in line with our earlier expectations that farm activities take priority when farmers are applying for loans. Tigray as a region is divided into five (5) different zones thus southern, eastern, central, western and north western. The highest number of respondents was from northwestern zone; 160 (30.9%) as well as borrowers 61 (32.6%). Southern, eastern, central and western zones have 15 (8.0%), 27 (14.0%), 39 (20.9%), and 45 (24.1%) borrowers respectively.

Out of 287 (55.2%) respondents who applied fertilizer, 112 (65.1%) and 148 (79.1%) accessed and demanded credit respectively. Whereas from 233 (44.8%) who never applied fertilizer, 60 (34.9%) and 39 (20.9%) accessed and demanded credit respectively.

Out of 144 (27.8%) respondents who applied manure, 19 (11.0%) and 73 (39.0%) accessed and demanded credit respectively. Whereas from 375 (72.3%) who never applied fertilizer, 153 (89.0%) and 114 (61.0%) accessed and demanded credit respectively.

Since majority of the households who demand for credit in this area are farmers and for agricultural purpose, it is assumed that with acquisition of credit, farmers are able to purchase reasonable amount of fertilizer to use on plots and thus less of the manure is utilized since its labor intensive.

7 RESULTS AND DISCUSSION

This section includes econometric model results and discussions of the findings. The researchers run two probit and two logit models. The first logit model was run for the credit demand with a dependent variable as amount demanded from which we estimated the error term that was included in the second logit model for fertilizer use intensity. The error term estimated from this second logit model was included in the probit model run for manure adoption. Bivariate probit model was run with two dependent variables; access to credit and demand for credit to achieve objectives I and II and test the hypotheses. The first objective was to identify socio-economic characteristics of farmers in Tigray region and the second was identifying factors that determine access to and demand for credit among farm households in Tigray region.

7.1 Estimated results of bivariate probit model on access to and demand for credit

Both access to and demand for credit is affected by various inter-related factors. A correlation coefficient matrix was run on the variables to establish whether there was multicollinearity among the variables. According to Studenmund (2011), the rule of thumb that confirms presence of multicollinearity is when the coefficient is 0.8 and above. Marital status was correlated with sex of the household head so we excluded it from the regressions. The results of the bivariate probit model for access to and demand for credit are presented below in Table 5.

From objective I and II, three hypotheses were tested and below is the discussion of the findings;

It was hypothesized that male-headed households had more access to and demanded more credit than female-headed households. However, the estimated coefficients on the variable sex of household head indicated that male-headed households were less likely to demand and access credit as is revealed by the negative coefficients of dummy variable sex where 1 was for male-headed households and 0 otherwise. The possible reason for this may be the fact that males are able to earn income from hiring out their labor (service) to others. Thus, they are less likely to demand credit than the females. This can also be attributed to the fact that financial institutions have targets

and objectives geared towards gender equality and women empowerment thus favoring women.

One of the researchers' hypotheses was to test if farming households have more access to and demand for credit. The result indicates that farming has positive relationship with demand for credit. This result agrees with the descriptive findings, which show that 96% of the borrowing households are- farmers. This may be due to the fact that Tigray region is mainly occupied by farm households who demand credit mainly for farming purposes that is buying of farm inputs such as fertilizer, seeds, livestock etc. This agrees with our descriptive findings which indicate that 95% of borrowing household's purpose of getting loan is for on-farm activities. Access to credit has positive relation with occupation from the results

This reason may be that agriculture is the priority of most financial institutions in Tigray region. Thus farm households are likely to get credit from financial institutions. Another reason may be that the government of Ethiopia through financial institutions wants to ensure food security by providing credit to the farmers to buy farm inputs in order increase output of farmers. This is may be step to reduce poverty in Ethiopia.

Another hypothesis was to test if large farms demand more credit. The coefficient of farm size is positive and significant. This result agrees with the findings of Ferede (2012). The reason may be that with large cultivated land size, the farm households utilize more farm inputs such as fertilizer, seed, labor (hired labor) and others that needs additional resource that might be obtain through credit. Also, it can be attributed to fact that large farm size means increase in farm income which would lead to increase in household's saving and investment. An increase in investment means more resources needed to undertake more business activities, which requires demand for credit. Furthermore, farm size has influence on access to credit. The reason for this may be associated with the fact that large farmers can generate more income from and be able to repay the loan without default. This is justifying by the positive coefficient and significant level of farm size.

Table 5: Estimates of the bivariate probit model

variables	Access coefficients	Demand coefficients
sex	-.213 (.158)	-.073 (.162)
Age	-.002 (.029)	.024 (.030)
Age square	-.00003 (.0003)	-.0003 (.0003)
Family size	.085*** (.033)	.123*** (.033)
Occupation	.045 (.254)	.223 (.276)
Education	.134 (.145)	-.018 (.147)
Religion	-.209 (.195)	-.776 *** (.221)
livestock	-.075 ** (.039)	-.063 * (.038)
Off-farm income	-.036* (.019)	-.022 (.019)
Assets value	.076*** (.029)	.077** (.031)
oxen	-.041 (.069)	.052 (.068)
Farm size	.044** (.019)	.071*** (.019)
constant	-.998 (.768)	-2.275 (.822)

Note: dependent variables are access to and demand for credit having 1=1 for access to credit or demand for credit, =0 otherwise. Levels of significance ***=1%, **=5%, *=10%. Numbers in parenthesis are standard errors. Likelihood-ratio test of $\rho=0$. Prob>chi2 = 0.000

Source: computations from 2010 NOMA data.

More findings about other control variables that were used in the analysis are given below;

The coefficient of religion is negative and significant on demand for credit (Muslims take on one). This result agrees with the descriptive findings, which indicates that

96% of the borrowing households are non-muslims compare to 5 % Muslims. The possible reason is that in Muslim religion, credit or saving is not allowed since paying or receiving interest is considered as haram¹⁸(Gobezie and Gumuz, 2009). Therefore people refuse to take credit even though they are unable to finance themselves. However, religion has no significant impact on access to credit. This means that financial institutions in Tigray do not discriminate borrowers by their religion affiliates.

There exists a positive and significant relationship between demand for credit and the family size. This result is consistent with the findings of (Oluwasola and Alimi, 2008). The reason may be due to the fact that bigger families may have bigger farms (large capacity for investment) which may need more input use, thus an increase in demand for credit. Family size has positive influence on credit access.

The coefficient of education is negative and insignificant. This result agrees with the descriptive findings, which indicate that 70% of the borrowing households are illiterate compare to 30% literate. The reason may be associated with the fact that credit is usually demanded for farming purposes that is buying of farm inputs. On the other hand, people with education go for off farm income opportunities thus demanding less credit. Credit access has positive relation with the level of education. This might be because education is associated with better understanding of the loan regulation as well as the borrowing procedures of the formal financial institutions of educated individuals (Lensink et al., 2007)

The tropical livestock has inverse relation with demand for credit. As households own high number of animals, they would demand less credit. This can be attributed to an increase wealth and income from these animals makes more money available in the household, hence less credit demand. According to Gryseels (1988) livestock is an integral part of farming system on which over 85 percent of Ethiopia rural farmers depend on. Access to credit is negative and significant. The reason may be due to the fact that some of the areas in region may have dry lands which are not good for

¹⁸ haram: anything forbidden according to Muslim religion

farming but suitable for livestock .Thus people in these areas with more livestock will demand less credit because livestock may serve as substitute for credit.

Age and age square coefficients are positive and negative respectively. This result agrees with the finding of Mpuga (2004).The reason may be due to the fact that at intermediate age, people's demand for credit increase with respect to age but it declines as the age of the individual advances since they tend not to like leaving debts for their children after their death.

7.2 Estimated results of logit model for amount demanded of credit and fertilizer use, and probit model with control function for manure adoption.

A probit model combined with control function was used to achieve objective III which was to determine whether fertilizer and manure are adopted as complements, substitutes or independently when farm households have access to credit. Table 6 below summarizes variable estimates of the logit and probit models with control function approach.A logit model run for the amount demanded of credit indicated that purpose of credit had a positive correlation to amount demanded of credit and was highly significant at 1%. Purpose was categorized into on-farming and off-farming and it was found that a 1% increase in on-farming activities led to a 3.8% increase in amount of credit demanded. Religion had a negative relationship with amount demanded. Moslems demanded less of credit. Occupation was categorized into farming and non-farming and it was found that a 1% increase in farming activities led to 0.15% increase in amount demanded of credit. It was found that age had a positive correlation with amount demanded of credit but as one grew older age had a negative correlation evidenced with a negative coefficient of square of age in the model.

In the fertilizer intensity model we found farm size and distance to the nearest market (in minutes) to be negative and highly significant at 1%. Since we calculated fertilizer intensity as the quotient of total fertilizer quantity and total farm size, then this is self-explanatory and expected that as farm size increases then less of the fertilizer is used overall. With poorly developed transport systems in Ethiopia, the further the market is

the less fertilizer will be demanded as transport fares become high. Participation in credit program had a positive but insignificant correlation with fertilizer demand as it indicated that a 1% increase in probability of participation in credit program lead to 0.09% increase in fertilizer use. This was also evidenced by the coefficient of the error term from credit demand model that was positive and highly significant at 1%. The fertilizer price was found to be positive which was contrary to our expectations of a negative correlation. This could be associated with the fact that there was little variation in the fertilizer prices between the two years and also that perhaps these prices are determined by distance to the nearest market. In our study we also found log of herbicides cost, and log of seeds cost to be positive and significant at 1%. This could be attributed to the fact that as seeds and herbicides get more expensive, farmers resort to more fertilizers to realize more output from the few seeds and herbicides used. Total value of household assets and religion had a negative correlation with fertilizer use.

Fertilizer application dummy was positive and highly significant at 1% in the manure adoption model. This means that 1% increase in the probability of fertilizer application leads to a 0.54% increase in the probability of manure application. This seems to indicate that these two inputs; manure and fertilizers are complements, thus, the adoption of fertilizer crowds in manure. This was in line with what Holden and Lunduka (2012) found; that in the presence of fertilizer subsidy, fertilizer adoption crowds in manure application among farming households in Malawi.

Table 6: Tobit and Probit models with control function approach

variables	Credit demand	Log of fertilizer use (kg/ha)	Applied manure
Credit dummy		0.086 (0.070)	
Source of credit	0.740*** (0.074)		
Purpose of credit	3.832*** (0.153)		
Error term from credit demand		1.407*** (0.505)	
Fertilizer dummy			1.030*** (0.1308)
Fertilizer price		1.485*** (0.037)	-0.391*** 80.100)
Error term from fertilizer demand			4.347* (0.1297)
Religion	-0.489 (0.505)	-0.0973 (0.5451)	
education		0.2707 (0.1495)	
Occupation	0.150 (0.177)		
Log of farm size		-0.3358*** (0.0913)	-0.485*** (0.1075)
Distance to market		-0.0024*** (0.0001)	-0.0012*** (0.0006)

Oxen endowment		0.0720	0.0215
		(0.0772)	(0.0796)
Tropical Livestock Units		0.0554	0.0711
		(0.0438)	(0.0439)
Age	0.038		
	(0.026)		
Sex	0.136		
	(0.230)		
Log herbicide cost/ha		0.2008***	0.2119**
		(0.0754)	(0.0802)
Log pesticide cost/ha		0.3354*	0.4194**
		(0.1164)	(0.1432)
Log oxen cost/ha		0.0979	0.3376**
		(0.0975)	(0.1209)
Log assets		-0.039***	
		(0.0211)	
Square age	-0.0004		
	(0.136)		
Log seed cost/ha		0.3064***	0.0171
		(0.0279)	(0.0303)
Family size		0.0768*	0.0727**
		(0.0310)	(0.0288)
constant	-0.5701	-0.114	
	(0.0678)	(0.161)	

Source: computations from 2003 and 2010 NOMA data

Note: dependent variables are credit use, fertilizer use intensity and manure adoption with 1= application of manure and 0 otherwise. Levels of significance ***=1%, **=5%, *=10%. Numbers in parenthesis are standard errors. Likelihood-ratio test of $\rho=0$. Prob>chi2 = 0.000

The same was with the (log of) pesticides, oxen hire and seeds costs. This could be attributed to the assumption that when the costs are high then less of these inputs are used therefore need for more manure on the plots in order to realize more returns. Fertilizer price had a negative coefficient and highly significant at 1% implying that when the price of fertilizer increases, less of manure is used and this concurs with the finding that fertilizer and manure are complements. This finding is also complimented by the positive and significant coefficient of the error term from the fertilizer demand model.

Farm size was negative and highly significant at 1%. This attributes to the fact that as manure application is labor intensive, large farms will experience less manure application especially in times of labor scarcity. A 1% increase in the household size leads to a 0.07% increase in manure application as this increases the available labor to apply the manure. This is deduced from a positive and significant coefficient of household size in the manure adoption model. Religion, occupation of household head and tropical livestock unit coefficients were positive but not significant.

8 CONCLUSIONS

In this study, the researchers investigated the influential factors, which determined access to and demand for credit in Tigray region, Ethiopia. They went further to investigate whether fertilizer and manure are complements, substitutes or independent in the presence of credit. 2003 and 2010 data was used for this study.

Credit has been increasingly accepted as a powerful instrument to lift the rural poor out of poverty. It plays a crucial role in increasing agricultural productivity via building up production assets (Amha, 2003). This shows how important credit is in lifting the poor people out of poverty in developing countries such as Ethiopia. But a lot of literature showed the difficulty in obtaining credit in developing countries. This is the reason why the researchers were interested in investigating factors that influence access to and demand for credit in Tigray region, Ethiopia.

The descriptive results indicated that 71 percent of male-headed households had access to credit as compared to 29 percent female-headed. This means that in Tigray region, male-heads have a higher probability of having access to credit than female-heads. The researchers recommend that the government and financial institutions should increase females' access to credit in the region. There is a gap between demanding and accessing credit for farm households who used fertilizer. 79 percent of fertilizer adopted households were found demanding credit but only 65.1 percent who had access. The descriptive results also showed that a majority of the farming households who demanded for credit (96.3%) had access to credit (94.8). This shows a small gap between farming households' demanding and accessing in Tigray region. Further, 65.7 percent of the married households had access to credit compared to 34.3 percent of unmarried households.

From the econometrics results, households' farm size had a positive association with access to and demand for credit. This indicated that an increase in farm size would increase households' demand for and access to credit. The results of tropical livestock unit have a negative and significant impact on access to and demand for credit. This showed that livestock could serve as a substitute to credit in Tigray region. This is because livestock can be converted immediately into cash when the needs arise.

Moreover, households' religion had negative and significant impact in determining demand for credit but insignificant on access to credit. Muslims households were less likely to access to and demand for credit. Family size has positive and significant impact on demand for credit. This indicates that large families are likely to demand more credit and financial institutions prefer giving credit to large families because of their large capacity to investment. Education has negative association with demand for credit but positive association with access to credit. Educated households were likely to have more access to credit than uneducated households because of their ability to read and understand regulations concerning the loan. The researchers recommend the government to ensure that uneducated households have more access to credit from financial institutions.

Additionally, a positive association between fertilizer adoption and manure application was found. This seemed to indicate that fertilizer and manure are complements. The tendency to use both manure and fertilizer on the same plot to supply nutrients and organic matter to crops seemed to be the practice employed by the farmers Tigray region. Livestock endowment, costs on herbicides, pesticides and oxen hiring coupled with family size had a positive and significant impact on the probability of manure adoption while the error term estimated from the fertilizer demand model had a negative impact on manure adoption in the same way as access and demand for credit had a negative and significant impact on manure adoption.

For fertilizer use intensity, education, cost of herbicides, cost of pesticides, expenditure on seeds and family size had positive and significant correlation whereas distance to the nearest market and farm size had negative and significant impact. The government of Ethiopia should try to improve infrastructure and transport system so as to make it convenient for the farmers to reach the market areas.

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10 Appendix

Table 7: various conversion factors for different animals.

animal	Conversion factor
Cow	0.70
Bull	0.90
Calves	0.32
Heifer	0.60
Sheep	0.10
Goat	0.10
Horse	1.00
Mule	0.70
Donkey	0.50
Camel	1.00
chicken	0.01

Source: Food and Agricultural Organization, 2005



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