FACTORS AFFECTING AGRICULTURAL PRODUCTION IN *TIGRAY REGION, NORTHERN ETHIOPIA*

by

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DECLARATION

I, Bihon Kassa Abrha, declare that this PhD Thesis entitled “Factors affecting agricultural production in Tigray region, Northern Ethiopia” is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. I also declare that this work has not been submitted before for any other degree at any other institution.

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Bihon Kassa Abrha Date

DEDICATION

This study is dedicated to my parents

Amete Temelso (1930-2003) and

Kassa Abrha Tekle (1919-2015)

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ABSTRACT

This study investigates the factors affecting agricultural production of farm households in the National Regional State of Tigray, Ethiopia. The major primary sources of data for the study were farm household surveys, focus group discussions and key informant interviews. The study revealed that the annual average crop production of respondents was found to be below the standard annual food requirement recommended by the international organizations. The proportion of irrigated land to total cultivated land was only 11per cent. The proportion of irrigated land in the two districts is lower than 11.27 per cent at the regional level. The utilization of chemical fertilizers for the majority of the respondents was below the recommended standard for the region. Although the farmers were interested in using improved seeds, the supplied varieties were not based on their preferences. Extension agents were mainly engaged in activities which were not related to their professions.

The farm income model result showed that landholding size ($p<0.0001$), possession of oxen($p<0.0001$), amount of fertilizer($p=0.010$), improved seeds($p=0.002$), irrigation($p=0.028$), soil quality($p=0.019$), village distance to the district market($p=0.066$), average distance of plots from the homestead ($p=0.023$) and crop rotation($p=0.016$) were determinant variables. Farmers were engaged in off-farm activities to fulfill the cash requirements in credit constrained conditions. The laws of the region do not allow farmers to be out of their localities for more than two years and the farmerswere restricted to renting out only half of their land. This discouraged farmers from off-farm participation for fear of land confiscation. In the Probit model, the determinant variables of off-farm participation were: irrigation ($p=0.001$), age ($p=0.007$), amount of money borrowed ($p=0.078$), village distance to the wereda market ($p=0.055$), fear of land confiscation ($p=0.023$) and access to electricity ($p=0.044$).

It is recommended that if farmers are to use chemical fertilizers, they should be supplied with High Yielding Varieties (HYV)and enough water through access to irrigation. Furthermore, farmers should be allowed to have long term off-farm employment to augment the farming sector.

Key words: *Agriculture, production, factors, farm households, Tigray, Ethiopia*

ABBREVIATIONS

ADDP	Ada District Development Project
ADLI	Agricultural Development Led Industrialization
BoARD	Bureau of Agriculture and Rural Development
CADU	Chilalo Agricultural Development Unit
CSA	Central Statistics Agency of Ethiopia
EPID	Extension and Project Implementation Department
EPRDF	Ethiopian People's Revolutionary and Democratic Front
FDRE	Federal Democratic Republic of Ethiopia
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
MoARD	Ministry of Agriculture and Rural Development
MoFED	Ministry of Finance and Economic Development
MPP	Minimum Package Program
PADEP	Peasant Agricultural Development Extension Program
PADETES	Participatory Demonstration and Training Extension System
PASDEP	A Plan for Accelerated and Sustained Development to End Poverty
PRSP	Poverty Reduction Strategy Paper
PSNP	Productive Safety Net Program
SDPRP	Sustainable Development and Poverty Reduction Program
SG	Sasakawa Global
SIDA	Swedish International Development Agency
SPSS	Statistical Package for Social Scientists
UNECA	United Nations Economic Commission for Africa
UNFPA	United Nations Population Fund
USAID	United States Agency for International Development
WADU	Wolayita Agricultural Development Unit

DEFINITION OF LOCAL TERMS

Zone	Government structure which consists of many *weredas* under it
Wereda	District level administrative hierarchy including many *tabias*
Tabia	A sub-district level administrative hierarchy including many *Kushets*
Kushet	A sub-division of *tabia*
Tsimad	Unit of cultivable land which is one fourth of a hectare
Belg	The secondary season in Ethiopia which covers the period from the month of March (*Megabit*) to May (*Ginbot*)
Meher	The main crop season in Ethiopia which covers the period from the month of June (*Sene*) to September (*Meskerem*)

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND OF THE STUDY

According to Barrios, Ouattara and Strobl (2008, p. 287), agriculture is the main engine of the economic growth for Sub-Saharan African countries. However, feeding the increasing population of Sub-Saharan Africa is becoming a critical challenge for most of the countries in this area (Owusu, Abdulai, & Abdul-Rahman, 2010,p. 108). In line with this, Diao and Hazell (2010,p. 2) underscore the existence of two schools of thought or debates in African agriculture. These debates focus on the potential roles of agriculture and industry in improving African development and the ability of the agricultural sector to ensure pro-poor growth. Hence, the argument that agriculture is a large sector and that upgrading it leads to a better aggregate growth, justifies the public investment in the sector (de Janvry,&Sadoulet,2010,p. 12).

Ethiopia is one of the largest African countries with a population of 73.9 million people. The country shares boundaries with Eritrea to the north, Kenya to the south, Somalia to the east and Sudan to the west. According to the Central Statistics Agency (CSA, 2008,p. 13) of Ethiopia, the majority (83.8%) of Ethiopians reside in the rural areas. Hence, subsistence and rain-fed agriculture is the economic base and means of livelihood ofthe majority of these people. The contribution of agriculture to GDP in Ethiopia is above the average contribution of Sub-Saharan Africa. The share of the agricultural sector in Sub-Saharan Africa is around 40 per cent (Barrios et al., 2008,p. 287).On the other hand, the contribution of the agricultural sector to GDP in Ethiopia is 41 per cent (MOFED,2012,p. 13).

Similarly, Diao and Hazell (2010,p. 4) confirm that an agricultural stimulated growth of one per cent annual increase in Ethiopia's per capita GDP leads to a 1.7 per cent reduction in the poverty rate per year. On the other hand, if the same increase in per capita GDP is caused by non-agriculture, its impact on poverty reduction is only 0.7 per cent. Thus, the government of Ethiopia has tried to improve the performance of

agriculture by planning and implementing different strategies. Agricultural Development Led Industrialization (ADLI) is the central pillar of the economic policy of the country. The Sustainable Development and Poverty Reduction Program (SDPRP), a Plan for Accelerated and Sustained Development to End Poverty (PASDEP) and the recent Growth and Transformation Plan (GTP) are some of the development strategies of the government.

Agricultural Development-Led Industrialization (ADLI) is a long term strategy in which, at the early stages of development, the agricultural sector is expected to play a leading role in the growth of the economy (MoFED, 2002, p.38). At this stage, agriculture is considered to be the engine of growth to feed large proportions of the population and thus is a source of input to the emerging industries. In the early stages of economic growth, the major economic activities are related to agriculture which has a strong growth linkage with other sectors (Morris, Kelly, Kopicki, & Byerlee, 2007, p. 15). In line with these arguments, there is a considerable body of literature that favours the idea that agricultural growth serves as an engine of growth and that irrigation-led technological changes are the key drivers behind the growth of productivity in the agriculture sector in Asia (Hussain, & Hanjra, 2004, p. 7). But, in Ethiopia, the ultimate goal of ADLI strategy is for the industry to take the lead.

In the Sustainable Development and Poverty Reduction Program (SDPRP), agriculture has been given an overriding and intentional focus by the government. This is because the agricultural sector is the source of livelihood for 85% of the population which includes the majority of the poor (MoFED, 2002, p. 41). As indicated in the document of SDPRP, its major focus isto ensure a food secure nation.

Ethiopia is probably the country with the greatest state involvement in the agricultural sector in Africa and, through its developmental state theory, it has the highest level of state investment (Lefort, 2012, p. 686).In 2008, for instance, 16 per cent of the government budget was allocated to the agricultural sector (Davis, Swanson, Amudavi, Mekonnen, Flohrs, Riese, Lamb, & Zerfu, 2010, p. 1). Countries which are successful in

agriculture allocated no less than 10 per cent of their public expenditure to agriculture and NEPAD took this percentage as a benchmark for the agricultural sector of Sub-Saharan countries (de Janvry, 2010, p. 28). The implementation of the 10 per cent threshold is still not easy for most African countries. For instance, the recent available data for Uganda and Nigeria indicated that the proportion of agricultural expenditure to total public expenditure is only 3 per cent and 4 per cent respectively (de Janvry, 2010, p. 28).

A Plan for Accelerated and Sustainable Development to End Poverty (PASDEP)was a five year plan (2005/06-2009/10) which put due emphasis on the commercialization of agriculture and integrating farmers with markets (MoFED, 2006, p. 47). In addition, during the period of PASDEP, the supply of agricultural inputs such as fertilizers, improved seeds and pesticides was expected to increase substantially (MoFED, 2006, p. 57).Five years later, PASDEP was replaced by the Growth and Transformation plan (GTP). The main focus of the GTP related to agricultural and rural development is to increase the capacity and extensive use of labour, enhance utilization of land, link specialization with diversification and strengthen agricultural marketing systems (MoFED, 2010, p. 45).

Supportive policies should be in place to stimulate agricultural production and other income diversification strategies. As clearly stated by Block and Webb (2001, p. 337), constraints such as poor land quality, lack of financial markets and climate variability cannot be improved by farm operators at the household level. Block and Web (2001, p. 337) explained that these are constraints that can be solved by investing resources in income and wealth generating activities. In Tigray region, land degradation has reached a critical stage which, combined with the insecure rainfall levels and increasing population, poses a major threat to the agriculture production (Gebreegziabher, Nyssen, Govaerts, Getnet, Behailu, Haile, & Deckers, 2008, p. 257). Earlier on, Pender and Gebremedhin (2007, p. 3) reported that low agricultural productivity, land degradation and poverty were severe and closely interrelated problems of the Tigray region. Therefore, these issues were good indicators for assessing the major problems of the farm operators at a

household level. Similarly, there was a need to focus on agricultural production and related issues of agricultural marketing and off-farm activities in this study.

1.2 PROBLEM STATEMENT

Agriculture is still the key sector in many developing African countries. Its contribution goes to the extent of stimulating other sectors by providing input supply.Ethiopia is one of the countries that allocated at least 10 per cent of its total public expenditure on agriculture which is the NEPAD benchmark for the SSA. Despite the focus of the government on the agricultural sector through Agricultural Development Led Industrialization (ADLI), the rural communities are unable to produce enough to feed themselves. In the Tigray region, many farm households are still unable to feed themselves and are on the list of the Productive Safety Net Program (PSNP).The objective of the program is for farmers to ensure minimum levels of food consumption and to protect the existing assets (Gilligan, Hoddinott, & Taffesse, 2009, p. 1685). Hence, the aim of this study is to investigate the factors affecting agricultural production in the Tigray region.

As the majority of the population is engaged in the agricultural sector, it is the critical sector for the future. To show the importance of agriculture, Myrdal (in Todaro, 2000, p.363) stated that "it is in the agricultural sector that the battle for long-term economic development will be won or lost".

African agriculture is dominantly rain-fed agriculture and, as a result, yields are low and farmers can be trapped in a cycle of poverty and food insecurity for decades (UNECA, 2009, p. 117).Thus, agriculture, as the only means of livelihood, is becoming a risky occupation on this continent. As a result, there are many reasons and motivations for a household to participate in off-farm employment. According to Alasia, Weersink, Bollman & Cranfield (2008, p. 12) one of the reasons for off-farm employment is for households to be self-insured from the innate variability of farm income and to stabilize

their total household income. Therefore, smallholder farm operators who are endowed with much labour, maintain a diversified income source in which off-farm income is a major component (Barrett, Reardon,&Webb,2001, p. 321).

The agricultural sector is the backbone of the Ethiopian economy. It is the leading sector that contributes to the Gross Domestic Product of the country. However, as farming in Ethiopia is precarious and usually at the mercy of nature, it is invariably an arduous struggle for the smallholders to make ends meet (CSA, 2009, p. 3).

The government has tried to address the major problems of agricultural production and marketing. According to Teshome (2006, p. 17), the focus of the government policy shifted to alternative livelihood activities when it was realized that subsistence farm operators were unable to make a living from agriculture. As a solution, the government sought other means of income for farmers. It was at this juncture that the government introduced livelihood packages to supplement household income. However, the focus of livelihood diversification was also within the agricultural sector such as generating additional income from beekeeping and similar occupations. Ellis (2000, p. 290) reported that the household level diversification had implications for rural poverty reduction policies since the conventional approaches which focused on increasing productivity, employment and incomes in a single occupation like farming, were missing their targets. For example, the cereal yields in Ethiopia were about 1250 kg/ha whereas, in South and East Asia, the yields were 2500 and 4500 kg/ha respectively (World Bank, 2007 in Dercon, & Christiaensen, 2010, p. 163).

An assessment of secondary sources in the districts of Tigray region showed a wide gap between expected and actual production of agricultural products. According to the reports of the Bureau of Agriculture and Rural Development of Tigray (2008/09), the planned area for cultivation in Kilte Awlalo and Ganta Afeshum *wereda* was 31,420.75 hectares and the expected production was 451,532.4 quintals. However, the actual production was only 270,426.1 quintals. The actual production of these *weredas* was just over half of the expected production. The report of the bureau also indicated that none of the Productive

Safety Net beneficiaries in the Eastern Zone had graduated on a voluntary basis.

The ability of the farmers to access remunerative markets is a critical determinant of their income and wellbeing (Kindness,& Gordon,2001, p. 5).The constraints of accessing agricultural markets for smallholder farmers are: barriers to entry, high transaction costs, high risk, asymmetry of information, low bargaining power and lack of human and social capital (Estelle, Celia, Jean-Francois, & Laurent, 2004, p. 26).The agricultural marketing system in Ethiopia tends to be informal, unregulated, constrained by weak market linkages and a lack of rural infrastructure (Alemu, Abrha, & Teklu, 2011, p. 15). In addition, there is a severe lack of institutional infrastructure that can facilitate farmers' links to markets and to the overall economy. When farmers were asked to prioritize their problems by extension agents, researchers and development organizations working in the rural areas, they repeatedly identified agricultural marketing as the major problem (Kindness,&Gordon, 2001, p. 6).

There are also non-farm income related problems emanating from the very narrow definition of rural income. Escobal (2001, p. 498*)* documented such a problem as the narrow view of rural income equating it to farm income and, more specifically to agricultural income. This view was reinforced by Devereux et al. (in Teshome, 2006, p. 17) who reported that policies did not address the broader challenges of off-farm diversification. However, the scarcity of land and the further fragmentation of small landholdings means that the off-farm sector has to be expanded to absorb the growing population in the rural areas (Holden, Shiferaw,& Pender, 2004, p. 370). Hence, the factors affecting agricultural production are also linked to agricultural market access and to the availability of off-farm employment opportunities.

To my knowledge, no previous research been conducted on the factors affecting agricultural production in Tigray region even though there are related topics with a different focus and research interest. For instance, research work by Woldehanna (2000) in the Southern Zone of Tigray focused on the economic analysis of farm and off-farm employment. Woldehanna analysed the impact of off-farm employment on households

and agricultural production. However, this study did not address the wide range of factors affecting agricultural production. Babulo, Muys, Nega, Tollens, Nyssen, Deckers and Mathijs (2008) also conducted research on household livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia. The major focus of these researchers was on the contribution of forest environmental resources on the livelihood strategies of the households in the study area.

Land expansion, which has been the main source of growth of cereal production in Sub-Saharan Africa, is now compromised by population growth and land is becoming scarce in these countries (de Janvry,2010, p. 22).Therefore, it is likely that in highly land fragmented communities, the farm and off-farm activities are expected to reinforce each other. Household food security depends not only on food availability but also on the coping strategies used by farm operators to acquire it (Olayemi, 2012, p. 136). In addition, Babulo *et al*. (2008, p. 154) explained that the potential of crop production as a dominant livelihood strategy to raise people out of poverty is very limited in Tigray region. In areas where access to credit is limited, off-farm income is expected to help households purchase inputs such as fertilizers and selected seeds and to introduce new technologies. It is, therefore, logical to assess the factors that are affecting agricultural production and associated activities of off-farm participation of farm operators in the study area.

1.3 OBJECTIVES OF THE STUDY

1.3.1 General objective

The main aim of the study is to investigate the factors affecting agricultural production in Tigray Region, Northern Ethiopia.

1.3.2 Specific objectives

This research paper addresses the following specific objectives:

1. To assess the major factors affecting agricultural production and farm income of the farm households in the selected districts.
2. To analyze the agricultural marketing challenges of farm households.
3. To evaluate the determinant factors that influence off-farm labour participation and the impact of each of these factors on the households' off-farm income.
4. To critically review the overall conditions of agricultural production in the regional state of Tigray.
5. To generate policy implications and make appropriate recommendations.

1.4 RESEARCH QUESTIONS

This research seeks to identify the factors affecting agricultural production and income, the determinants for off-farm participation and the marketing challenges of farm households. Specifically, the study addresses the following main questions:

1. What are the determinant factors for agricultural production and their impact on the income of the farm households?
2. What are the major challenges of the household heads in marketing their produce?
3. To what extent are major determinant factors for farm operators influencing participation in off-farm activities and what is the impact of each of these factors on their off-farm income?
4. What are the influencing factors of agricultural production at the regional level?
5. What are the major policy implications of the research findings and what recommendations can be made?

1.5 SCOPE AND LIMITATIONS OF THE STUDY

1.5.1 Scope of the study

The major focus of this study was to investigate the factors affecting agricultural production in eastern Tigray, Northern Ethiopia. Related issues such as the challenges of agricultural marketing and factors affecting off-farm participation were part of the study. The research area selected for the survey study was Eastern Zone of Tigray which is one of the seven Zones of the region. The agricultural production at the regional level was also critically reviewed from secondary sources. The themes reviewed included crop production, livestock production, natural resource development and conservation activities in the regional state of Tigray.

1.5.2 Limitations of the study

Lack of organized and adequate historical data at the regional level was one of the limiting factors in this study. This emanates from the poor record handling and lack of willingness of some of the offices to provide the relevant documents. In addition, the available agricultural production related data was highly exaggerated compared to the sources at national level. This was a challenge for addressing research objectives which depended on the secondary data of the region.

The Central Statistics Agency (CSA) of Ethiopia is an institution of relatively high capability which provides reliable statistics for all regions of the country. However, the CSA does not have compiled data on the natural resource development and conservation activities of regional states. As a result, the data from the regional bureau was collected through secondary data sources.

1.6 IMPORTANCE OF THE STUDY

In the developmental endeavours of different regimes in modern Ethiopia, the agricultural sector has attracted the attention of policy makers. It is the key sector in the

current government's development strategy because Agricultural Development Led Industrialization (ADLI) is the national economic policy of the country. Thus, the topic of this these and its findings have regional and national importance. It is also one of the critical topics in the areas of development studies as a discipline.

Specifically, the importance of this study is to uncover the real challenges for farmers in the areas of agricultural production and related marketing as well as off-farm participation. It suggests ways of removing the challenges of farm operators at the *tabia* level. Furthermore, the findings of the study are expected to play an important role in informing the officials at the *tabia*, district and regional level, to recognize the problems of the farm households and to take corrective measures. It also serves as the basis for future related research works. The findings and conclusions of the thesis could be used to address the challenges of farmers in other regions with similar contexts at a policy level.

1.7 STRUCTURE OF THE THESIS

The thesis consists of six chapters as indicated below:

Chapter 1: presents the introductory part which includes sections such as background, problem statement, objectives, research questions, limitations and scope and structure of the study.

Chapter 2: presents the literature review on factors affecting agricultural production, agricultural marketing and households' participation in off-farm activities.

Chapter 3: deals with the historical perspectives of agrarian policies and agricultural production in Ethiopia and the background of the study area.

Chapter 4: outlines the research design and methodology section. This section includes the data type and sources, sampling and survey design, data processing and analysis and issues of validity and reliability. It also outlines the regression model used in the study.

Chapter 5: concentrates on the presentation and discussion of the resultson agricultural production, marketing and farm households' off-farm participation together with the income in the two selected districts. The critical review of agricultural production at the regional level is part of this chapter.

Chapter 6: presents the summary, conclusion and recommendations of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The Sustainable Livelihood Framework is the general framework of this study (Figure 2.1). It is a framework for examining people's access to resources and other different livelihood activities, underlying causes for poverty and interventions (Adato and Meinzen-Dick 2003:152; Ferrol-Schulte, Wolff, Ferse and Glaser 2013:254). Adato and Meinzen-Dick further stated that the International Food Policy Research Institute (IFPRI) and Standing Panel on Impact Assessment (SPIA) studies have adapted the sustainable livelihood framework in the areas of agricultural research. Livelihood perspectives provide a distinctive initial point for comprehensive analysis of complex and highly dynamic rural context (Scoones 2009:183).

Vulnerability is one of the components in the sustainable livelihood framework. It includes shocks such as changes in human and animal health, seasonality in agricultural production and prices as well as employment opportunities (Adato and Meinzen-Dick 2002:8; Adato and Meinzen-Dick 2003:153). Vulnerability things are mainly outside people's control (Allison and Horemans 2006:759). In addition, the framework recommends five different types of assets (Adato and Meinzen-Dick 2002:9; Adato and Meinzen-Dick 2003:153; Allison and Horemans 2006:759; Amekawa 2011:133). First, the natural capital consists of assets such as land, water, forests, air quality and biodiversity. Second, the physical capital comprises roads, transportation, buildings, water supply, energy and communication facilities. Third, financial capital consists of cash, liquid assets, credit and government transfers. Fourth, human capital includes formal education, skills, indigenous knowledge, health and nutrition. Fifth, social capital includes issues such as relations and organizations that provide access to opportunities, safety nets, and emotional wellbeing. It is also recognized that the interaction among these assets is desirable and inevitable (Allison and Horemans 2006:758). For instance, land (natural capital) may be needed to access credit (financial capital) for farmers to get benefits from new technologies by purchasing agricultural inputs (Adato and Meinzen-

Dick 2003:153). Vulnerability and asset holding are also linked as farm households with more assets are less vulnerable (Amekawa 2011:133).

The issues of vulnerability, access to assets, livelihood strategies and outcomes are influenced by policies, institutions and processes operating at different hierarchies (Adato and Meinzen-Dick 2002:9; Adato and Meinzen-Dick 2003:153; Amekawa 2011:134). Livelihood strategies are choices employed by people to obtain income, security and well being and productive objectives (Adato and Meinzen-Dick 2002:10). The sustainable livelihood studies emphasize the importance of livelihood diversification as a critical strategy to earn additional income mainly from the non-farm sector (Amekawa 2011:135). Livelihood outcomes are about income, food security and sustainable use of natural resources (Adato and Meinzen-Dick 2002:10). Further, they stated that improved asset base and reduced vulnerability conditions are also included in livelihood outcomes.

Specifically, this chapter presents the literature related to factors affecting agricultural production in different areas of the globe. In a bigger context, the agricultural production is influenced by the policy changes at a national and international level. At the community or household level, it is influenced by the household characteristics, agricultural production technologies and the availability of agricultural loans.

Environmental factors such as rainfall, soil type, erosion and vegetation affect agricultural production and farm operators' income in the sector are critical factors included in the review. Also included are: access to roads and extension facilities, termed physical and institutional infrastructure, agricultural production supplemented by the availability and accessibility of markets for the agricultural products and off-farm employment participation of farmers. The literature review serves as a benchmark to interpret the results obtained from the survey, focus group discussion and in-depth interview. The academic journal articles are the dominant source of the literature review.

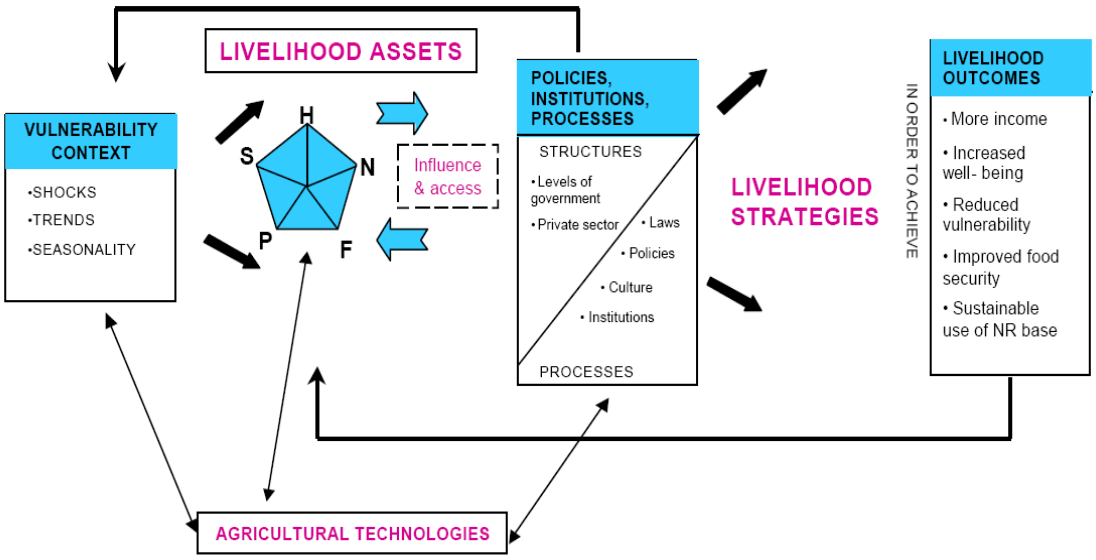

Figure 2.1: The Sustainable Conceptual Framework with agricultural technologies

Source: Adapted from DfID 2001 in Adato and Meinzen-Dick 2002

2.2 DEFINITION OF KEY CONCEPTS

Farm employment—farm or on-farm activities are all activities carried out by family members on household owned and rented lands. According to the definition of MoARD (2010, p. 8) it includes activities mainly related to crop production and livestock. These are: crop production, vegetable and horticulture production, fattening and fodder production, dairy, honey production, poultry, share crop production, rearing of livestock and home gardening, among others. This definition of farm employment and farm income is consistent with this study.

Diversification— in this study, diversification implies the households' involvement in two or more activities to ensure a stable income. According to Barrett et al. (2001, p. 315), risk reduction, realization of economies of scale, diminishing return to factor use in any given application, response to crises and liquidity constraints are some of the reasons for people to diversify their activities.

Off-farm/non-farm employment— many authors try to distinguish between off-farm and non-farm employment. For instance, Baker (1995, p. 131) explained that non-farm employments are activities which are carried out on the farm but they are not related to crop production. On the other hand, activities carried out away from the farm are called off-farm activities. However, in most of the empirical studies, off-farm employment is becoming the generic term. In this study, any employment which is off the households' owned or rented land is regarded as off-farm activity. The terms off-farm and non-farm are used interchangeably in this thesis.

Agricultural wage— it is one of the off-farm activities in which rural households get income from agriculture related work but not on their own land. This is income obtained from an involvement in the farm labour market.

Non-agricultural wage—it is one of the off-farm activities in which farm operators obtain income from non-agricultural activities. These include income a household gets from working on, for example, construction, food-for-work and masonry.

Self-employment—it is one of the off-farm activities in which households get income from their own business activities. According to Woldehanna (2000, p. 28), self-employment includes activities such as petty trading, transporting by pack animals, fuel and wood selling, charcoal making, selling fruits, making pottery and handicrafts and stone-mining.

2.3 GENERAL ISSUES OF AGRICULTURAL PRODUCTION

After the downfall of the military regime, the critical issue for the new government (Abbink, 2011, p. 515) was the development of the agrarian sector. Similar to previous regimes, the land policy continues to be the most debatable issue in Ethiopia. There are groups with the opinion that the existing land policy is the root cause of the country's socio-economic backwardness, poverty and food insecurity (Adenew, & Abdi, 2005, p.

7). These groups believe that rural land should be privatized and farmers be allowed to sell or mortgage their land whenever it is needed. On the contrary, outside the circle of the government, there are groups who are against privatizing rural land for fear of smallholders losing their land and the creation of new landlords (Adenew, & Abdi, 2005, p. 8). The government of Ethiopia tried to neutralize the question of privatizing land and warding off pressure from international donors by conducting land registration and issuing land certificates to farmers (Crewett, & Korf, 2008, p. 215). The government has also acknowledged that the absence of tenure security affects farmers' mobility, investment in land and land transactions (Adenew, & Abdi, 2005, p. 3).

Tigray was the first region to introduce land registration in 1996. The other big regions, Amhara, Oromia and the Southern Nations Nationalities and Peoples Region (SNNPR), followed suit in 2002 (Adenew, & Abdi, 2005, p. 6). There are slight differences between regions in the process of land registration and certification of land holders. According to Deininger, Ali, Holden & Zevenbergen (2008, p. 1792), the land certification of Tigray region is issued with the name of the household head, whereas in other regions, the land certification requires the names of both the head and the spouse. For instance, the land policy of Amhara region has ensured the women's rights by issuing joint titles. The land certificate includes the name and photograph of both husband and wife (Adenew, & Abdi, 2005, p. 8).

When viewed from the global perspectives of development and agricultural economics, the transition from low productivity semi-subsistence agriculture to high productivity commercialized agriculture has been a core theme for half a century or more (Barrett, 2007, p. 300). Globalization has also led to the rapid growth of world trade, the reduction in information and communication costs and the internationalization of production by multinational corporations (Pingali, 2006, p. 5). However, there are a number of global challenges such as tensions between the high demand for bio-fuels against agro-foods causing soaring food prices and pressure on natural resources (Wilhelmina, Joost, George, & Guido, 2010, p. 363). Food prices rocketed in 2008 and the impact of the 2009 global economic crisis indicated the vulnerability of the poor to external

circumstances (Tiwari, & Zaman, 2010, p. 2).

In the face of rapid environmental and climate change, higher income and growth has led to more resilient growth routes while the poor have no obvious means of making necessary investments in agriculture to adapt the new circumstances (Dercon, 2011, p. 7). Thus, countries gain or lose in the process of globalization, depending on where they are in the process of agricultural transformation. Countries at the low end of the agricultural development process lose out in the process of globalization because of the low productivity of their agricultural systems which are uncompetitive in an integrated global food market (Pingali, 2006, p. 12).

2.4 FACTORS AFFECTING AGRICULTURAL PRODUCTION AND FARM INCOME

The comprehensive agricultural support policies by government or donors such as fertilizer subsidies, credit subsidies, fixed prices, floor prices and public irrigation schemes, were the main features of the Asian Green Revolution of the 1970s (Bahiigwa, Mdoe,& Ellis, 2005, p. 119). Bahiigwa *et al.* (2005) further indicated that it was challenging to replicate the Asian Green Revolution in Africa because the Structural Adjustment Program(SAP) of the 1980s and 1990s eliminated the agricultural support policies enjoyed by Asian countries. The Structural Adjustment Program, with the emergence of neo-liberal conservative ideologies, reduced the government sponsored agricultural support (Markelova, Meinzen-Dick, Hellin, & Dohrn, 2008, p. 1).One of the aims of the program is for governments to reduce external and internal deficits by restricting money and credit growth (Weissman, 1990, p. 1622).As a result, it became difficult for many farmers to get access to services (Markelova, Meinzen-Dick, Hellin, & Dohrn,2008, p. 1; Benson, & Jafry, 2013, p. 382).

The major reforms in the Structural Adjustment Program were, firstly, to encourage the involvement of the private sector in agricultural marketing activities, to reduce or eliminate government agricultural input and product marketing subsidies, enhance the diversification of agricultural exports and encourage the government to motivate NGOs

and cooperatives to perform their roles (Bingen, Serrano, & Howard,2003, p. 406).Similarly, the structural adjustment program and the policies of Washington Consensus rejected sectoral policies that focused on the macro fundamentals and promoted the significant role of market forces (de Janvry, 2010, p. 19). Conversely, in the case of Africa, agriculture has suffered from major market failures and there was a need for government intervention to ensure growth and development which was ignored by the Washington Consensus (de Janvry, 2010, p. 32).

There are views that the Green Revolution in Africa should be designed differently from that of Asia because African in general and Sub-Saharan Africa in particular, has mainly a rain-fed agriculture and varying agro-ecological conditions (de Janvry, 2010, p. 32).In addition, irrigation facilitated the adoption of Green Revolution technologies such as varieties of rice and wheat in Asia and it had an impact on income, prices, food security and growth (Hussain, & Hanjra, 2004, p. 5). In order to achieve the Millennium Development Goals of eliminating hunger and poverty, the growth of the agricultural sector is vital (Rockstrom, Karlberg, Wani, Barron, Hatibu, Oweis, Bruggeman, Farahani, & Qiang, 2009, p. 543).

2.4.1 Household characteristics of farm operators

The household characteristics consist of many variables that affect the agricultural production of farm operators. Some of these variables are: age, gender, education level, family size, landholding size and possession of oxen, as reviewed below.

2.4.1.1 Education and agricultural production

Research findings have indicated the importance of education in agricultural production and income. For example, Asfaw & Admassie (2004, p. 216) reported that the conventional factor of production such as growth of stock, of capital and labour were unable to explain fully the growth in national income. The contribution of education to

the growth of national income was recognized in the 1960s.To achieve agricultural development, the investment in production techniques and technology should be supported by a comparable investment in human capital (Schultz in Bingen *et al*., 2003, p. 407). This is because information and knowledge are prerequisites for farmers to adopt technology, access input, change ways of doing things and market their produce (Chowa, Garforth, & Cardey, 2012, p. 8).

Formal education enhances farmers' engagement in environmental programs and methods for the sustainability of agriculture (Burton, 2013, p. 22).Education is also believed to stimulate economic growth by enhancing the productive capability of farmers as well as eliminating the customs that are contrary to growth such as traditional word-of-mouth communication methods (Asfaw, & Admassie, 2004, p. 216). If there is inequality in educational endowments, the returns from irrigation are likely to remain low for poor farmers, thereby supporting the notion that "knowledge poor will remain income poor" (Hussain, & Hanjra, 2004, p. 8). There is agreement that the accumulation of knowledge through education is an important factor for economic development (Asfaw, & Admassie, 2004, p. 216).

2.4.1.2 Gender and agricultural production

Gender refers to socially constructed roles and relationships of women and men in a given culture or location (Adeoti, Cofie, &Oladele, 2012, p. 238). In enhancing agricultural production and income, the full participation of men and women is very important. Women tend to be the major players in the farm labour force engaged in production, harvesting and processing activities (Jafry, &Sulaiman, 2013, p. 470).It is also known that the majority of food is produced by women farmers and they are responsible for fulfilling the basic needs of the family (Camara, Diakite, Gerson, & Wang, 2011, p. 141). Studies have also indicated that women farmers are more environmentally conscious compared to men farmers (Burton, 2013, p. 22). Nevertheless, there are research findings that indicate the existence of gender inequalities in the agricultural sector. For instance, there is categorization of some crops to be "men's

crops" and others as "women's crops" (Mohammed, & Abdulquadri, 2011, p. 37). A study conducted in Ghana by Adeoti et al. (2012, p. 240) indicated that vegetable production demanded more physical strength and was dominated by men. On the other hand, de Brauw, Li, Liu, Rozelle and Zhang (2008, p. 343) revealed that, in China, the contribution of women to livestock production was 64 per cent while 59 per cent of the marketing work was dominated by men. They noted that this is labour feminization and that the earnings are controlled by their male counterparts.

Women farmers are also challenged by the absence of capital, information and access to markets which prevents them from producing enough to fulfil the basic necessities (Jafry, &Sulaiman, 2013, p. 470). The scarcity of knowledge related to women's rights exposes them to land grabbing and the loss of their heritage (Camara et al., 2011, p. 146). Historically, there were other issues that hindered women's participation and influence in the agricultural sector. One of the hindrances was the tradition of passing farms from father to son, while daughters were denied farm ownership (Alston, 2003, p. 168). Furthermore, the mind-set that land rights belonged to men only made women voiceless in the ownership of land (Githinji, Konstantinidis, & Barenberg, 2014, p. 3). Consequently, as the contribution of women in the agricultural sector is vital, there is a need to clarify which obstacles are unique to them (de Brauw *et al.*, 2008, p. 344).

Researchers are also interested in investigating the productivity differences between male and female headed households. In this respect, researchers found mixed results. In the study conducted in China, de Brauw, Huang, Zhang & Rozelle (2013, p. 697) showed that female headed households achieved the same crop yield as their male counter parts. In the survey conducted in the four major regions of Ethiopia (Tigray, Amhara, Oromia and SNNP), Ragasa, Berhane, Tadesse and Taffesse (2013, p. 466) established that, if other influencing factors were constant, there was no productivity difference between plots possessed by female and male farmers. They further stated that it is the differences in access to quality extension services, access to inputs and the quality of the plot that created differences in productivity. If women get equal access to the application of inputs, information and technologies, there is no sound reason for them to be less

productive than men (de Brauw *et al*., 2008, p. 348). In Ethiopia, gender differences in economic production remain a challenge with the majority of women still facing discrimination. However, the revised Family Law of Ethiopia has improved the rights of women to manage common marital property along with their husbands (Hallward-Driemeier, & Gajigo, 2013, p. 4).

2.4.1.3 Age, family size, landholding size and agricultural production

Agricultural production is influenced by other household characteristics such as the farm operator's age, family size and landholding size. The age of the household head is a proxy variable for the farming experience of farm operators. Farmers are highly dependent on their previous knowledge of farm practices in cultivating different crops (Adomi, Ogbomo, & Inoni, 2003, p. 390). Hence, experienced farmers are expected to enhance the productivity of their holdings. However, it is not without limit as older farmers lack the required physical strength on the farm and lower the probability of technology adoption (Moussa, Otoo, Fulton, & Lowenberg-DeBoer, 2011, p. 363; Burton, 2013, p. 23).

Land is the most critical natural resource for countries like Ethiopia where the agricultural sector is the engine of the national economy (Amsalu, Stroosnijder, & de Graaff, 2006, p. 448). Farm operators with larger landholding sizes would have a better farm income if sufficient family labour was available. This leads to an increased demand for children who can work on the land (Hedican, 2006, p. 324; Kim, &Park, 2009, p. 278). It is not possible to expand the landholding size without matching it with an increase in the size of the household. Hence, households with larger families face a challenge to feed each of the family members and this will have its own negative effect on the nutritional status of the family (Olayemi, 2012, p. 137).

2.4.1.4 Possession of oxen and agricultural production/ income

Historically, for thousands of years, oxen have been recognized as the first draft animals to serve human beings, to cultivate land and pull heavy loads (Bryant, 2010, p. 360).The possession of oxen determines the farming ability of farm operators because if farmers do not have oxen they would be obliged to rent out their land to other farmers (Holden et al., 2004, p. 375). In this case, farmers would enter into sharecropping. This further diminishes the production and income of the household as the yield is shared with oxen owners. There are advantages associated with owning oxen. Oxen owners can cultivate and sow their land at the right time. This has a positive impact on the productivity of land. In addition, oxen could also be rented out on a daily payment basis to till the land for other households. Therefore, they may serve as a source of additional income for the owners.

2.4.2 Agricultural production technologies

Agricultural production technologies include biological and chemical technologies. Specifically, these technologies include chemical fertilizers, selected seeds or High Yielding Varieties, irrigation and soil quality enhancing technologies. Farmers use these technologies in order to enhance the production and productivity of the land. It is also indicated that, for poor farmers, adoption of technology places new demands on their limited resource base (Kamruzzaman, & Takeya, 2008, p. 218).

Chemical fertilizer

African governments have promoted the increasing use of agricultural inputs in their own countries inspired by the Asian Green Revolution which was brought about by using high-yielding seed and fertilizer technologies(Crawford, Kelley, Jayne, &Howard, 2003, p. 277).In a similar vein, Aune & Bationo (2008, p. 121) argued that the entry point for intensification is the use of organic and inorganic fertilizer in the Sahel because, if soil fertility is not improved, the use of other technologies such as high-yielding varieties will not have a significant impact.

Crawford et al. (2003, p. 281-2) further indicated that the objectives of input promotion strategies have many features such as financial, economic, social and political objectives. The financial aspect of the input promotion strategy is to increase the net income of farmers, traders or other participants in the agricultural economy. The economic feature of input promotion strategy is also to increase the real income of the society as a whole. The social aspect of the input program is the improvement of welfare indicators that are difficult to measure in terms of monetary values. Some of the social objectives are to improve nutrition intake and national food self-sufficiency. The political objective of the input program arises because of the government intervention for the sake of equalization of benefits. Some programs may be designed intentionally to build political support; as a consequence, they may benefit one or more groups at the expense of others.

Documents indicated that the application of inorganic fertilizers in Sub-Saharan Africa is minimal (de Janvry, 2010, p. 22; Freeman, & Omiti, 2003, p. 23). For instance, de Janvry (2010, p. 22) stated that the utilization of fertilizer in Sub-Saharan Africa (SSA) is only 11 kg/ha compared to 130kg/ha in South Asia and 271 kg/ha in East Asia. The application of fertilizer in SSA is considered as the lowest rate in the world (Xu, Burke, Jayne, & Govereh, 2009, p. 79).This is a clear indication that the intensification of African agriculture remains a critical development challenge because the fertilizer application in a hectare of land in SSA is below standard (Crawford et al., 2003, p. 281). The insufficient use of fertilizer in Africa has resulted in the area productivity being

below the world average (Morris et al., 2007, p. 2; Kuhn, Gaiser, & Gandonou, 2010, p. 509).

The major reasons for low fertilizer use could be because of demand and supply factors (Crawford et al., 2003, p. 285). On the demand side, farm households may not accept the profitability of fertilizer use; alternatively, they may accept it as profitable but too risky in financial terms. Fertilizer input may also be too risky for farmers because the level of input use is determined before the onset of the rainy season which is uncertain. For instance, positive expectations about the rainfall conditions of the coming season leads to increased chemical fertilizer application by 41.92 kg/ha in Eastern Ethiopia (Fufa, &Hassan, 2006, p. 46). The uncertainty about the weather has a negative effect on the application of yield-augmenting inputs as they are unprofitable in the absence of enough rain (Morris et al., 2007, p. 52).Possible reasons for the lack of profitability could be attributed to low crop responses because of agro-ecological conditions, unresponsive seed varieties, fertilizer utilization or inappropriate application rates (Crawford et al., 2003, p. 285).

Other possible reasons for lack of profitability could be due to high input prices or low output prices because of high transportation costs, policy interventions or non-competitive behaviour of marketing agents (Crawford et al., 2003, p. 285). The problem may not be profitability but rather the inability of farmers to pay for goods and services due to limited access to credit to finance fertilizer purchases (Crawford et al., 2003, p. 285).At the beginning of the rainy season, farmers are generally in need of cash for food, leaving little cash for purchasing chemical fertilizers (Hayashi, Abdoulaye, Gerard, & Bationo, 2007, p. 258).

On the supply side, the high costs at the source by importers and local manufacturers may limit the access to fertilizer (Crawford et al., 2003, p. 285). In addition, inadequate arrangements for financing the purchase of fertilizer by importers and traders, poor port, rail and road infrastructure, transportation costs and non-competitive behaviour of suppliers may also affect the supply of fertilizer (Crawford et al., 2003, p. 285).

The production season is a factor to assume the risky venture of input utilization. Only in good times does taking risks increase net returns (Dercon, & Christiaensen, 2010, p. 163). For this reason, the farmers should be empowered to make their own decisions on how to manage the fertility of their own land (Morris et al., 2007, p. 12).

There are also views that the dependency on chemical fertilizers only for agricultural production might not be sustainable as it results in the depletion of organic soil contents thereby reducing the potential benefit of fertilizer utilization (Ghosh, 2004, p. 151).Most of the time, the application of chemical fertilizers is not based on soil tests which leads to the utilization of fertilizer either above or below their requirements (Ogoke, Ibeawuchi, Ngwuta, Tom, & Onweremadu, 2009, p. 825). Moreover, Waithaka, Thornton, Shepherd & Ndiwa (2007, p. 213) found that, in western Kenya, extension agents did not recommend the use of di-ammonium phosphate (DAP) by farmers because it aggravates the acidity of the soil. If chemical fertilizer application is not controlled and is used more than required, it could result in soil contamination and water pollution (Wu, 2011, p. 117).

Improved seeds

In combination with chemical fertilizers, improved varieties of seeds are critical agricultural inputs that help farmers to obtain improved agricultural yields. The productivity and value of crops is improved through the genetic manipulation of selective breeding (Sassenrath, Heilman, Luschei, Bennett, Fitzgerald, Klesius, Tracy, Williford, & Zimba, 2008, p. 287). Moreover, formal sector supplied improved seeds should fulfil certain quality standards set by the national regulations (Bishaw, Struik, & Van Gastel, 2012, p. 657). Seeds that fulfil the quality requirements have a positive impact on the productivity of land. For instance, Li, Liu and Deng (2010, p. 457) found that 30 per cent of the growth rate of agricultural production was due to new seed varieties. A study conducted in Afghanistan by Kugbei (2011, p. 198) confirmed that the yield from the improved wheat seeds was 33 per cent higher than the local seed varieties.

Furthermore, Alemu, Mwangi, Nigussie & Spielman (2008, p. 305) stated that improved seeds can cause a remarkable improvement in agricultural productivity and production for small-scale farmers in Ethiopia if they are combined with modern science and modest changes in farmers' cultivation practices. As the improved seeds are small, farmers are more concerned about the characteristics of the seeds rather than the price (Li et al., 2010, p. 468).The farmers may reduce costs by saving and using the seed varieties for the following production year (Rohrbach, Minde, &Howard, 2003, p. 319).In a study conducted in Nigeria, Awotide, Awoyemi, & Diagne (2012, p. 576) showed that poverty reduction should be combined with the provision of improved rice seeds to farm operators at the appropriate time.

Irrigation facilities

The poorest people who mainly depended on rain-fed agriculture for their livelihoods reside in Sub-Saharan Africa (Burney, &Naylor, 2011, p. 110). Burney and Naylor stated that crop yields in Sub-Saharan Africa were low and influenced by the variability of weather conditions in the area. The cropland which is irrigated accounted for only 3 per cent compared to 39 per cent in South Asia and China (de Janvry, 2010, p. 22). One of the lessons of the Asian Green Revolution was that repeated cultivation during a year and improved yield could be possible with the application of irrigation combined with fertilizer and improved crop varieties (Burney, &Naylor, 2011, p. 111). Water, as one of the major instruments of poverty alleviation, plays a significant role in food production, food security, hygiene, sanitation and environment (Hussain, & Hanjra, 2004, p. 3).The proper utilization and the reduction of wastage of water resources is critical. This is because the level of water consumption in agriculture is influenced by the efficiency of irrigation systems and cultivation methods used by farmers (Castro, & Heerink, 2010, p. 168). For instance, introducing a system of trading water can be a powerful incentive to reduce the amount of water used in agriculture once it has a value and can be sold by the rightful owners (de Janvry, 2010, p. 30).

Irrigation is one of the critical inputs in agriculture which benefits the socio-economic status as it leads to poverty reduction. However, irrigation can also trigger socio-economic upheavals when it causes problems such as disease, land degradation, water pollution and destruction of living beings and natural ecosystems (Hussain, & Hanjra, 2004, p. 4). Hussain & Hanjra (2004, p. 4) further stated that poor populations are most affected by the potential negative effects of irrigation.

Access to good irrigation allows the poor to increase production, gives them opportunities to diversify their income base and reduce their vulnerability to the seasonality of agricultural production and external shocks (Hussain, & Hanjra, 2004, p. 4).

As the first beneficiaries from irrigation infrastructure are often land owners, poor landless farmers are not direct beneficiaries in the short run (Hussain, &Hanjra, 2004, p. 6) but may, in the long run, receive an indirect benefit in the form of increased employment opportunities, higher stable wages and lower food prices (Hussain, &Hanjra, 2004, p. 6; Berg, &Ruben, 2006, p. 872). While irrigation is believed to provide advantages for net food buyers, it may have disadvantages for those who are net food sellers (Berg, &Ruben, 2006, p. 872).

Farmers incur costs to utilize productivity enhancing technologies. On the one hand, there are complementary technologies that could be utilized with little or no financial costs to the farmers. Aune & Bationo (2008, p. 121) explain that mulching and seed priming are among the technologies that boost crop production without cost implications for farmers. Seed priming is carried out by soaking seeds in water to stimulate germination and reduce germination time. They also found that a crop residue application rate of 500kg per hectare increased crop yield. On the other hand, the competing uses of crop residues such as for fodder, building materials and fuel, have limited the benefits obtained from mulching (Moges, & Holden, 2007, p. 551).

Crop rotation

As declining soil fertility is a major challenge for Sub-Saharan Africa, farmers in Nigeria use shifting cultivations as a means of sustainable agriculture (Kintomo, Akintoye, & Alasiri, 2008, p. 1262). Crop rotation is a regularly recurrent succession of different crops on a given plot of land (Tulu, 2011, p. 57). It helps to ensure the required fertility and controls weeds, insects and plant diseases through the appropriate application of crop orders (Knox, Leake, Walker, Edwards, & Watson, 2011, p. 176).Shifting cultivations are in contrast to continuous monoculture in which a single crop species repeatedly grows on the same plot for years (Nel, 2005, p. 274). Shifting cultivation or fallowing methods of improving soil quality are not indicated in situations where there is rapid population growth (de Rouw, & Rajot, 2004, p. 264; Kintomo et al., 2008, p. 1262).

Rice-wheat rotation was practiced for many years and expanded during the Green Revolution in South Asia (Yadav, 2002, p. 39) but, as a result of specialization, the continuous production plan led to the abandonment of crop rotation (Knox et al., 2011, p. 172). Continuous production of the same crop over time causes a soil nutrient imbalance and hence a reduction in the productivity of land (Muramoto, Gliessman, Koike, Shennan, Bull, Klonsky, & Swezey, 2014, p. 625). In addition, monoculture leads to an unsustainable use of land because plant specific pests and diseases are established (Thierfelder, & Wall, 2010, p. 310).

In western Kenya, the consumption of nitrogen by crops exceeds the inputs leading to soil nutrient depletion and a reduction in the productivity of land (Powlson, Gregory, Whalley, Quinton, Hopkins, Whitmore, Hirsch, & Goulding, 2011, p. 576). However, crop rotation with legume crops improves the supply of nitrogen through symbiotic fixation which reduces the artificial nitrogen fertilizer requirement for the following crop (Nel, 2005, p. 275; Ogoke et al., 2009, p. 825; Kunzova, 2013, p. 1189).This is beneficial for resource poor farmers who have infertile land and apply chemical fertilizers below the required standard (Nel, 2005, p. 276). In the Tigray region farmers have been using the traditional system of crop rotation, fallowing, manure and wood ash for a long period of

time to keep the soil fertile and improve the productivity of land (Edwards, Gebre-Egziabher, & Araya, 2010, p. 10).

Intercropping

Intercropping is another practice of cultivation used by farmers to improve soil quality and productivity. The aim of intercropping is to enhance the yield of farm land by using resources that cannot be used by a single crop (Kamruzzaman, & Takeya, 2008, p. 220). Intercropping is practiced by a large proportion of farmers in developing countries (Guvenc, & Yildirim, 2006, p. 30). While in western Kenya, intercropping with leguminous plants and fallow rotation has been applied to increase the fertility of the soil (Waithaka et al., 2007, p. 213),in developed countries monoculture has increased crop yield with a huge energy cost of production and operation of machinery, fertilizers and pesticides (Karlidag, &Yildirim, 2009, p. 107). This is because in developed countries intercropping was not suitable for mechanized farming and was abandoned (Guvenc, & Yildirim, 2006, p. 30).

Intercropping is becoming crucial for increasing crop productivity and fulfilling the food requirements of the world's growing population (Karlidag, & Yildirim, 2009, p. 108). The intercropping method has also contributed to the sustainability of agriculture (Guvenc, & Yildirim, 2006, p. 30; Karlidag, & Yildirim, 2009, p. 108). In addition, to ensure yield and quality in intercropping, the varieties that are considered to be complementary in the utilization of resources should be identified (Guvenc, & Yildirim, 2006, p. 31).

Intercropping wheat and chickpea at 30cm spacing and weeding twice, increased wheat yield to 39.43 quintals per hectare (Banik, Midya, Sarkar, & Ghose, 2006, p. 330). Banik et al. (2006) further explained that the yield for mono-crop wheat at 30cm spacing and weeded twice was 26.71 quintals per hectare. In a study conducted in Turkey, Karlidag and Yildirim (2009, p. 114) showed that strawberries intercropped with early maturing vegetables were more productive and ensured efficient utilization of land and resources

compared to the sole strawberry cropping system. Furthermore, intercropping legumes and maize led to the reduction of weeds (Flores-Sanchez, Pastor, Lantinga, Rossing, & Kropff, 2013, p. 756). Similarly, in Africa, the need for intensification and diversification led to the substitution of mono-cropping systems by a complex intercropping practice (Alene, Manyong, & Gockowski, 2006, p. 52). Farmers in the Southern region of Ethiopia have benefitted from the intercropping of annual and perennial crops.

As presented above, the agricultural production technologies such as chemical fertilizer, improved seeds and irrigation affect the productivity and income of farm operators. In addition to these factors, the productivity and income of farmers was influenced by access to credit in rural areas.

2.4.3 Credit markets/agricultural loans

Agricultural credit is described as banking finance for primary production, processing and trade of agricultural products, and the production and distribution of inputs (Aggelopoulos, Mamalis, & Soutsas, 2011, p. 234). Poor farmers have very little chance to borrow from the formal sector because they rarely have collateral acceptable to banks. They may not have clear title deeds for the land they cultivate but even if they do, rural land markets may not function well enough for land to be considered a "bankable" asset (Kindness, &Gordon, 2001, p. 29).Smallholder farmers may have access to credit from Micro-credit institutes which do not have the collateral requirements. Micro-credit schemes are often associated with group lending where peer pressure is an effective substitute for collateral and group members may take action to prevent one member from defaulting (Kindness, &Gordon, 2001, p. 29).

There are different views regarding the involvement of governments in agricultural development. One view is that the involvement of the governments in the economy results in a danger of rent seeking and corruption (Bezemer, & Headey, 2008, p. 1346). In this regard, the focus of the structural adjustment program in Sub-Saharan Africa was

to get governments out of agricultural credit, input supply and reduce or eliminate agricultural subsidies (Bingen et al., 2003, p. 406). This was because government support policies such as commodity and input subsidies were financially unsustainable and contributed to the macroeconomic crises seen in the 1980s (Crawford et al., 2003, p. 278). The stagnation of the economic growth and the increasing deficit of state budgets in this period led to the adoption of stabilization and structural adjustment plans (Estelle et al., 2004, p. 14).

The adoption of the structural adjustment program was considered as a paradigm shift from the widely accepted idea that the government "could solve the problem", in the 1960s and 1970s,to the government "is the problem" in the 1980s (Crawford et al., 2003, p. 278). After structural adjustment programs were implemented in many countries, non-governmental organizations provided micro-finance services in the rural areas to fill the gap caused by the abolishment of the agricultural credit previously provided by the government.

The credit provided by the NGOs was criticized as the loan periods were too short and the amount of the loan too small for agricultural investment (Bingen et al., 2003, p. 406).Hence, farmers were reluctant to apply yield-enhancing technologies because they were afraid of risks such as drought, pest attacks and unstable prices (Aune, & Bationo, 2008, p. 120).

The other concern was the state intervention and support program to ensure agricultural transformation. Avoiding government assistance (to avoid rent seeking and corruption) is similar to throwing away the baby with the bath water (Bezemer, & Headey, 2008, p. 1346). It is the neo-liberal paradigm advocates who argue that the role of the government in the economy should be limited to the protection of individuals and property rights, the enforcement of contracts voluntarily entered into and the safeguarding of competition among economic actors (Zenawi, 2012, p. 140).In a similar context, Aune & Bationo (2008, p. 123) found that the development of cotton production in Mali was highly supported by government policies such as credit, input distribution and guaranteed prices.

Developed countries continued to subsidize the agriculture sector regardless of the imposition of structural adjustment programs in the developing countries.

2.4.4 Environmental factors

Environmental factors influence agricultural production and therefore the income of farm operators. The environmental factors included in this review are rainfall, erosion, vegetation and soil type of the area. The extension and intensification of agriculture has contributed to climate change by accounting for between 25and 30 per cent of global greenhouse gas emissions (de Janvry, 2010, p. 25). Kintomo et al. (2008, p. 1262) stated that one of the causes of the reduction in productivity and environmental quality is the intensive land use of farm operators.

Rainfall

The extent of rainfall is one of the critical factors that influence the agricultural production of farmers. In rain fed agriculture, the percolated rainfall in the roots is the source of moisture and water consumption for the crops (Rockstrom et al., 2009, p. 544).The erratic nature of rainfall makes rain fed agriculture unreliable for farmers and it is for this reason that the agricultural productivity of rain fed areas is lower than irrigated areas (Rockstrom et al., 2009, p. 544). Ethiopia has a rain-fed agriculture therefore production is sensitive to variations in rainfall. The loss of life as a result of drought in 1973, 1974 and 1984 showed the existence of a strong link between climate and Ethiopia's economy (Conway, & Schipper, 2010, p. 227). As the level of productivity loss increases with the reduction in rainfall, adaptation in areas with more moisture stress becomes challenging (Di Falco, & Chavas, 2008, p. 91).

According to World Bank, in South Africa, as the number of cooler days was reduced,the number of warmer days increased (Maponya, & Mpandeli, 2012, p. 48). The Bank further indicated that South Africa's average rainfall was estimated to be 450mm per year

which is below the average of 860mm. Thus, rainfall is the source of risk and uncertainty regarding the agricultural production outcomes of the harvest season (Rockstrom et al., 2009, p. 544).

Erosion and vegetation

Soil erosion is one of the challenges of agricultural productivity especially in areas where there is poor vegetation cover and the soils are not resilient (Powlson et al., 2011, p. 581). In Ethiopia, soil erosion has contributed to the existing problem of food insecurity and is becoming a real threat to the sustainability of the country's dominantly subsistence agricultural system (Bewket, 2011, p. 54). The major causes of soil erosion are water, wind and tillage (Powlson et al., 2011, p. 581). In a study conducted in Laos, farmers identified that intense rainfall, repeated cultivation, cultivation on steep slopes and high elevation sites, and short fallow periods were the essential factors that caused severe soil erosion in the area (Lestrelin, Vigiak, Pelletreau, Keohavong, &Valentin, 2012, p. 69). According to Bakker, Govers, Kosmas, Vanacker, Van Oost & Rounsevell (2004, p. 468), the cultivation of steep land is a cause of soil erosion as well as the driver of land-use change because steep slopes are hard to cultivate. The extent of soil erosion is exacerbated by the clearing of permanent vegetation for repeated farming of crop land or reduced by the re-establishment of natural vegetation and the land becomes covered by plant biomass (Fen-Li, 2006, p. 420; Pimentel, 2006, p. 123).

2.4.5 Physical and institutional infrastructure facilities

In the physical and institutional infrastructure facilities, roads and extension services are reviewed below.

Roads infrastructure

Roads are major physical infrastructures that allow people and goods to move faster and

easier (Campbell, 2010, p. 269). Roads provide new possibilities for people to access different areas (Jaarsma, & Willems, 2002, p. 125) and reduce segregation (Barrios, 2008, p. 12). Hence, improving rural roads helps rural communities to engage with the market economy and lift themselves out of poverty (Warr, 2010, p. 152).

The majority of poor people live in the rural areas which have low levels of road infrastructure (Warr, 2010, p. 152). As a result, farmers are hindered from building links that may improve their livelihoods (Hellin, Dixon, Higman, & Keleman, 2011, p. 385). It also increases the transportation cost for farmers to sell their products, purchase consumer goods and exploit the opportunities of off-farm activities (Warr, 2010, p. 152).

Extension facilities

The main task of extension agents is to support and encourage farmers to enhance their productivity (Adesoji, 2009, p. 335). They are responsible for translating the findings of the research institutes to the farmers and sending the agricultural challenges of farmers back to the research institutes (Ajani, & Onwubuya, 2013, p. 19). Farmers also have the opportunity to influence the research agenda for the research institutes to focus on relevant outputs (Kibwika, Wals, & Nassuna-Musoke, 2009, p. 9). Hence, the extension agents attempt to improve the livelihood of farmers by transferring research based knowledge to the agricultural sector (Rivera, 2011, p. 165).

The communication approaches and channels used by the extension agents influence farmers to adopt new innovations (Akinbile, & Otitolaye, 2008, p. 343).Worth (2006, p. 182) reported two major schools of thought related to agricultural extension. The first one considers extension as the transferring of technology and the second considers it as part of the human development program. Worth further illustrated the importance of the extension agents being cognizant of the objective of extension whether it is to develop the agricultural sector or the people.

The sceptical and traditional view of extension services and agents is that extension agents are government agencies whose activities are to distribute any information they are told to deliver without the required motivation and training (Christoplos, 2012, p. 188). A study conducted in China by Hu, Yang, Kelly and Huang (2008, p. 305) indicated that extension agents are assigned duties which are not related to agricultural extension such as family planning, budget management, elections, fire protection, legal matters and others.Hu et al.(2008, p. 305) also found that extension agents whose primary duty is to provide agricultural extension services to farmers spent less than one-third of their working time on extension related activities.

According to Kibwika et al. (2009, p. 10), agro-ecological conditions are changing and the needs and concerns of farmers are dynamic therefore fixed packages which are provided to farmers are becoming less appropriate as the result of increasing climate variability and unpredictability. Extension services which follow the path of "business as usual" may be challenging to farmers (Christoplos, 2012, p. 188). To be effective, the extension services need to focus on the way the services are delivered and the socioeconomic and agro-ecological conditions of farmers (Anderson, & Feder, 2004, p. 42).

2.5. FACTORS AFFECTING AGRICULTURAL MARKETING

According to the spatial model of land use developed by Von Thunen, land is allocated to the activity providing the highest rent (Chomitz, & Gray, 1996, p. 490). Furthermore, vegetables are perishable and costly to transport compared to grain and therefore farm operators near a city find vegetables more profitable. Von Thunen, in his circular structure of the agricultural land use, also observed that the intensity of agricultural production decreases with increasing distance of plots from the market (Sieber, 1999, p. 210).

Governments of all political ideologies in the world have intervened in agricultural marketing and pricing since the 1930s (Dunkan, & Jones, 1993, p. 1495). Access to reliable markets provides smallholders with a reasonable price for their produce which leads to improved income and livelihood (Girma, 2011, p. 50). The role of government intervention in agricultural marketing has been to reduce price uncertainty and to create conducive environments for agricultural production and investment into secure national supplies of food, raw materials and major export crops (Dunkan, & Jones, 1993, p. 1495). In addition to improving the farm operators' production capacity, access to markets is a vital strategy to meet the objectives of rural development and poverty reduction (Fischer, & Qaim, 2011, p. 1255).

In Sub-Saharan Africa, subsistence agricultural producers face several barriers to gain access to markets and productive assets (Alene, Manyong, Omanya, Mignouna, Bokanga, & Odhiambo, 2007, p. 318). The lack of access and absence of required storage facilities leads to local price reduction at harvest time because all the poor farmers are obliged to sell their produce at the same time to generate income (Burney, &Naylor, 2011, p. 111). In the process of selling the agricultural products, farmers face many challenges. Some of the challenges are indicated below.

Weak market linkages

Surplus producing areas co-exist with areas of deficit but farmers are unable to take advantage but farmers are unable to take advantage of the deficit markets because the markets are poorly coordinated (Aleneet al., 2007, p. 318).When the market for agricultural inputs and outputs is poorly developed, this creates unfavourable relationships between input and output prices (Aune, & Bationo, 2008, p. 120).

Asymmetry of information

Information asymmetry occurs when transacting parties do not have equal information. This can lead to opportunistic behaviours (Hobbs, 1996, p. 18). Specifically, the

asymmetry of information leads to specification opportunism in which the transacting party with better information is able to deceive the other party on aspects of the transaction such as product quality, weighing scales and other related aspects (Gebremedhin, Moti, & Hoekstra, 2009, p. 774). In line with this, Alene et al. (2007, p. 319) showed that, because of poor and asymmetric access to information, farmers in Kenya receive low prices from the traders who purchase grain from them. Although small farmers may be engaged in specification opportunism, they are also the main victims (Gebremedhin et al., 2009, p. 774). To avoid the challenges of asymmetry of information, transacting parties attempt to gather information relating to activities and transactions from different sources. According to Charatsari & Lioutas (2013, p. 114), farmers mainly depend on the agronomists, extension agents, other farmers, family members, friends, printed materials and websites as sources of information.

High transaction costs

Transaction costs are the critical challenges preventing smallholders from marketing their agricultural products (Markelova, & Mwangi, 2010, p. 632). The costs associated with information, negotiation and monitoring are called Fixed Transaction Costs (FTCs) (Key, Sadoulet, & de Janvry, 2000, p. 245; Alene et al., 2007, p. 320). The FTCs do not vary with the volume of the inputs and outputs traded as a farmer may incur the same search cost to sell one ton or ten tons of produce (Alene etal., 2007, p. 320).In marketing agricultural products, smallholders are faced with the option of either receiving below market prices or incurring high costs when searching for better prices (Tadesse, & Shively, 2012, p. 2). On the other hand, Proportional Transaction Costs (PTCs) include the costs of transferring the products or inputs being traded such as transportation costs and the time spent delivering the product to the market (Alene et al., 2007, p. 320). The fixed and proportional transaction costs are two phase decision processes of market participation because Fixed Transaction Costs affect the decision to transact and Proportional Transaction Costs affect the amount to transact (Kyeyamwa, Speelman, Van Huylenbroeck, Opuda-Asibo, & Verbeke, 2008, p. 66).

One of the objectives of forming cooperatives is to resist any market failure and ensure economies of scale through joint purchasing of inputs and joint marketing of agricultural products which is defensive in nature(Cook, 1995, p. 1155; Kindness, & Gordon, 2001, p. 17). In Ethiopia, marketing cooperatives are promoted in the rural development strategy of the country as a tool for the commercialization of smallholder agriculture (Bernard, Taffesse, & Gabre-Medhin, 2008, p. 148). Cooperatives help producers to aggregate their products and integrate their efforts to create better access to different market places, improved price negotiation and economies of scale (Baden, 2013, p. 297). Stringfellow, Taylor, Lucey, Mckone & Hussain (1997, p. 4) have outlined the existence of trade-offs between economies of scale and group cohesion which is a critical factor for sustained success. The existence of larger numbers of members is helpful in achieving economies of scale while increasing the cost of coordination simultaneously (Bernard, & Spielman, 2008, p. 63). Hence, for successful performance, members of cooperatives need to have homogeneity of identities (Barham, & Chitemi, 2009, p. 58).

Cooperatives are also helpful because farmers get access to credit services. Smallholder farmers are constrained by the lack of assets because they have limited access to extension as well as to credit services. To address this challenge, they willingly establish cooperatives (Benson, &Jafry, 2013, p. 388). As credit organizations favour group loans, farmers collectively improve access to finance through pooled resources required for down payment and can overcome problems of large investments needed in processing technologies, storage facilities or transport (Kindness, &Gordon, 2001, p. 17).

The findings of Barham & Chitemi (2009, p. 58) indicated that the agricultural marketing performance of cooperatives improves when there is a higher representation of male to female leaders. The reason they provided was that women have additional domestic responsibilities therefore do not have enough time to search for new market opportunities.

Lack of rural infrastructure

Rural infrastructure is one of the facilities that need to be in place to facilitate marketing agricultural products. As a result of poor conditions of roads in developing countries, farmers are forced to carry their products to main roads and then transport them to the market (Kamruzzaman, & Takeya, 2008, p. 217). This is time consuming and expensive for rural people (Kamruzzaman, & Takeya, 2008, p. 217; Kyeyamwa et al., 2008, p. 70).

2.6 DETERMINANT FACTORS FOR OFF-FARM ACTIVITIES AND OFF-FARM INCOME

There is an opportunity for an alternative source of income strategy because the demand for labour in the agricultural sector varies from peak to off-peak seasons (Chaplin, Davidova, & Gorton, 2003, p. 62).In addition to the seasonality of the required labour force, the labour absorptive ability of the agricultural sector declines over time (Eapen, 2001, p. 68). These are two of the reasons why the diversification of rural households is required. Income diversification is the involvement of farmers in different income generating activities such as farm and off-farm to fulfil their household needs (Abdulai, & CroleRees, 2001, p. 438; Fabusoro, Omotayo, Apantaku, & Okuneye, 2010, p. 418). Off-farm employment helps farmers to get working capital and secure income to finance inputs in a credit constrained situation (Pfeiffer, Lopez-Feldman, &Taylor, 2009, p. 125). In a study conducted in Mexico, Pfeiffer et al. (2009, p. 135) discovered that increasing off-farm income by one Peso increased the purchase of inputs by 0.33 Pesos. This is, therefore, the allotment of household assets and labour resources which finance the inputs (Demurger, Fournier, & Yang, 2010, p. 533).

There are many factors contributing to the diversification of income generating activities by farm households. At the macro level, diversification indicates a shift from agriculture to industries and services (Fabusoro et al., 2010, p. 422), however, the focus of this review is on diversification activities at the micro or household level where diversification could be seen from the “push factor” and “pull factor” perspectives

(Barrette et al., 2001, p. 316; Escobal, 2001, p. 499; Shi, Heerink, & Qu, 2006, p. 440).

Diversification from the push factor viewpoint is driven by limited risk-bearing capacities of farm operators with inadequate financial systems, and production risks arising from climatic uncertainty (Barrette et al., 2001, p. 316; Shi et al., 2006, p. 440). Land degradation and infertile land have also played a role in increasing demand for off-farm employment (Holden et al., 2004, p. 387). In these situations, these households are obliged to select a range of activities to stabilize their income and consumption (Barrette et al., 2001, p. 316; Castro, & Heerink, 2010, p. 169; Owusu et al., 2010, p. 117). However, households should identify the incentives and constraints associated with selecting a portfolio of activities (Demurger et al., 2010, p. 533). Distress-push rural diversification may be helpful for survival but its contribution to poverty reduction is minimal (Bezemer, & Headey, 2008, p. 1347).

The pull factor is the second determining factor for income diversification. This income diversification perspective has emerged from the existence of commercial farming and nearness (proximity)to urban areas through production and expenditure linkage activities of the farm communities (Barrette et al., 2001, p. 316).

The diversification activity of rural households is considered to be a self-insurance *ex ante* concept of risk mitigation (Barrette et al., 2001, p. 322). The other facet of diversification is to cope with *ex post* shocks to income at the time of crop failure and loss of livestock. In this case, off-farm income may reduce the fluctuation of farmers' total income and enhance their ability to resist and properly handle the challenges of farm income risks (Jette-Nantel, Freshwater, Katchova, & Beaulieu, 2011, p. 330). Studies equating off-farm labour supply as an *ex post* reaction to low farm income lead to the hypothesis that agricultural income and off-farm labour participation are negatively correlated (Bhaumik, Dimova, & Nugent, 2011, p. 379).Other studies indicated that off-farm employment is influenced by the labour demand of the farm type in which the farmers are engaged. For instance, Howard and Swidinsky (2000, p. 11) and Alasia et al. (2008, p. 15) explained that the available surplus labour for off-farm employment is

scarce when farmers are engaged in livestock related operations such as dairy.

The potential role of the rural off-farm sector deserves particular consideration in Africa because African countries have fast growing populations and increasingly limited agricultural resources (Babatunde, & Qaim, 2010, p. 303). Hence, the significance of off-farm activities to the welfare of the rural communities should be given equal importance to the productivity of the agricultural sector (Morera, & Gladwin, 2006, p. 358).

It was found that, in Africa, the non-farm activity is highest in areas with better agricultural productivity and income, emphasizing the importance of inter-sectoral linkages (Reardon, 1997, p. 737). In addition, the problems caused by sudden losses of incomes are the foundations for the public policy programme to provide a safety net when there is a need (Poon, & Weersink, 2011, p. 379).

Although the opportunities for lucrative non-farm income are not equal for all farm operators, non-farm income diversification in rural Africa is widely practiced (Barrette et al., 2001, p. 323). In line with this, Reardon (1997, p. 737) found that the share of non-farm income to total income for upper income households is much higher than for poor households. On the other hand, Reardon, Coulter, Stamoulis, Lanjouw & Balisacan (2000, p. 272) found a U-curve relationship between non-farm income share and total household income or farm size. They further stated that the U-curve relationship indicates that the non-farm income share to the total income is relatively high for the two income extremes, the poor and the rich households, while the proportion of non-farm income to total income for a middle income household is low. This shows that the poor households are forced to get alternative sources of income and the rich households are also able to finance lucrative migrant work and start their own businesses (Shi et al., 2006, p. 449). This indicates that the rich farmers participate in off-farm employment for the purpose of profit maximization while the purpose of participation for the poor is to minimize risk (Kilic, Carletto, Miluka, & Savastano, 2009, p. 140). In Sub-Saharan Africa, the contribution of off-farm income to the total household income is in the range of 30 to 50 per cent (Fabusoro et al., 2010, p. 422). Farm households who are limited to only farm

income either have a larger land holding size than the average or are located in inaccessible areas (Chaplin et al., 2003, p. 69).

2.6.1 Age, education, gender and family size and off-farm activities

The education level of household heads is one of the determinant factors of off-farm employment. If the supply of labour in the labour market is in excess of demand, an educated individual, specifically at university level, has a better chance of participating in off-farm activities compared to an individual without a university education (Bhaumiket al., 2011, p. 381). In demand constrained labour markets, education is used as a screening device and is the most determining factor for high-paying and skilled employment (Barrette et al., 2001, p.325; Bhaumik et al., 2011, p. 381). This bias in favour of workers with higher education, which is generally accompanied by employment of over-educated workers in jobs that have low educational requirements, is observed not just in developing countries but also in developed countries such as Sweden (Bhaumik et al., 2011, p. 381).

Similarly, Canagarajah, Newman & Bhattamishra (2001, p. 413) have observed the gender perspectives of non-farm employment in the study they conducted in Ghana and Uganda. They found that self-employment increased income inequality for women, whereas wage work led to a reduction of inequality in both countries. On the contrary, wage income increased inequality among men in both countries with mixed effects for men with regards to self-employment. In another study, males were found to be more involved in off-farm employment such as construction and mining than females because the sector is male dominated (Shi et al., 2006, p. 447). Women faced many entry barriers to off-farm employment which needed the attention of policy makers to reduce these obstacles (Owusu et al., 2010, p. 117).

2.6.2 Land holding size, land ownership security and off-farm activities

Some studies have established the relationships between the households' landholding size and their participation in off-farm activities. Hazell & Haggblade (1993, p. 164) reported that the share of non-farm income to total household income related to the corresponding land holding of farm operators. Their major finding was that more than one-third of the income of farm households, whose land holding size was less than 0.5 hectare, was from non-farm income. They added that landless and near landless households in all the countries considered in the study depended on non-farm income. Therefore, regions with small land sizes have more people in off-farm employment because the farm income is not sufficient to support a household (Chaplin et al., 2003, p. 69). In addition to the size of the landholding, the quality of the land is a determinant factor for farmers to participate in off-farm activities. A study conducted in China by Guoqiang & Wenting (2013, p. 4072) found that the off-farm participation of farmers residing in areas endowed with better natural resources was lower than farmers in areas with poor natural resources.

According to Bugri (2007, p. 272), the influential article written by Hardin titled "Tragedy of the Commons" was the basis for donors and governments to draft land tenure policies. In this article, Hardin argues for the individualized ownership of shared property because resources owned in common are accessible to all and thus prone to unchecked utilization and overexploitation (Bugri, 2007, p. 272; Ogbaharya, & Tecle, 2010, p. 491). The land tenure system also has its own impact on farmers to use their land efficiently and make long term investments on it. If farmers believed the land tenure system was insecure, it would be a challenging task to ensure the sustainable and wise utilization of land.

2.6.3 Access to formal credit, information and distance to the town and off-farm activities

In developing countries, lack of money is the most critical problem for farmers (Kwon, Orazem, &Otto, 2006, p. 59). In the absence of credit arrangements, farmers are forced to use a large proportion of their income to purchase inputs such as fertilizers and pesticides (Pfeiffer et al., 2009, p. 127). Off-farm income makes farmers more able to fulfil the monetary requirements for new technology. There is a positive relationship between off-farm income and the value of investment in agriculture (Tudor, & Balint, 2006, p. 257; Anriquez, & Daidone, 2010, p. 63). In line with this, Alene et al. (2007, p. 327) found a positive link between off-farm income and the intensity of the use of fertilizer in Kenya. They found that a one per cent increase in off-farm income increases fertilizer demand by 0.22 per cent. The adoption of production enhancing inputs may increase or decrease depending on the availability of credit and/or off-farm employment. In addition, agricultural growth and increasing demand for manufactured goods and services could be causes for increasing non-farm rural employment (Bah, Cisse, Diyamett, Diallo, Lerise, Okali, Okpara, Olawoye, & Tacoli, 2003, p. 18).

2.6.4 Access to electricity and off-farm activities

Electrification is a critical infrastructure challenge in developing countries because it is a requirement for development (Mainali, & Silveira, 2012, p. 168). Access to electricity enhances economic and social development which ultimately leads to an overall improvement in the quality of life (Kanagawa, &Nakata, 2008, p., 2017; Bensch, Kluve, & Peters, 2011, p. 567). Countries with high electricity consumption per capita showed superior achievements in both Gross Domestic Product per capita and Human Development Index (Kanagawa, &Nakata, 2008, p. 2018). Nevertheless, only 11 per cent of the population in the rural areas of Sub-Saharan Africa have access to electricity (Bensch et al., 2011, p. 567), a proportion too small to get advantages from it. In developing countries, rural communities rely on firewood, animal dung and fossil fuels

such as diesel and kerosene as their sources of energy (Chakrabarti, & Chakrabarti, 2001, p. 33). Fossil fuel, as source of energy, is also believed to be a threat to human health and the environment (Chakrabarti, & Chakrabarti, 2001, p. 37).

Access to electricity facilitates education by allowing students to read at night and to power teaching aids (Chaurey, Ranganathan, & Mohanty, 2003, p. 1693; Akpan, Essien, & Isihak, 2013, p. 504). In addition, it helps rural health centres to preserve medicines and other income generating activities (Mainali, &Silveira, 2012, p. 171). Many business owners choose a location for their businesses where there is electricity in the village or along the roads (Kooijman-van Dijk, 2011, p. 532).

2.7 CONCLUSIONS

The world has faced many challenges such as increasing food prices and global economic crises that have made the poor more vulnerable to external shocks. It is difficult for the poor to make the required investments in agriculture while adapting and being resilient to environmental and climate changes. Moreover, SAP has reduced government support to farmers that had been given in the form of fertilizer subsidies, credit subsidies and public irrigation schemes. These are the reasons that studies have indicated the difficulty of replicating the Asian Green Revolution in Africa particularly as the Asian countries had enjoyed the full support of their governments.

At the community and household levels, agricultural production is influenced by many factors. Research findings have documented the importance of education in boosting agricultural production and income. Educated farm households are expected to have the required information and knowledge to adopt technology, access inputs and properly market their agricultural produce. Moreover, the full participation of men and women in labour contributions and decision making is vital for the productivity of the sector. However, there are mixed results in relation to the participation and benefits of men and women in agriculture. Some of the researchers have indicated the existence of gender

inequalities in the agricultural sector. Others have argued that the inequality has been created because of the unequal access of women households to inputs and information technologies.

The review indicated that African governments have promoted the utilization of improved seeds, chemical fertilizers and irrigation inspired by the success story of the Asian Green Revolution. However, the application of chemical fertilizers in Sub-Saharan Africa is by far lower than the South and East Asian countries. Supply and demand factors have played a role in the low utilization of inputs in Africa. The literature has further indicated that enhancing land productivity using chemical fertilizers may not be sustainable. Thus, farmers use the methods of intercropping and crop rotation for improving the yield of land in a sustainable way. These methods are environmentally friendly and reduce the amount of chemical fertilizers to be applied.

All governments in the world, regardless of the political ideology, have intervened in the issues of agricultural marketing and pricing. The purpose of these interventions was to create an enabling environment for agricultural production and investment to secure food self-sufficiency, raw materials and major export crops. Similarly, studies also indicated that smallholder farmers are asset constrained and they have limited access to credit and extension services. They face several barriers such as weak market linkages, asymmetry of information and high transaction costs.

Farmers need an alternative source of income for the demand of labour in the agricultural sector varies between the peak and slack seasons. In the slack season, excess labour for off-farm activities is available. Broadly, the need for diversification could be deduced from the push factor and pull factor perspectives. Diversification from the push factor viewpoint is that households are forced to fill the income deficit of the agriculture sector. This kind of diversification is termed as distress-push and it is helpful for the survival of the households. Its contribution to poverty reduction is minimal. On the other hand, the income diversification from the pull factor viewpoint comes from the existence of off-farm opportunities such as commercial farming and nearness to urban centres.

The review has also shown a U-curve relationship between the share of non-farm income and total income of farm households. This implies that the share of off-farm income to total income is high for poor and rich households with different objectives. The poor households are forced to complement the insufficient income from the agricultural sector and the rich households are able to participate in lucrative off-farm activities. In addition, off-farm participation and income are influenced by several variables such as the socio-economic factors, access to electricity, credit, information and distance to town.

The issue of agriculture in Ethiopia is the most sensitive and debatable topic. The agricultural sector and peasants are influenced by the ideologies and policies advocated by governments in power in different periods. The next chapter deals with the agrarian policies and agricultural production of modern Ethiopia.

CHAPTER 3: AGRARIAN POLICIES AND AGRICULTURAL PRODUCTION IN ETHIOPIA

3.1 INTRODUCTION AND BACKGROUND OF THE STUDY AREA

This chapter focuses on the historical perspectives of agrarian policies and agricultural production of different regimes in Ethiopia. Modern Ethiopia has been under three political regimes which are: the monarchy until the overthrow of Emperor Haile Selassie I in 1974, the Derg regime which was the military government with Marxist and Leninist ideology which ruled Ethiopia from 1974 to 1991 and the current Ethiopian People's Revolutionary Democratic Front (EPRDF) government that has been in place since 1991.

During the imperial regime, there were different landholding systems in the northern and the southern parts of the country. The northern part of the country had the *rist* system and, in the south, the *Gult* system was introduced as a result of emperor Minelik's expansion southwards. During Imperial Ethiopia, for the first time, central and national development plans were drafted. These development plans were: The First Five Year Plan (1957-1962), The Second Five Year Plan (1963-1967) and The Third Five Year Plan (1968-1973). Major programs like the Chilalo Agricultural Development Unit (CADU), Wolayita Agricultural Development Unit (WADU) and Adda District Development Project (ADDA) were launched during the Third Five Year Plan.

After the revolution of 1974, the military government endorsed the Rural Land Proclamation in 1975 and eliminated the land tenure system of the imperial regime. The proclamation required the formation of a peasant association where household heads were entitled to be members. The government marketing parastatal called the Agricultural Marketing Corporation (AMC) was established in 1976 with the purpose of collecting grain from peasants at unreasonably low prices. The service cooperatives served as agents of the AMC by selling inputs to farmers and purchasing agricultural products from them. The regime also tried to introduce agricultural development programs such as the Minimum Package Program II which was later replaced by the Peasant Agricultural Development and Extension Program (PADEP). In the dying daysof

the military regime, the mixed economy policy was announced.

The military junta was overthrown by EPRDF in 1991. The Front accepted the right to use the land tenure system which was practiced during the Derg regime. Unlike the previous regime, the EPRDF government adopted a free market economic policy. To this end, the government took policy measures to correct the macro economic problems inherited from the Marxist-Leninist regime. The agricultural sector was the focus of these three regimes guided by different doctrines as indicated below.

3.2 AGRARIAN POLICIES AND AGRICULTURAL PRODUCTION DURING THE IMPERIAL REGIME (PRE-1974).

Prior to the revolution of 1974, the agrarian economy in Ethiopia was feudal in the classical sense of the term (Ghose, 1985, p. 127; Belete, Dillon & Anderson, 1991, p. 160) and the land holding system was uneven (Alemu, Oosthuizen, & Van Schalkwyk, 2002, p. 16). In the northern part of Ethiopia, *rist* was the oldest and the most common land tenure system (Abegaz, 2004, p. 317; Rahmato, 2006, p. 4; Yami, Vogl, & Hauser, 2011, p. 83). Under the *rist* system, the customary rights held by a corporate community or descendent group meant that individuals could only use rights to their allotments. In the south, the *Gult* lordship and members of the nobility, local gentry and soldiers had the rights for the *gult* land holding system (Alemu et al., 2002, p. 16; Rahmato, 2006, p. 4). The nobility were absentee landlords while the gentry resided close to their land (Rahmato, 2006, p. 4).During the feudal era, it is believed that the system kept the peasantry impoverished and preserved out-dated primitive cultivation practices (Beleteet al., 1991, p. 160).Both the nobility and the gentry had their land worked by tenant farmers who had to give them from one-third to two-thirds of their harvests in the form of rent (Rahmato, 2006, p. 4). The discrepancies between the south-north landholding rights continued until they were made uniform by the 1974 revolution and the land reform proclamation of 1975 which turned land into the hands of the state (Belete et al., 1991, p. 160; Alemu et al., 2002, p. 16;Bezabih, Kohlin, & Mannberg, 2011, p. 835).

A central and nationwide development plan was first drafted in Imperial Ethiopia for a five year period (Getachew, 2005, p. 2). The First Five Year Plan (1957-1962) was intended to realize a monetized robust Ethiopian economy which was mainly non-agricultural. Agriculture was discriminated against by the sectoral policies and industrialization became an overarching development agenda in the First Five Year Plan (Alemuet al., 2002, p. 4; Getachew, 2005, p. 2).

Policy planners outlined the strategies that could be applied to increase agricultural productivity, two of which were: to extend the surface land used for cultivation (extensification) and to increase labour productivity on cultivated farm fields (intensification) (Getachew, 2005, p. 2). Getachew (2005, p. 2) added that the rationale for the extensification was the fact that a large portion of Ethiopia's arable land was idle and the government was leasing huge tracts of land to local and foreign investors to promote large-scale commercial farms. Despite the First Five Year Plan's aspiration to monetize and integrate agriculture with an industrial economy through the promotion of large scale commercial farms, Ethiopia could not even meet the growing consumption demands of its people.

The Second Five Year Plan (1963-1967) began by acknowledging that the country had become an importer of wheat instead of being an exporter (Getachew, 2005, p. 2). The failure was partly said to have been caused by the lack of attention given to subsistence farmers who had more than 80 percent of the cultivated area in the 1950s and 1960s (Alemu et al., 2002, p. 4; Getachew, 2005, p. 2). The Second Five Year Plan envisaged an increase in production tofill the food deficit through the introduction of advanced methods of farming and improved technical means for the peasant sector of the economy. Moreover, this document formally recognized that one major obstacle in the development of agriculture was the feudal land tenure system (Getachew, 2005, p. 2). The imperial regime did not have any genuine political commitment to address the challenges facing peasant agriculture because large scale farming had been developed the agricultural sector (Getachew, 2005, p. 3).

The shortage of food and the unemployment of unskilled migrants to the urban areas in the late 1960s convinced planners that, in order to develop its economy, Ethiopia needed to increase agricultural productivity among subsistence farmers (Sisaye, & Stommes, 1980, p.160; Alemu et al., 2002, p. 4). In the Third Five Year Plan (1968-1973), agriculture was prioritized without modifications to the overall growth strategy (Alemu et al., 2002, p. 4; Getachew, 2005, p.3).

The Third Five Year Plan had a well-planned strategy to modernize peasant agriculture through the allocation of human and financial resources to locations that were identified as promising areas (Getachew, 2005, p. 4). With the assistance of the Swedish International Development Authority (SIDA), the first comprehensive package program called the Chilalo Agricultural Development Unit (CADU) was launched in Arssi Province in 1968 (Sisaye, & Stommes, 1980, p. 163; Belay, 2003, p. 55). Then the Wolayita Agricultural Development Unit (WADU) and the Adda District Development Project (ADDP) followed in 1970 and 1972 respectively (Getachew, 2005, p. 4). The WADU package program was assisted by the World Bank and the ADDP by the United States Agency for International Development (USAID) (Sisaye, &Stommes, 1980, p. 163). This strategy of concentrating development efforts in selected and promising areas was called the Minimum Package Program I. The Minimum Package Program (MPP) provided minimum services, mainly fertilizer, credit and marketing, because it was costly in terms of human and financial resources to replicate widely (Alemu et al., 2002, p. 4; Belay, 2003, p. 56; Getachew, 2005, p. 4). The CADU officials suggested that a Minimum Package Program be provided to rural residents living along the main roads (Sisaye, & Stommes, 1980, p. 167).

The CADU, WADU and ADDP projects were constrained by a number of organizational and structural problems (Getachew, 2005, p. 4). According to Sisaye & Stommes (1980, p. 163), the CADU project was primarily a Swedish undertaking which originated in the Swedish University of Agriculture at Uppsala. Sisaye & Stommes further noted that, in the initial stages of the project, Ethiopians were excluded from decision making and were utilized for background information, translation and facilitating the bureaucratic

procedures for site selection and project approval. On the other hand, at the stage of project implementation, CADU attracted qualified Ethiopians who succeeded in gaining responsible positions. These were progressive, educated personnel who were interested in promoting change and who demonstrated sincere concern for poor farmers (Sisaye, & Stommes, 1980, p. 166). They further indicated that, in 1975, the number of Swedes working in CADU had reduced from 40 to 5 while Ethiopians assumed administrative control over the project. The CADU project was challenged to integrate the various stakeholders such as local administration structures, the project office, the Agro Industrial Bank of Ethiopia, the Ministry of Agriculture and Highway Authority (Getachew, 2005, p. 4). The other challenge was that the landlords deeply resented the project and were suspicious of the project's effort to address and communicate with their tenants.

The USAID project, Ada District Development Project (ADDP), was planned by the Stanford Research Institute (Sisaye, & Stommes, 1980, p. 166). Sisaye and Stommes added that, although the USAID project was supposed to be an experiment for highland agriculture, the Ada district was not a representative area and was selected for its proximity to the capital city, land tenure system and availability of transportation infrastructure. The Minimum Package Project was planned to expand its coverage to include the entire country by the end of the decade of 1970s (Alemu et al., 2002, p. 5). Nevertheless, its life was cut short as its operation was discontinued in the mid-1970s because of the donors' dissatisfaction with the Ethiopian political system of the time and they stopped funding the projects (Alemu et al., 2002, p. 5). The comprehensive package projects failed to serve the tenants and small-scale farmers for whom they were intended. The main beneficiaries of the projects were landlords and commercial farmers (Belay, 2003, p. 56). Instead of providing greater security to tenants, the imperial regime focused on the large-scale commercial farms and package programs in selected pilot areas (Abegaz, 2004, p. 327). These issues, aggravated by unfavourable agro-ecological forces and population pressures, greatly increased the vulnerability of the rural population to famine (Kiros, 2005, p. 85).

As indicated, different international organizations had interests and were involved in

improving the productivity of the agricultural sector of the country. These organizations may have relaxed the financial needs of agricultural programs of the country but did not bring sustainable development. The agricultural technologies and practices imported by these donor organizations were also sometimes beyond the financial capacity of smallholders. As a result, many smallholders were evicted from their land in the disguise of commercial farming and commercial farmers benefited from the projects.

3.3 AGRARIAN POLICIES AND AGRICULTURAL PRODUCTION DURING THE DERG REGIME (1974-1991)

In 1974, Ethiopia became unstable because urban strikes and rural risings brought about the downfall of the Imperial government in September of that year. It was replaced by a Provisional Military Administration Council (Sisaye, &Stommes, 1980, p. 169; Bezabih et al., 2011, p. 835). Faced with pressing urgency of the peasantry, the radical student movement was inspired by the doctrine of socialism (Getachew, 2005, p. 5; Holden, Deininger, & Ghebru, 2011, p. 33). In December 1974, the Military group declared socialism as the ideology, instituting a new social and economic order for Ethiopia (Sisaye, & Stommes, 1980, p. 169; Getachew, 2005, p. 5; Deininger et al., 2008, p. 1789). The military government endorsed the Rural Lands Proclamation of 1975, abolishing the obsolete tenure system of the Imperial regime, by nationalizing all rural land and redistributing it to the tillers of the land. The proclamation also stipulated the formation of a peasant association organized in an area of about 800 hectares. All the heads of the households (around 300 to 400 farmers) residing in the area were entitled to membership (Ghose, 1985, p. 129; Clapham, 1989, p. 7; Belete et al., 1991, p. 160; Getachew, 2005, p. 5).

The 1975 peasant association proclamation provided autonomy and local power for peasants to redistribute land, maintain common assets, resolve conflicts and enable local development programs by decentralizing existing local administration (Sisaye, & Stommes, 1980, p. 169; Rahmato, 1993, p. 39). Membership in the Peasant Associations was open to peasants only and landlords were not allowed to participate, for they might

have used the organizations for their own purposes (Desalegn, 2009, p. 140). Within a short time, the Peasant Associations, which had been started as popular self-administration organizations, came under the control of the military regime to carry out its political functions (Desalegn, 1993, p. 39). They were used as instruments for strict government control to the local level and to propagate the socialist ideology with obligatory participation of peasants (Bernard, & Spielman, 2008, p. 62). Thus, the PAs were expected to collect taxes, maintain law and order, disseminate directives to the peasantry, implement the government's grain requisition programs and recruit young men into the military (Desalegn, 1993, p. 39).

The Agricultural Marketing Corporation (AMC), which was a government marketing corporation, was established in 1976 (Alemu et al., 2002, p. 8). The infamous AMC forced delivery of grains at unreasonably low prices that discouraged agricultural production and further impoverished the rural producers (Kiros, 2005, p. 85). Measures such as grain quotas, fixed procurement pricing systems and grain check points were applied to increase the grain procurement capacity of the AMC (Alemu et al., 2002, p. 8). The service cooperatives served as agents of the AMC by selling farm inputs and basic consumer goods to peasants and purchasing agricultural products from them (Ghose, 1985, p. 131). The justifications for the grain requisitioning were to bring down prices in the urban areas and to eliminate the private grain marketing system (Desalegn, 1993, p. 43). Furthermore, Desalegn (1993, p. 43) explained that none of these objectives was met as peasants continued to be pressurized by the AMC and constricted by grain merchants. Consequently, food prices in the urban areas increased.

To fit the new development objectives, the Derg regime revised the Minimum Package Program intended to cover three fiscal periods from 1977/78-1979/80 (Sisaye, & Stommes, 1980, p. 172; Belay, 2003, p. 58). The revision included a limit of less than 10 per cent of the population living along the main roads. The Minimum Package Program II included a road component designed to improve and construct additional rural roads. Moreover, unlike the MPP I which was implemented through the model farmers, MPP II used the peasant associations as the local link for the distribution of green revolution

inputs and credit under the supervision of the Agricultural and Industrial Development Bank and EPID (Sisaye, & Stommes, 1980, p. 172).

The document, developed and disseminated in 1978 by the then Ministry of Agriculture and Settlement, enumerated that the basic objectives of Ethiopian Agriculture was geared towards ensuring enough production for the growing population, to satisfy the supply of primary goods for local industries, produce exportable crops for foreign exchange and create employment opportunities (Getachew, 2005, p. 5). In this way, the agricultural share in the total value of export earnings over the ten year period (1975/76 to 1984/85) was close to 90% (Belete et al., 1991).

Although the government enforced radical and wide scale measures, the economy of the country in general and the supply of food in particular was declining at an alarming rate (Getachew, 2005, p. 7). The MPP-II did not meet its intended objectives because the numbers of extension agents were limited and they were expected to cover wide areas without sufficient facilities and logistic support (Belay, 2003, p. 59). Furthermore, the 1983/4 drought caused the Derg to draft and endorse a Ten Year Perspective Plan (1984/5-1993/4) (Alemu et al., 2002, p. 7; Getachew, 2005, p. 7). This Ten Year Perspective plan acknowledged the overall decline in the growth rate of the Ethiopian economy because of factors like the low levels of domestic savings, which led to low levels of investment, disruption of normal economic activity by the internal and external enemies of the revolution, higher inflation, a negative trade balance with the decline of exports and the higher growth of government expenditure (Getachew, 2005, p. 7).

The plan had the objectives of improving surplus extraction and self-sufficiency in food production of the country (Alemu et al., 2002, p. 7). In line with this, the fragmented land holdings and settlement patterns were believed to have hindered the rural sector improvement and the plan emphasized the importance of countrywide resettlement and villagization schemes alongside the establishment of cooperatives (Getachew, 2005, p. 8). The government's campaign to resettle people from the drought prone areas of the north was imposed on the peasants and was regarded as a political trick to drain and dry

out the political support base of the armed movements in the north (Getachew, 2005, p. 8).

After the development of the Ten Year Perspective Plan, a new agricultural development program called the Peasant Agricultural Development and Extension Program (PADEP) was introduced and was expected to cover from May 1985 to 1990 (Getachew, 2005, p. 8). This was because the MPP-II was phased out in 1985 and replaced by PADEP (Belay, 2003, p. 59).

PADEP was funded by the World Bank with the aims of promoting smallholder productivity and to support the continuation of the Minimum Package Program (Cohen, 1988, p. 336). The administration of PADEP also resembled that of CADU as the country was divided into eight program zones organized along commonalities in agro-ecological make up and farming practices (Cohen, 1988, p. 336; Belay, 2003, p. 59; Getachew, 2005, p. 8). For the purpose, about 250 high potential *weredas* were included within the eight zones in order to concentrate resources and extension efforts (Getachew, 2005, p. 8). The main objectives of PADEP were increasing food production to a level of self-sufficiency, production of cash crops for export, input for domestic industries, development of rural cooperatives, preventing soil erosion and using suitable farming systems in erosion prone areas of the country (Belay, 2003, p. 60).

According to Belay (2003, p. 60) in the selected *weredas*, an extension agent was assigned to serve 1300 farm households through contact farmers organized into groups although the conventional Training and Visit (T &V) system recommends one extension agent for 800 farmers. It is known that T& V used a new way of information transfer which was a one way top-down flow of information from research institutes to farmers through regular visits of field agents (Benson, & Jafry, 2013, p. 383). All in all, available information on PADEP performances indicates that, for various reasons, the achievements recorded remained far below the targets initially set (Getachew, 2005, p. 8).

In 1990, during the dying days of the socialist regime, a mixed economic policy was announced and, as a result of this change, the collective farms were completely demolished (Alemuet al., 2002, p. 14). With the exception of buying and selling of land, most of the other constraints on land were relaxed by the 1990 policy reform which allowed for sharecropping, the transfer of land to legal heirs and the hiring of labour (Alemu et al., 2002, p.17).

3.4 AGRARIAN POLICIES AND AGRICULTURAL PRODUCTION DURING THE ETHIOPIAN PEOPLE'S REVOLUTIONARY AND DEMOCRATIC FRONT (EPRDF) REGIME (SINCE 1991)

The military junta was overthrown in 1991 and the right to use the land tenure system which was practiced in the military regime was continued (Crewett, & Korf, 2008, p. 205). The new government did not take decisive measures that led to the full privatization of rural land (Deininger et al., 2008, p. 1789).

The land tenure system of the country is one of the most debatable issues in academia and other land related stages. In addition, land policy has been, and is, an ideological battlefield of political parties in Ethiopia. The two antagonistic land policy positions are "fairness" which favours state ownership, and "efficiency" which favours private ownership of land (Crewett, & Korf, 2008, p. 204). The land policy and position of the ruling party was clearly stated in the constitution of the country which was endorsed in 1995. In the constitution, it is clear that the right to possession of rural, urban and natural resources is fully vested in the state and in the Ethiopian people (FDRE, 1995, p. 98). Regional land policies of all regions are also in accordance with the federal law which prohibits farmers from selling or mortgaging their plots (Adenew, & Abdi, 2005, p. 6; Crewett, &Korf, 2008, p. 208; Deininger et al., 2008, p. 1790).

According to Ogbaharya and Tecle (2010, p. 498) the government defends the current land tenure system, ensures social justice, provides tenure security and protects the right of the government to set aside land for public use. The government believes that the

privatization of land leads to peasant evictions and poverty as well as undesirable migration of landless farmers to urban centres (Crewett, & Korf, 2008, p. 205). Hence, farmers are prevented from selling their land thereby losing their critical livelihood asset, through the public ownership of land (Bezabih et al., 2011, p. 835). On the other hand, opposition groups and civil society organizations criticise the system as they believe that government ownership of land and associated resources undermines tenure security, discourages investment for sustainable use of resources and hinders economic growth (Crewett, & Korf, 2008, p. 206; Ogbaharya, & Tecle, 2010, p. 498).

The transitional government adopted a free market economic policy supported by the International Monetary Fund and the World Bank (Belay, & Manig, 2004, p. 128; Ogbaharya, & Tecle, 2010, p. 496). During the transition period, the major focus of EPRDF was on correcting the macro economic problems that were inherited from the Marxist-Leninist regime by introducing macro price policy reform (Alemu et al., 2002, p. 10). The government undertook four chains of reforms. Firstly, in 1991 and 1992, price and trade policies were liberalized. To meet the objectives of the price and trade reform, the agricultural prices were decontrolled. In addition, the monopoly of the government marketing parastatal and distribution of food grains was abolished (Alemu et al., 2002, p. 11; Jayne, Govereh, Wanzala, &Demeke, 2003, p. 300). Fertilizer retail marketing was liberalized while wholesale prices remained under the control of the government (Alemu et al., 2002, p. 12). By the end of 1996/97,the control over wholesale prices of fertilizers was phased out (Alemu et al., 2002, p. 12).

Secondly, in 1992, stabilization policies to correct macro price distortions were introduced (Alemu et al., 2002, p. 10). Thirdly, in 1993, short, medium and long term timetables were drawn up to privatise state farms as part of structural adjustment programs (Alemu et al., 2002, p. 10). The short-term strategy which was implemented in 1991/92 transformed state farms that had already been taken over by farmers because of the mixed economy policy announced in 1990 and disposed of farms which were unmanageable for technical reasons (Alemu et al., 2002, p. 14). The medium-term strategy was focused on the privatization of state farms which were believed to be

unprofitable and engaged in the production of non-strategic products. The long-term strategy was aimed at retaining those state farms that have strategic importance and needed heavy investments.

Lastly, in 1993, the development strategy of the country was changed from an industry-led to agricultural-led strategy. Policies which focused on the development of the agricultural sector and are guided by a strategy called Agricultural Development-led Industrialization (ADLI) (Alemu et al., 2002, p. 10; Kiros, 2005, p. 86; Amsalu et al., 2006, p. 457; Dercon, & Zeitlin, 2009, p. 3; Lavers, 2012, p. 109) were introduced. Thus, ADLI is a strategy that focuses on modernizing peasant agriculture and intensifying yield productivity through the supply of appropriate technology, fertilizers, certified seeds, rural credit facilities and technical assistance (Getachew, 2005, p. 9).

The ADLI strategy is opposite to the development strategy which had been used for over three decades from 1957 to 1992 (Alemu et al., 2002, p. 20). Soon after the downfall of the military regime, the transitional government of Ethiopia announced that a major part of the budget and manpower would be allocated to rehabilitate and develop peasant agriculture (Getachew, 2005, p. 8). To this end, a collaborative agricultural project by Sasakawa Global 2000 initiative was started in 1993 to revitalize the agriculture sector and narrow the gap between food supply and demand (Belay, & Abebaw, 2004, p. 141).

Sasakawa Global 2000 project developed an extension package to assist 160 model farmers with credit and support with agricultural inputs such as seeds, fertilizers and technical assistance (Belay, & Abebaw, 2004, p. 141; Getachew, 2005, p. 9; Ogbaharya, & Tecle, 2010, p. 497; Edwards et al., 2010, p. 7). The farmers' own plots were used as Extension Management and Training Plots (EMTPs) to demonstrate the application of improved implements and new agricultural techniques (Getachew, 2005, p. 9). The size of each EMTP was half a hectare and, if farmers were unable to meet the half hectare requirement individually, the adjacent farmers were allowed to pool their plots to form an EMTP (Belay, & Abebaw, 2004, p. 149).

The reports from the project sites of Sasakawa Global 2000 were encouraging as the average yield per hectare of the EMTPs was significantly higher than the national average (Getachew, 2005, p. 9). Even though there were regional and other variations, the EMTPs overall mean yield of maize was 5.7 t/ha which was 192 percent above the national average (Sasakawa Global report in Getachew, 2005, p. 9). In addition, the yield from locally available seed of wheat and teff was 2.7 and 1.8 t/ha respectively (Croppenstedt, Demeke, & Meschi, 2003, p. 59). The encouraging yield increments obtained by EMTP participating farmers persuaded the government that, by adopting the SG 2000 approach, self-sufficiency in food production could be ensured (Belay, & Abebaw, 2004, p.150). As a result, in 1995, the government decided to take the initiative to run the program and started the national agricultural extension system called Participatory Demonstration and Training Extension System (PADETES) (Alemu et al., 2002, p. 21; Belay, & Abebaw, 2004, p. 150; Davis, Swanson, & Amudavi, 2009, p. 19; Davis et al., 2010, p. 8).

This new extension program, PADETES, was designed and started with 32,047 farmers in 1995 (Alemu et al., 2002, p. 21; Getachew, 2005, p. 9). Even though it uses a similar approach to SG-2000 together with a modified T&V approach, it extended the technology package to high value crops, livestock, post-harvest protection, agro-forestry, soil and water conservation and beekeeping (Belay, & Abebaw, 2004, p. 150; Davis et al., 2009, p. 19). The number of adopting farmers in the PADETES program increased from 35,000 in the beginning to over 3.6 million (Davis et al., 2009, p. 19; Davis et al., 2010, p. 9). Nevertheless, it became apparent that yields from the up-scaled plots were not as high as the original demonstration plots due to a lack of supervision by the extension agents (Davis et al., 2009, p. 19). When the government identified the challenges of insufficient extension agents, it decided to use the technical and vocational education and training centres (TVETS) to enhance the supply of additional development agents (Davis et al., 2009, p. 20; Davis et al., 2010, p. 9). Before 2000, there were only 15,000 extension agents but, since then, the government has trained nearly 60,000 extension agents to provide the required service for rural communities (Ragasa et al., 2013, p. 441). The Farmer Training Centres (FTCs) at the *kebele* level were also

identified as critical centres for farmers to receive information, training, demonstrations and advice in classrooms and demonstration fields (Gebremedhin et al., 2009, p. 774; Davis et al., 2009, p. 20; Davis et al., 2010, p. 10).

3.5 BRIEF BACKGROUND OF THE STUDY AREA

Tigray region, situated between 12^0 15' and 14^0 57'N latitude 36^0 27'E and 39^0 59'E longitude, is in the northern part of the nine regions of Ethiopia. The language mainly spoken in the region is Tigrigna. Mekelle is the capital city of the region. It covers an approximate surface area of 54,572km^2. Altitude varies from about 500 meters above sea level (masl) in the northeast to almost 4000 masl in the southeast. According to the agro-climatic classification of the area, about 53% of the land is below 1500 masl and is classified as lowland (*kola*), 39% situated at 1500-2300 masl and known as medium altitude (*weinadega*) and 8% is over 2300 masl and is classified as highland (*dega*) (Beyene, Gibbon, & Haile, 2005, p. 64).

Tigray shares common borders with Eritrea in the north and Sudan on the west and with regions of Amhara and Afar on the south and east respectively. It is divided into six administrative zones and 32 districts locally known as *wereda*. This region has been the front of many wars in Ethiopian history. One of the battles fought in the area was the defeat of the Italians in 1896 in the battle of Adua, Tigray region. The Tigray People's Liberation Front (TPLF) started its armed struggle for the freedom of Tigray that took place over seventeen years (1975-1991). The Relief Society of Tigray (REST) estimated that approximately 8650 homes were burnt, 8000 people killed, 200,000 people displaced, 20,000 tons of grain seized or burnt and over 10,000 domestic livestock killed or plundered from 1975 to 1982 (REST in Barnabas, & Zwi, 1997, p. 40). The recent Eritrean-Ethiopian war which took place from 1998 to 2000 was started and fought in all fronts of Tigray region which borders Eritrea.

Conflict and displacement led to a loss and degradation of human capacity in the

community in the form of physical disability, loss of skilled labour, social withdrawal and depression (Ager, Strang, & Abebe, 2005, p. 161). Moreover, Ager et al. (2005, p. 161) stated that the conditions of war and refuge led to an interruption of the social ecology of a community, involving social relations within families, links with civic and political authorities, religious and cultural institutions and peer groups. Hence, in the situation of war and conflict, farmers were unable to invest their time and money on the sustainable utilization of land and environment.

In2007, the Population and Housing Census of Ethiopia[1] indicated that the total population of the Tigray region was estimated at 4,316,988 (CSA, 2010, p. 13). From the total population, 844,040 (19.5%) and 3,472,948 (80.5%) were urban and rural residents respectively. The land law of the Regional National State of Tigray was passed in 1997 and land redistribution was stopped (Holden et al., 2011, p. 33). Land redistribution aimed at reducing the number of landless households would result in further fragmentation of small plots and tenure insecurity of land holders (Amsalu et al., 2006, p. 457). The CSA (2013, p. 17) stated that the main agricultural products in the region are cereals, pulses, oil seeds, vegetables, root crops and permanent crops. The same source indicated that the amount produced, in quintals, in the main season are: cereals 15,463,990, pulses 836,909, oil seeds 739,698, vegetables 110,885, root crops 68,117 and permanent crops 110,663.In general, the farm operators produce mainly for household consumption. For example, the utilization of grain crops is for household consumption (65.79%), seed (13.99%), sales (15.49%), wages in kind (0.89%), animal feed (0.82%) and others (CSA, 2009, p. 18).

The study area, Eastern Zone of Tigray, shares common borders with Central Zone in the west, South Eastern Zone in the south, Afar region in the East and Eritrea in the north. It consists of nine *weredas* (districts) of which two are town *weredas*. These districts are: Ganta Afeshum, Hawzen, Kilte Awlalo, Atsbi Wonberta, Adigrat town, Wukro town, Gulo Mekeda, Erob and Saesie Tsaeda Emba. According to the 2011/12 report of the

[1]This document is the most recent Population and Housing Census of Ethiopia.

Bureau of Planning and Finance of Tigray region, the total area of the Eastern Zone is 625,572 hectares. The total population of the Zone in 2011/12 was estimated to be 858,809.

The population size of the two districts Ganta Afeshum and Kilte Awlalo are 100,786 and 118,141 respectively. The Eastern Zone consists of 142 *tabias* and 535 *kushets*. The Construction, Roads and Transport Bureau of the region indicated that the total length of all types of roads in Eastern Zone has reached 585.63 kilometres. The density of roads is 94.59 km/1000km^2. This is higher than the average density of all Zones in the region which is 61.83 km/1000km^2. The total cultivated land and total crop production of the Eastern Zone was taken from the various reports of the Central Statistics Agency of Ethiopia. The following table summarizes the total cultivated land and total production of the Zone.

Table 3.1: Cultivated area and total agricultural production of Eastern Zone

Year	Cultivatedarea (hectares)	Production (in quintals)	Productivity (quintals/ha)
2005/06	68,357.31	779,931.37	11.41
2006/07	86,870.95	1,104,919.37	12.72
2007/08	94,335.30	1,526,440.44	16.18
2008/09	94,695.52	1,246,781.80	13.17
2009/2010[2]	-	-	-
2010/11	95,669.34	1,720,766.80	17.99
2011/12	89,959.84	1,466,305.07	16.30
2012/13	89,746.91	1,436,680.32	16.01

Source: Central Statistics Agency of Ethiopia various reports

As indicated in the methodology section, two districts were selected from the Eastern Zone of Tigray. The regional states of Ethiopia and the Zonal division of Tigray region

[2]The cultivated area and production of the year is at regional level.

and the specific *tabias* selected from Kilte Awlalo and Ganta Afeshum *wereda* for the study are shown below.

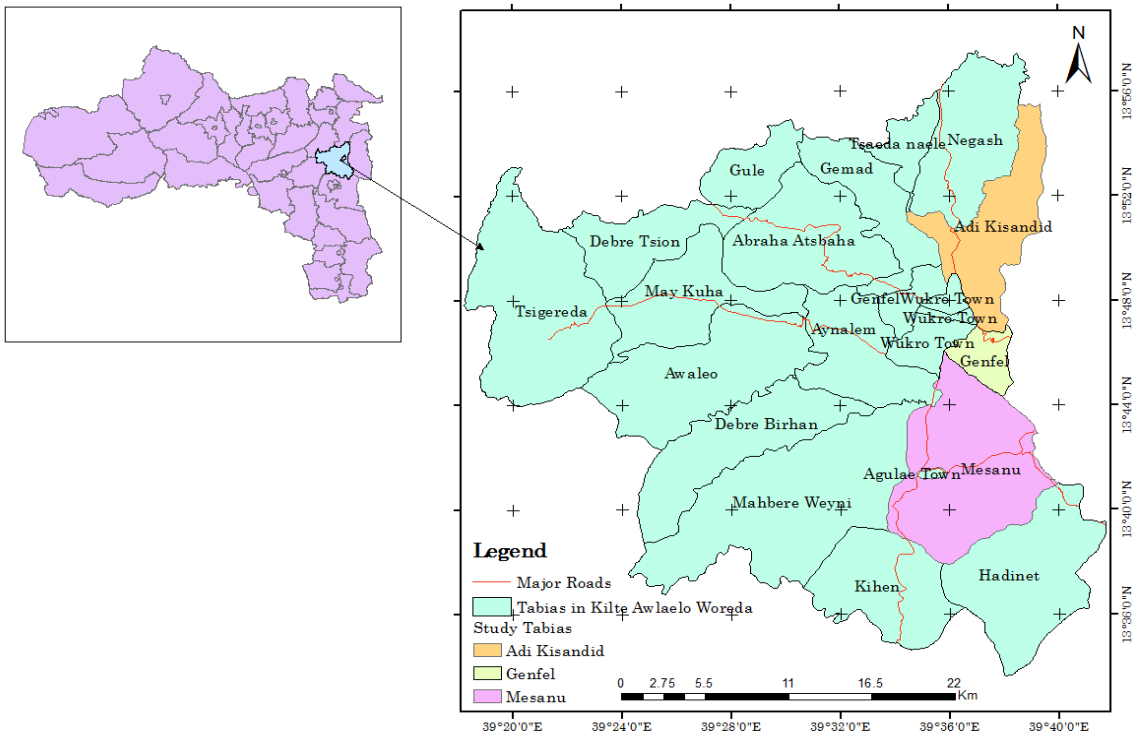

Figure 3.1: The research tabias selected from Kilte Awlalo

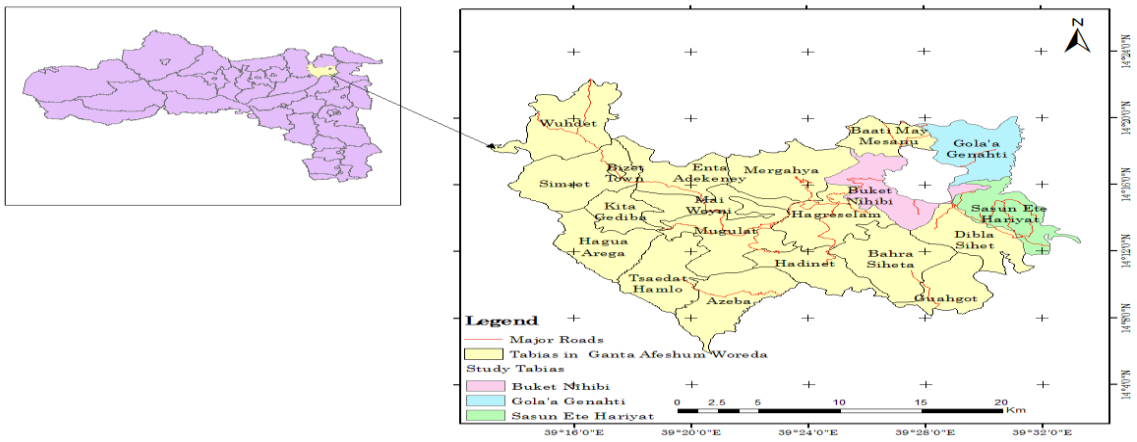

Figure 3.2: The research tabias selected from Ganta Afeshum weredas

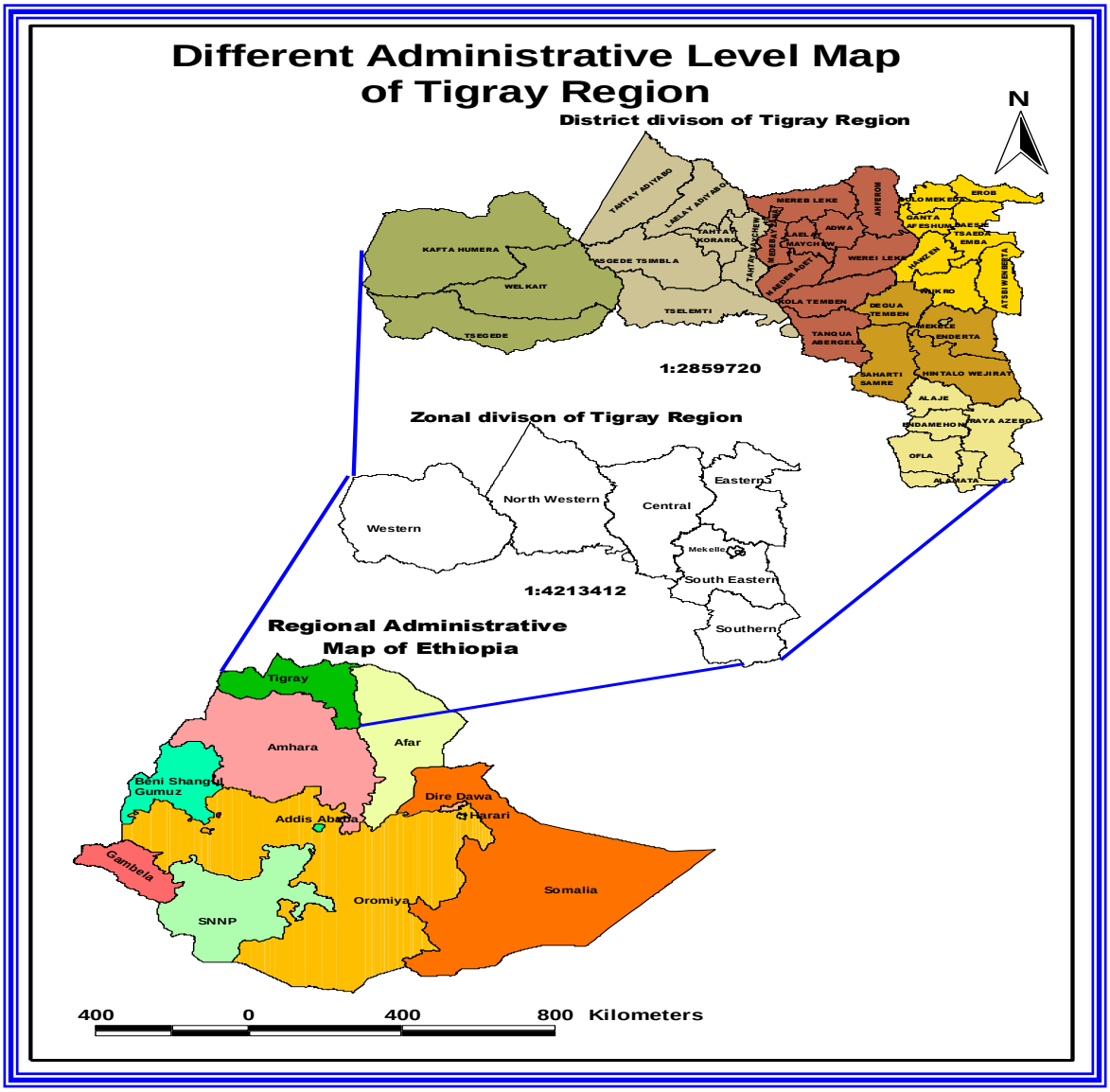

Figure 3.3: Regional state of Ethiopia and Zonal division of Tigray region

3.6 CONCLUSION

In the imperial regime of Ethiopia, *rist* and *Gult* were the landholding systems in the north and south respectively. The *rist* system was the customary rights in which individuals had only the right of use of their land. On the other hand, the *Gult* system provided the ownership of land to the servants of the regime such as members of the nobility, local gentry and soldiers. The tenant farmers cultivated the land for the owners

and gave them from one-third to two-thirds of their harvest in the form of rent. The land holding rights of the *rist* and *Gult* in the north and south continued until the revolution which placed land under state ownership.

The five years successive national development plans were drafted during the imperial era. In the first phase of the plan, the policies were against the agricultural sector and industrialization became the preferred sector to ensure development of the nation. However, the industrial sector as a major policy agenda did not bring change and, as a result, the country could not even meet the growing consumption demands of its people. The failure was partly caused by the government's lack of attention given to the subsistence farmers who possessed most of the cultivated areas.

The Second plan focused on improving the agricultural production by exposing farmers to advanced farming methods and techniques. For the first time, this document formally recognized that the feudal land tenure system was the major obstacle for the development of agriculture. However, the imperial regime did not have a genuine political commitment to address the challenges of smallholders. Large scale farming was preferred to develop the agricultural sector. Finally, the Third Five Year Plan was adopted with the aim of modernizing peasant agriculture through the allocation of financial and human resources to locations identified as areas with potential. Many projects were designed with the collaboration of international organizations such as USAID, SIDA and the World Bank. The main beneficiaries of the projects were the landlords and commercial farmers. Development did not serve the interests of tenants and small scale farmers.

After the downfall of the imperial regime, the military government nationalized all rural land and redistributed it to the tillers of the land. The government took this measure because of the pressing urgency of the peasantry, the radical student movements and the doctrine of socialism. The establishment of the peasant association provided autonomy and local power for peasants to redistribute land, resolve conflicts, maintain common assets and enable local development programs. Later on, the peasant association which has been considered as a local empowerment institution was controlled by the military

regime for its political functions.

The peasant association served the military state to collect taxes, maintain law and order, disseminate directives to the peasantry, implement the government's grain requisition program and to recruit young men into the military. Moreover, the measures such as grain quotas, fixed procurement pricing systems and grain checkpoints were used to increase the grain procurement capacity of the AMC. The low prices of the AMC discouraged agricultural production and further impoverished the rural producers. The mixed economic policy, endorsed in the last breath of the Derg regime, allowed for sharecropping and the transfer of land to legal hires. Nonetheless, the selling and buying of land was still prohibited even in a mixed economic policy.

The EPRDF took power and followed the same rural land policy as that of the military regime. The "right to use" land tenure system or the state ownership of land continues to be one of the most debatable issues in Ethiopia. The government claims this policy ensures social justice, provides tenure security and helps the government to set aside land for public use. On the other hand, critics say that the state ownership of land and other resources undermines tenure security, discourages investment in agriculture and hinders economic growth. The government still has a strong and unshakable stand on the state ownership of land.

The EPRDF led government tried to change some of the policies to fit the free market economic policy and demolish the socialist ideology of the previous regime. In 1991 and 1992, price and trade policies were liberalized. The monopoly of the state AMC was eliminated. In addition, the development strategy of the country was changed from being industry-led to an agricultural-led strategy. Policies which focused on the development of the agricultural sector were drafted and guided by a strategy called Agricultural Development-Led Industrialization (ADLI).

The government attempted to allocate the major part of the budget and manpower to rehabilitate and develop peasant agriculture. To this end, international organizations such

as Sasakawa Global 2000 participated in the provision of credit for inputs and technical assistance to farmers. Sasakawa Global 2000 was successful in increasing the national average mean yield of maize. Encouraged by the Sasakawa's achievement, the government decided to take the initiative to run it and started the national agricultural extension system called Participatory Demonstration and Training Extension System (PADETES). However, it became apparent that the yield from the up-scaled plots was not as high as the original demonstration plots because of lack of sufficient supervision by the extension agents.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

In assessing the factors affecting agricultural production in the study area, a mixed method research approach was adopted in which both qualitative and quantitative research techniques were used in the study. The type and source of data are explained. The dependent and independent variables of the models used in the study are properly explained and operationalized. The issues related to the target population and the sampling procedures of the study are explained in this section. The methods of data processing and analysis as well as the measures that have been taken to address the issues of validity and reliability are part of this chapter.

4.2 RESEARCH DESIGN

Research design provides a logical structure for research data gathering and analysis (Bryman, 2008, p. 31). The study adopted a cross-sectional survey research design as its framework to guide the process of data collection. According to Bryman (2008, p. 46), cross-sectional survey research design is the collection of data mainly using questionnaires or structured interviews to capture quantitative or qualitative data at a single point in time.

4.3 DATA TYPE

The focus of this study is to investigate the factors affecting agricultural production in the Tigray region, Northern Ethiopia. In addition, related issues such as agricultural marketing challenges and off-farm participation are part of the study. To this end, a mixed method research approach which involves the mixing of qualitative and quantitative research methods was used. The application of these combined research methods is vital for answering different types of research questions.

According to Henning, Van Rensburg & Smit (2004, p. 3), in a quantitative study, the

focus is on the representation of subjects and the relationships between the different variables under consideration. On the other hand, the focus of qualitative research is not the issue of representation and quantification. In the processes of data collection and analysis, qualitative study gives due attention to words rather than quantification (Bryman, 2004, p. 266; Bryman, 2008, p. 366). The mixed methods research design creates a wider picture by enhancing the depth and insight given by numbers through inclusion of dialogue and narratives (O'Leary, 2010, p. 128).

The major factors affecting agricultural production are the household characteristics, technologies, credit markets, environmental (soil and climate) and rural infrastructure facilities (Endale, 2011, p. 23). In addition, the factors affecting agricultural production at the regional level are critically reviewed from the secondary sources. These factors are addressed using qualitative techniques. In order to assess the agricultural marketing challenges of farm households, a qualitative technique was also used. It is believed that agricultural production constraints and agricultural marketing challenges are addressed in a better way if they are explained using the words of the farm operators and other stakeholders. In relation to the agricultural production at the regional level, critical reviews of secondary sources, mainly from the Central Statistics Agency of Ethiopia and BoARD of the region were carried out. On the other hand, quantitative techniques are applied to variables such as the determinants of households' farm, off-farm labour participation and off-farm income.

It is imperative to state the epistemological considerations about the acceptable knowledge in a discipline (Bryman, 2004, p. 11; Bryman, 2008, p. 13) or to identify the rules used for discovering what exists (O'Leary, 2010, p. 5). O'Leary adds that there are many and competing philosophical positions to understand our world and they influence the research processes. The Positivist framework is one of the competing philosophical positions. Positivism is a rejection of metaphysics and finding truth through empirical means (Henning et al., 2004, p. 17) and it is the epistemological position that utilizes the methods of the natural sciences to study social reality (Bryman, 2008, p. 13). On the other hand, interpretivism is an alternative to the positivist orthodoxy and it

acknowledges that there is a difference between people and objects of natural sciences which requires the social scientist to understand the subjective meaning of social action (Bryman, 2008, p. 16).

As stated above, a mixed methods research design is one in which both qualitative and quantitative techniques are used in a single study. Researchers who used mixed research methods employ philosophical and methodological pragmatism (Onwuegbuzie, & Johnson, 2006, p. 54). For pragmatism, all human inquiry was related to experience and experience was active rather than passive and science opened new areas of experience for investigation (Heelan, & Schulkin, 1998, p. 272).

4.4 DATA SOURCES

The sources of data for the research are both primary and secondary sources. The major primary sources of data are structured questionnaires, focus group discussions and interviews as detailed below.

Structured survey questionnaire

Questionnaires were developed for responses fromthe selected rural household heads at the *Kushet* level (Appendix 1). The questionnaire was translated into the local language (*Tigrigna*). The questions were related to the agricultural production and marketing challenges, determinant factors for off-farm work and farm and off-farm income. The structured survey questionnaires were administered with the support of experienced research assistants. Each of the questions in the questionnaire was discussed with the research assistants before the field survey was started.

Focus group discussions

At the *tabia*[3] level, focus group discussions were conducted with the selected rural households (Appendix 2). The focus group participants were selected purposely based on

[3]Local administration which is lower than district and consisting many *Kushets* (villages) under it

their knowledge and experience of the topic. This session included participants at the *tabia* level such as *tabia* administrators, elders, youth association leaders, rural trade and industry experts, credit and saving institute officers, micro enterprise owners and women's association leaders. At the *tabia* level, three sets of focus group participants were involved. The plan was to take four groups of focus group participants from all *tabias* included in the study. However, because of the repetition of the information, two groups from Kilte Awlalo and one group from Ganta Afeshum district were utilized. In each of the sessions, eight to ten relevant individuals were included. Interviewees were not willing to be tape recorded due to the sensitivity of the topic. Hence, the reflections of farmers in the focus group discussion and interviews were captured by taking notes.

Interviews

At the *tabia* level, separate interviews with the extension agents were conducted. Taking two *tabias* from each selected district, the crop, irrigation, livestock and natural resource experts were interviewed (Appendix 3). Moreover, key informants from the regional bureau of agricultural and district level agricultural experts were interviewed (Appendix 4). The interviews were carried out after the preliminary results of the structured questionnaires. This arrangement helped the researcher to include more questions that needed further explanation.

Document analysis

In order to critically review the agricultural production at the regional level, secondary data sources were consulted. The Central Statistics Agency (CSA) documents were the main sources for reviewing agricultural production in Tigray. In addition, different publications and source documents such as rural development plans, regional development strategic plans and federal government documents were considered. Agricultural Development-Led Industrialization strategy (ADLI), Growth and Transformation Plans (GTP) of the federal and regional, Ministry of Agriculture and Rural Development, Bureau of Finance and Economic Development of Tigray, as well as Agricultural Marketing Support Agency were some of the relevant secondary sources institutions. Internet and previous studies worldwide and other relevant documents were

also used as secondary sources.

4.5. MODELS AND OPERATIONALIZATION OF VARIABLES

Econometric models

The econometric models that were used in this research are based on the scientific requirements of the variables (dependent and explanatory) that are considered and models used by other researchers with similar topics. It is worth considering the methods and models used by other researchers for comparing results of the researches.

Econometric model of farm income

The factors affecting agricultural production are expected to affect the total agricultural income of farm operators. For the sake of details, additional functional form for crop income is also specified.

In analysing the total farm income (farminco) and crop income (cropinco) the Ordinary Least Squares (OLS) is used. The livestock income (estimated value of livestock) is included in the total farm income model. The justification for using OLS model is that total farm and crop income are continuous dependent variables and they are expected to take a non-zero value for all farm households (Endale, 2011, p. 35).

Accordingly, the following regression model is specified:

$Y= \beta_0+ \beta_1x_1+ \beta_2x_2+ \beta_3x_3+ \text{-----} + \beta_kx_{k+} \varepsilon$----------(1)

$y = X' \beta + \varepsilon$

Where:

y= is the dependent variable;

X= vector of explanatory variables;

β= the parameter to be estimated;

ε= the error term.

Then, the functional notation of the dependent and independent variables is:

$farminco = \beta_0 + \beta_1 lansize + \beta_2 age + \beta_3 age^2 + \beta_4 gender + \beta_5 eduhead + \beta_6 famsize + \beta_7 oxen + \beta_8 ferti + \beta_9 seed + \beta_{10} irri + \beta_{11} cred + \beta_{12} extagent + \beta_{13} landfert + \beta_{14} rain + \beta_{15} disaverage + \beta_{16} zerograz + \varepsilon$

$cropinco = \beta_0 + \beta_1 lansize + \beta_2 age + \beta_3 age^2 + \beta_4 gender + \beta_5 eduhead + \beta_6 famsize + \beta_7 oxen + \beta_8 ferti + \beta_9 seed + \beta_{10} irri + \beta_{11} cred + \beta_{12} extagent + \beta_{13} landfert + \beta_{14} rain + \beta_{15} disaverage + \beta_{16} zerograz + \varepsilon$

The descriptions of dependent and independent variables that are used in the above functional notation are stated below.

Dependent variables

Household crop income (prodbirr)

Crop income is the total value of crops produced in the production year of 2011/12 (2004 E.C.[4]).

Household farm income (farminco)

Farm income is the total value of crops and livestock in the year 2011/12 (2004 E.C.).

Independent variables

Land holding size (totalland)

This variable is measured in terms of hectares. It is also hypothesized that the larger the land holding size (own and rented cultivated land) of the farm household, the higher the volume of production and farm income.

Age of the household head (age)

This variable is a proxy for experience of farm households. The variable age is associated

[4]Ethiopian Calendar

with the learning process of households in handling their overall agricultural practices. It is expected to influence farm income positively as long as farmers are in the active age range.

Gender (gender)

In Ethiopia, the contribution of both women and men to the productivity of agriculture is vital. But the opportunities are relatively skewed towards men compared to female household heads. According to Endale (2011, p. 24) gender bias towards access to land and education for men is the cause of poor performance of women in agriculture. Hence, it is hypothesized that male household heads are expected to produce more and get better agricultural income compared to female household heads. Gender is a dummy variable 1 if the household head is male and 0 otherwise.

Educational status of the head (educlevel)

Educated households are expected to have better exposure to information that enhances agricultural production. They are also expected to be innovators in accepting new waysof doing things. This variable is measured in terms of the number of years of schooling thatis expected to have a positive impact on agricultural production and hence income.

Family size (adultequiva)

Family members of the household (adult equivalent)[5] are a potential source of labour in the agricultural sector. Households with many family members will have the chance to diversify their agricultural activities and rent the land of others. Hence, it is hypothesised that the larger the number of members of the family who are engaged in agricultural activities, the greater the income from agriculture will be.

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[5]OECD-modified scale which assigns the value of:

For the household head =1

Everybody else aged more than 14 =0.5

Every child less than 14 =0.3

Oxen (oxenown)

These are the key assets in the rural areas of the country. A household needs two oxen to plough a plot. For smooth management and timeous cultivation of land, a household needs a pair of oxen. Agricultural production is directly influenced by the ownership of oxen. It is, therefore, hypothesised that the larger the number of oxen the household has, the more the income from agriculture will be.

Technologies

According to Negatu (2006, p. 153), in Ethiopian agriculture, biological and chemical technologies are the most promoted technologies. The widely used technologies by farm operators in Ethiopia are fertilizer(fertitotal), improved seeds(imprseed) and irrigation(irriown) technologies. The variables fertilizer (fertitotal) and irrigation (irriown) are continuous variables measured in terms of kg/*Tsimad* and in hectares respectively. The remaining variable (imprseed)will take a dummy variable that is 1for households using improved seed and 0 otherwise. Moreover, it is hypothesized that agricultural production is positively influenced by the application of each of these technologies. These variables are also proxy variables for the availability of fodder which enhances the income of farm operators from their livestock income.

Access to credit (amountborro)

Capital is the scarcest asset in the developing countries in general and rural areas in particular. There is a need for money to adopt new technologies such as yield increasing inputs. In line with this, Ellis (1992, p. 128) stated that input delivery should be combined with credit provision in order to reduce the working capital constraints to adopting new inputs forfarm households. In Tigray region, Dedebit Credit and Saving Institution (DECSI) provides the microfinance accessible to farmers in the rural areas. Farmers may also get "in-kind" loans such as fertilizers and improved seeds from the farmers' cooperatives in their communities. Thus, this variable is measured in terms of the Ethiopian currency (Birr) that the household took in the production year. It is hypothesized that the availability of rural credit is expected to increase agricultural production and income.

Visits by the extension agents (contactmonth)

Farmers need to possess agriculture related knowledge and information to increase agricultural production. One of the means for this is through the advice provided to farmers by extension agents. This variable takes the average number of contacts of the household head with the extension agents per month in the production year.

Distance to the nearest market (villawerema)

This is one of the indicators of how easily the farm households are able to access the nearest market. This variable is measured in terms of the distance (in kilometres) of the *tabia* from the nearest market. The shorter the distance to the nearest market, the higher the income from the agricultural produce should be.

Environmental factors

According Odulaja and Kiros (1996, p. 87), the environmental factors include rainfall, soil type, humidity, temperature, erosion and vegetation which are location specific. In this study, land fertility (overall) and rainfall (enoughrain) are used to represent the environmental factors. The variable land fertility is measured as 1 if the overall land the household possessed is fertile and 0 if it is of poor fertility. Farmers who have many plots of land gave the overall fertility of their land. Likewise, the rainfall variable is 1 if rainfall is optimal and 0 if it is low for that specific year.

Zero-grazing (zerograze)

This is a controlled grazing system where animals do not graze totally or have controlled grazing. It is expected to have a positive impact on the crop production and income. Zero-grazing is meant to reduce the environmental degradation and crop destroyed by livestock. The variable zerograze is measured as 1 if the village is practicing zero-grazing and 0 otherwise.

Average distance of plots (disaverage)

Farmers possess different plots of land in different locations. This variable is measured as average walking time (in minutes) of all plots from farmers' dwelling houses. It is

hypothesised that the shorter the average walking minutes, the better the farm and crop income.

Crop rotation (croprotation)

Crop rotation is a method of growing different crops in the same plot overtime. Crops are rotated in order to maintain the productivity of land (Tulu, 2011, p. 57). Hence, farmers applying crop rotation are expected to get a higher farm and crop income. It is a dummy variable measure as 1 if the farmer applies crop rotation and 0 otherwise.

Off-farm participation model (Probit model)

The Probit model is categorized as the qualitative response regression model. It is a model used for binary responses where the response probability is the standard normal cumulative distribution function (Wooldridge, 2009, p. 844). It is used when the dependent variable assumes only two values.

In order to investigate the determinants of off-farm participation, there is a need to identify the major types of off-farm activities. These major off-farm employments are: agricultural wage, non-agricultural wage, self-employed and other income. All of the following explanatory variables are expected to relatively explain the variation in off-farm income in general. The interest of this study was to see the cumulative effect of these different components on the overall off-farm employment and off-farm income.

To see the determinant factors for the household to participate in the different off-farm activities, the Probit model was applied (Babatunde, & Qaim, 2009, p. 14). The Probit model is stated as follows:

$Pr(Y= 1/ X) = \phi (X' \beta)$ ----------(2)

Where:

Pr= denotes probability;

Y= a binary response variable with two possible outcomes (1 and 0);

X= vector of regressors (explanatory variables);

Φ= is the Cumulative Distribution Function (CDF) of the standard normal distribution;

β = the parameter to be estimated by maximum likelihood.

Probit model as a latent variable model is stated as follows:

$$Y^* = X'\beta + \varepsilon \text{----------(3)}$$

Where the $N(0, 1)$ and Y is an indicator for whether the latent variable (Y*) is positive as follows:

$$Y = \begin{cases} 1 \text{if } Y^* > 0 \\ 0 \text{ otherwise} \end{cases}$$

$$\text{Off-farm} = \beta_0 + \beta_1 age + \beta_2 age^2 + \beta_3 eduhead + \beta_4 gender + \beta_5 famsize + \beta_6 lansize + \beta_7 distown + \beta_8 cred + \beta_9 lansecu + \beta_{10} accinf + \beta_{11} elect + \varepsilon$$

$$\text{Off-farm} = \begin{cases} 1 & \text{if the household participated in off-farm employment} \\ 0 & \text{otherwise} \end{cases}$$

Off-farm employment income model

In computing the income of the household from the different types of off-farm income, the determinants of off-farm participation variables are applied. This approach is in line with similar studies on the participation of off-farm employment. The explanatory variables are applied again in the off-farm employment income. Because the variables that influence the probability of participation in off-farm employment are determining the income from that employment (Babatunde, & Qaim, 2009, p. 15).

According to Gujarati (2003, p. 616), a sample in which information for the dependent variable is available for some of the observation only is called a censored sample and the Tobit model is a censored regression model. Hence, the Tobit model censors or leaves out those who do not participate in off-farm activities. It assumes that the zero values associated with non-participation in off-farm activities are the results of a rational choice (Alene et al., 2007, p. 321). Hence, a Tobit model is used to measure the influence of each of the variables on the off-farm employment income (offtotalbirr). This model is

selected to accommodate the situation that some of the sampled farm households may not participate in off-farm employment. The equation of the Tobit model is specified as follows:

$y_i^* = \beta' X_i + \varepsilon_i, \varepsilon_i \quad N(0, \delta^2)$ ----------(4)

When the standard Tobit model is censored at 0, it is specified as follows:

$$Yi = \begin{cases} y^* & \text{if } y^* > 0 \\ 0 & \text{if } y^* \leq 0 \end{cases}$$

Where:

ε_i is the error term;

y_i^* is a latent variable that is observed for values greater than 0 and censored otherwise;

X_i are the explanatory variables;

β' is the vector of parameters to be estimated.

$$\text{offtotalbirr} = \beta_0 + \beta_1 age + \beta_2 age^2 + \beta_3 eduhead + \beta_4 gender + \beta_5 famsize + \beta_6 lansize + \beta_7 distown + \beta_8 cred + \beta_9 lansecu + \beta_{10} accinf + \beta_{11} elect + \varepsilon i$$

Based on the above functional notations, variables that affect the off-farmparticipation and off-farm income are described as follows:

Age (age)

The age of the household head may have a positive relation toparticipation in off-farm activities. However, the direct relation of age to off-farm participation is not without limits. In line with this, Alasia et al.(2008, p. 14) explained that more experience increases the relative employability of the operator but there comes a point when the individual may not be able to handle the tasks. This means that, as the household head ages, the chances to participate in off-farm activities will decrease.

Education (readwrite)

This variable is measured as 1 if the household head is able to read and write and 0 otherwise. Education is expected to have a positive effect on the participation of off-farm employment and income.

Gender (gender)

Taking our real context into consideration as a male dominated society, the decision and participation regarding off-farm employment is expected to have a gender perspective. Male headed households are expected to participate more in all types of off-farm activities compared to female headed households. Gender is a dummy variable which takes 1 if the household head is male and 0 otherwise.

Family size (adultequiva)

The family size (adult equivalent) is expected to have a positive relationshipwith the off-farm participation. This is because households with large families will have an excess of labour so that some of the family members will have the chance to participate in off-farm activities.

Total irrigated land size (irritotal)

Total irrigated land includes both owned and rented land for the household under consideration. If the irrigated land holding size (ha) of the household is relatively large, the on-farm labour requirement will be high. Hence, irrigated land holding size of the household will have a negative relationship to off-farm employment. On the other hand, if the reason for off-farm participation is the pull factor, it is expected to have a positive relationship. Many researchers take the landholding size as a variable. However, total size of irrigable land is believed to be a more relevant variable because of the intensification and repeated harvests.

Distance to the district town (villawerema)

This variable is expected to have a negative impact on off-farm participation and off-farm income because, if the district town is far (km) from the village, the participation of farm households is expected to decrease.

Electricity (elecaccess)

Access for electricity in the area or a nearby area may encourage small businesses and

other non-agricultural activities in the area. As a result, it is expected to positively stimulate off-farm participation and off-farm income. It takes a dummy variable which is 1 if there is access to electricity and 0 otherwise.

Access to formal credit (amountborro)

Credit helps farm operators to improve the productivity of their land. It gives them access to farm inputs to benefit more from their land. This variable is negatively related to off-farm participation and off-farm income. Therefore, farmers engage in off-farm activities to fulfil the cash requirement of the household when there is no credit access. Access to credit is measure in terms of money borrowed by the household head.

Land ownership security (fearconfisca)

In Ethiopia, all the land is owned by the government. In the Constitution of the nation, it is clearly stated that "government has the duty to hold, on behalf of the people, land and other natural resources and to deploy them for their common benefit and development" (FDRE, 1995, p. 132). But farm operators have the right to use land, lease it for a specified period of time and legally transfer it to family members. Households may feel insecure when they are away from their localities for a long period for off-farm employment. Their fear that their land could be annexed and redistributed to other landless farmers is real. Land ownership security is a dummy variable which takes 1 if the household heads perceive that they are secure to work away from their localities for a long period of time and 0 otherwise. Thus, the more the household heads perceive security, the more the likelihood of participation in non-farm employment.

Access to information (radioposse)

Information technologies serve as decision support instruments for farmers to make sound decisions (Sassenrath et al., 2008, p. 292).The proxy variable for access to information is the possession of a radio. A radio is the best means of communication as it is affordable by farm operators and boosts the awareness of farmers concerning different livelihood alternatives. It is a dummy variable, 1if the household possesses a radio and 0 otherwise.

4.6 SAMPLING DESIGN AND SAMPLING METHODS

One of the seven Zones of Tigray regional state, Eastern Zone, is the focus of this research. There are many reasons why Tigray national regional state and Eastern Zone are selected for the study. The most important reason is that this region is one of the older human settlements in Ethiopian history. Thus, its land is highly fragmented and degraded compared to the other regional states of the country. This region is, therefore, in need of research findings concerning issues of agricultural production and related issues of marketing and off-farm employment that might contribute to improving the income of these farm operators.

In the selection of rural household respondents, a multistage sampling technique was used. What makes the sampling technique a multistage is that, firstly, one of the seven Zones was selected. Then, from all the districts in the Zone, two districts and three *tabias* from each district were selected. Finally, using systematic random sampling, respondents were selected from the list of farmers of each village found in the *tabia*. Therefore, Eastern Zone is one of the seven administrative Zones of the region. It has seven rural and two town districts locally known as *wereda*. These rural districts are: Gulo Meheda, Erob, Saesi Tsadamba, Ganta Afeshum, Hawuzen, Kilte Awlalo and Atsbi Wonberta. Based on the lottery method, two districts, namely, Kilte Awlalo and Ganta Afeshum were selected. These districts have around 50,036 households of which 27,049 households were in Kilte Awlalo and 22,987 in Ganta Afeshum. Further, based on the lottery method, three *tabias* from each district were selected. These selected *tabias* are Gola Genahti, Sasun Bethariat, Buket,Adiksanded, Genfel and Mesanu.

The unit of analysis of this study was, therefore, the rural household heads from these selected *tabias* of the two districts. To check the validity of the questionnaire, a pilot study was conducted in February 2013 on a convenience sample of 20 farmers from each of the two districts. As the result of the pilot, some relevant questions that were previously overlooked were included in the questionnaire. Even though researchers have confidence in what they are doing, the importance of the pilot study cannot be ignored

(Blaxter, Hughes, &Tight, 2006, p. 137). The questionnaire was designed based on themes such as major agricultural production, marketing and off-farm employment variables. The questionnaire was prepared based on the specific objectives of the study as a theme. The respondents were selected using systematic random sampling from the list of household heads in each of the *tabia* Administration offices. The farm household heads at the *tabia* level are listed by sub-sections of *Kushets* (villages) from which the respondents were selected (for the details see Appendix5). Probability sampling is an essential aspect of statistical methods and econometric models to allow the researcher to make some generalizations about the population from which the sample is taken.

Once the population size of each *tabia* and village was known, the next move was to determine the sample size for the survey. Hence, the sample size was determined using the following formula (Bartlett, Kotrlik, & Higgins, 2001, p. 47):

$$n_1 = \frac{(t)^2 * (p)(q)}{(d)^2}$$

$$= \frac{(1.96)^2 * (0.5)(0.5)}{(0.05)^2}$$

$$= \mathbf{384}$$

Where:

t= value for selected alpha level of 0.05 is to be 1.96;

p= expected proportion. According to Macfarlane in Naing, Winn and Rusli (2006, p. 10) if there is doubt about the value of p, it is best to error towards 50% as it would lead to a larger sample size;

q= 1-p;

d= acceptable margin of error.

The above sample determination formula is valid if the calculated sample sizeis smaller than or equal to 5% of the population size (Daniel in Naing et al., 2006, p. 13). Daniel

further stated that if this proportion is larger than 5 per cent, there is a need to use the formula with finite population correction[6]. In this case, the above formula is valid because the sample size computed (n_1=384) is less than 5 per cent of the population size (8640*0.05=432). Hence, since the sample size is less than 5 per cent of the population size, there is no a need to apply the finite population correction formula.

To finalize the correct sample size there is a need to anticipate the return rate of the questionnaire and the completeness of the information. Response rate is assumed to be 96% and the final sample size (n_2) is computed as follows:

Assumed response rate=0.96

n_2= sample size adjusted for response rate

Hence, **n_2= 384/0.96 = 400**.

Based on the result of the above formula, to collect the survey data, questionnaires for 400 rural household heads were distributed. This was done after the questionnaire was translated into the local language, Tigrigna. The duration for data collection was from April to May, 2013. The actual response rate was 100 per cent though it was expected to be 96 per cent as indicated above.

[6] **$n_2= n_1/(1+n_1/population)$**

Table 4.1: Number of sampled households from each *tabia*

No.	District	*Tabia*	Total household(*)	Number of sample households (**)
1		Genfel	1634	76
2	Kilte Awlalo	Adiksanded	2221	103
3		Mesanu	1463	67
4		Sasun Bethariat	1160	54
5	Ganta Afeshum	Gola Genahti	1181	55
6		Buket	981	45
	Total households		**8640**	**400**

Source:

*List of household heads from each of the selected *tabias* (2012/13).

**sample size proportionately computed from the given total households of each *tabia.*

4.7 DATA PROCESSING AND ANALYSIS

In the analysis of data, descriptive statistics such as averages, percentages in the form of tables and graphs were used. Questionnaire results were also supplemented by the focus group and key informant results. Thus, responses to the questionnaire survey were entered into STATA Software for analysis. In the analysis of the collected data, descriptive statistics and econometric models were employed. In order to determine the influence of independent variables on the dependent variables, multiple regression, Probit and Tobit models were used. The responses from focus group discussants and interviews of key informants were analysed qualitatively.

4.8 ISSUES OF VALIDITY AND RELIABILITY

In the research process, the issues of validity and reliability were critically addressed. Validity is about the appropriateness of the indicator to measure the intended concept (Bryman, 2008, p. 151). It considers the relevance of the methods, approaches and

techniques employed to address the issues of interest (Blaxter et al., 2008, p. 221; O'Leary, 2010, p. 43). In order to ensure the validity of the research findings, the purposes of the research were properly communicated to the respondents. They were told that it was for academic purposes and their responses should not be linked to any assistance or direct benefits. The confidentiality assurance is also a means to get valid information from the respondents without any fear of identification. The pilot study was conducted to ensure the validity of all questions in the questionnaire. Finally, the test of all assumptions of the models used and the appropriateness of these models are some of the attempts to ensure the validity of the results.

On the other hand, reliability is the consistency of a measure of concept and results under repeated trials (Bryman, 2008, p. 149; O'Leary, 2010, p. 43). Personal administration of the focus group discussions and in-depth interviews were done with the intention of ensuring the reliability of the study. The researcher took time to engage without missing the essence of the questions in the questionnaire. During the rainy season, farmers are too busy to spare their time as respondents. Hence, the time for the survey was arranged to be before June for the convenience of the respondents.

4.9 CONCLUSION

This chapter addressed the research design and methodology used in the study. The research was carried out in the two districts of the National Regional State of Tigray. Based on a sample determination formula, a sample size of 400 household heads was selected for the survey. In order to check the validity of the questions in the questionnaire, a pilot study was conducted in these districts. The data collected through questionnaires was entered and analysed using STATA software. This software was used to generate the results of Ordinary Least Square (OLS), Probit and Tobit models employed in the study. The in-depth interviews and focus group discussions were also used and the responses were analysed qualitatively. Finally, the secondary sources related to agricultural production in Tigray were critically assessed qualitatively. The presentation and discussion of results are presented in the next chapter.

CHAPTER 5: RESULTS AND DISCUSSION

5.1 INTRODUCTION

This chapter presents the results and discussion of the factors that affect agricultural production in Tigray region, Northern Ethiopia. In addition, the socio-economic characteristics of respondents, the major factors affecting farm production and farm income of farmers are analysed. Agricultural production and income influencing factors such as land size and irrigation, utilization of inputs, crop rotation and intercropping, credit availability, soil quality, rainfall conditions and extension agents' support are presented and discussed.

Furthermore, agricultural production and income were found to be influenced by access to markets and off-farm participation of the farmers. With regards to agricultural marketing aspects such as distance to the district and the regional market, the sources of market information and the role of farmers' cooperatives are examined in this section. Above all, it is assumed that the involvement of farmers in non-farm activities supplement the income from the agricultural sector. Hence, the factors that affect farmers' off-farm participation and the income generated from it are part of this discussion. Finally, the secondary sources dealing with the conditions of agricultural production in the national regional state of Tigray are critically reviewed. Based on the nature of the data, a qualitative and quantitative presentation and analysis are presented.

5.2 SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

The biographic data as well as the socio-economic characteristics sub-section included the age, gender, family size and education levels of respondents in the survey study. The results are discussed in relation to the context at the regional level as indicated below.

The majority of the respondents were in the age range of 45 and 56 years (Table 5.1). The majority of the farmers were in the active working age category. Gender wise, the majority of the female farmers were in the age range of 33 to 44 years. The age of the farmer was also taken as a proxy variable for his/her experience in the sector.

Table 5.1: Age and gender of respondents

Age group	Gender		Total
	Male	Female	
21-32	5	10	15
33-44	63	41	104
45-56	117	37	154
57-68	78	14	92
69-80	25	3	28
81-92	6	1	7
Total	**294**	**106**	**400**

Source: Survey result, 2013

As indicated in Table 5.2, the mean age of household respondents was 51.It is known that land redistribution has been stopped since 1991. The landholding size of households was a strong justification for the government to stop further fragmenting of land. The frontier model which focuses on the expansion of the area to be cultivated when the need arises, is not feasible in the country. Hence, the fate of new couples in possessing land is through transfer from parents at the time of death or voluntary resettlement. This means that the average age of respondents (51.02 years) is therefore an indication that the majority of landholders got the land before 1991.

As shown in Table 5.2, the average family size was 6.21.In the agricultural sample survey 2011/12 conducted by the Central Statistics Agency of Ethiopia, the average family size of households in Tigray region was4.95 (CSA, 2012c, p. 13). The average family size of the sampled districts is substantially higher than the average family size at the regional level. In addition, out of the 400 respondents, 189 household heads were able

to read and write. This included religious, adult and formal education. The majority of respondents able to read and write were at grade three level with an average of 4.43 years of schooling.

The total of all family members in the sampled (N) households was 2484. From these, 154 household members were out of their *tabias* for different purposes. From these absent family members, 30%, 25% and 21% were in the urban centres within the *wereda*, in other regions and in Mekelle which is the capital city of the region, respectively. Moreover, the major reasons for their absence were employment (36%) and education (32%).

Table 5.2:Average age, family size and education level of respondents

Variable	Number of respondents	Mean	Standard deviation	Minimum	Maximum
Age	400	51.02	12.52	21	87
Family size	400	6.21	2.35	1	12
Education level	189	4.43	2.63	1	12

Source: survey result, 2013

5.3 THE FACTORS AFFECTING AGRICULTURAL PRODUCTION AND THEIR IMPACT ON THE INCOME OF THE FARM HOUSEHOLDS

As indicated in Table 5.3, the average landholding size of respondents for Kilte Awlalo and Ganta Afeshum was 0.6 and0.43 hectares respectively. The landholding size of Ganta Afeshum *wereda* was smaller than that of Kilte Awlalo. In both districts, the landholding size was smaller than the regional average. At the regional level, the average landholding size of Tigray was 0.92 hectares per household (CSA, 2012c, p. 13). Land and land holding size is a critical factor for sustainable livelihood and asset accumulation in rural areas. However, this landholding size was too small to sustain the life of farm operators in the area. This was exacerbated by the large family size of households in the area. This

view is supported by researchers who conducted their research at the regional and national level. For instance, Gebreselassie (2006, p. 43) stated that, based on the existing level of productivity and price structure, the average grain producer needs 2.8 hectares of land to lead a life above the poverty line. In the same argument, studies conducted in rural areas of Ethiopia revealed that, for each additional hectare of land cultivated, food security increased on average by 32 per cent (Kiros, 2005, p. 182).

Table 5.3: The average owned and rented land by district

	Kilte Awlalo			**Ganta Afeshum**			**Bothdistricts**	
Results	Own land	Rented land	**Own &rented**	Own Land	Rented Land	**Own & rented**	**Own**	**Rented**
Respondents	246	93	**246**	154	55	**154**	**400**	**148**
Mean (land size)	0.6	0.5	**0.79**	0.43	0.31	**0.54**	**0.53**	**0.43**
Std.Dev.	0.29	0.24	**0.41**	0.25	0.18	**0.33**	**0.29**	**0.24**

Source: survey result, 2013

Farmers were asked to rate the slopes of each of their plots. The majority (71 per cent) of the farmers responded that the land they possessed was flat (Table 5.4). The numbers of farmers who cultivated on steep terrain were 15 per cent and this could expose the land to severe erosion. As indicated in the table above, 320 respondents possessed two plots. This means that 80 farm operators only had one plot. On the other hand, 40 (10%) farm operators owned five different plots. This does not indicate the inequality of land possession in the areas because the farmers with five plots may actually have possessed small and fragmented plots which are located in different areas. In the study conducted in the Amhara National Regional State, Bewket (2011, p. 60) found that fragmented landholding in various locations helped farmers to access plots having different moisture and fertility conditions. In addition, farmers who were renting land also owned more plots compared to farmers tilling their own land only.

The walking time to plots, from the farmers' residential units, ranged from 1to 180 minutes. Though there were only two respondents, they stated that they walked a single

trip of 3 hours and a round trip of 6 hours to reach some of their plots. The average single trip distance of all respondents was computed to be 24.5 minutes. The average round trip was therefore 49 minutes. The average walking distance to plots in the study area was higher than the findings of other researchers. For instance, Gebremedhin et al. (2009, p. 778) found that the average plot distance from homesteads in the three districts of Somalia region was 18.22 minutes.

Farmers were asked about the soil quality of their land. Hence, 120 (49%) from Kilte Awlalo and 66(43%) of respondents from Ganta Afeshum districts stated that their land was classified as infertile. Almost half (47%) of the respondents in both districts possessed infertile land. In the rural areas, the nutrients enhancing practice of fallowing was almost abandoned. In all seasons, no land was kept idle and the soil quality was deteriorating with time.

Table 5.4: The slopes of each plot possessed by the respondents

Plots	**Slopes**			**Respondents**
	Flat	Medium	Steep	
Plot 1	312	45	43	400
Plot 2	213	60	47	320
Plot 3	123	32	41	196
Plot 4	76	6	17	99
Plot 5	25	7	8	40
Total plots	**749**	**150**	**156**	**1055**

Source: survey result, 2013

In a highly fragmented land, irrigation increases the intensity of agricultural production and more than one harvest per year maybe possible. Of all the respondents, 25% of the respondents irrigated their own land (Table 5.5). The average own irrigated land and total farm land (own and rented-in) was 0.18 and 0.21hectares respectively. The ratio of irrigated land to total land was 0.11. The proportion of irrigated land to the total landholding size of farmers (11 per cent) was small. The proportion of irrigated land in

the study districts was slightly lower than the regional average. At the regional level, 11.27 per cent of the total cultivated land was irrigated (BoARD, 2012b, p. 31). The practice of irrigation in Ethiopia has a long way to go to bring about the desired change in agricultural production (CSA, 2011a, p. 12).

Table 5.5: Irrigated land (own and rented) in hectares

Irrigated land	Respondents	Per cent	Mean (hectares)	Standard deviation
Own land	101	68	0.18	0.15
Rented land	19	13	0.21	0.12
Own & rented land	28	19	0.37	0.24
All irrigators	**148**	**100**	**0.24**	**0.29**
Irrigated to total land ratio	**400**	**100**	**0.11**	**0.28**

Source: survey result, 2013

In the study areas, check dams, river diversion and private wells were identified to be the dominant source of water for irrigation (Table 5.6). In the Eastern Zone of Tigray as a whole, 1,853 hectares of land was irrigated using all sources of water in the area (CSA, 2011a, p. 29). At the regional level, the CSA of Ethiopia reported that river diversion was the source of water for 68 per cent of the irrigated land in Tigray (CSA, 2013a, p. 325). The same source indicated that river diversion was the dominant source of water for smallholder farmers. The major problem of river diversion as a source of water for irrigation is that most of the rivers are non-perennial rivers. They do not flow throughout the year which hinders farmers from obtaining a continuous benefit from irrigation.

With respect to irrigation, respondents stated the existence of major problems. They reported rampant pest problems. There was no supply of chemicals to control crop disease. Farmers were, therefore, forced to grow maize which was less profitable and less susceptible to disease than vegetables. There was a scarcity of water for irrigation as some of the water points dried up in the dry season and there was wastage of water

through broken water canals. To reduce the impact of water scarcity on crops, *tabias* introduced a water rationing scheme. However, this scheme was not effective as there was no planned and programmed allocation of water to irrigators.

Some farmers mentioned that they were obliged to wait up to 45 days to get water for their crops. There was also theft of cash crops and the inclination of all farmers to grow the same crop which led to a reduction of the selling price of agricultural products. The fuel price for the water pumps was high and there was insufficient supply of fuel in the *tabia* and the *wereda*. Sometimes, farmers went to Mekelle, the capital city of the region, to get fuel for their water pumps. Besides, farmers stated that if they did not take fertilizer in the rainy season, they would not be allowed to get water for irrigation. As a precondition, they purchased the amount of fertilizer determined by the administrators and extension agents.

Table 5.6: Mean irrigated land (ha.) and water source of respondents

Water source	**Respondents**	**Mean (hectares)**	**Standard Deviation**
Check dams	50	0.30	0.42
River diversion	48	0.21	0.22
Communal wells	11	0.26	0.17
Private wells	26	0.17	0.13
Spring	4	0.06	0.07
Check dams &river diversion	8	0.38	0.15
River diversion & communal wells	1	0.06	-
Total	**148**	**0.24**	**0.29**

Source: survey result, 2013

The survey result indicated that 379 (94.75 per cent) of the respondents applied chemical fertilizer and the remaining 21 (5.25 per cent) did not use chemical inputs (Table 5.7).In the region, the standard amount of chemical fertilizer (DAP and Urea) application is 200 kilograms per hectare or 50 kilograms per *Tsimad* for all type of crops, soil types and

agro-ecologies. The majority (59.63 percent) of the respondents did not fulfil the benchmark set by the region. On the average, they applied 26.45kgs per *Tsimad* chemical fertilizers. This is almost half of the standard set by the agricultural bureau of the region. In addition, the mean (38.39 kg/*Tsimad*) fertilizer application of all respondents was also lower than the standard stated above.

Table 5.7: The number of fertilizer users and intensity of fertilizer application

Kg/Tsimad	Respondents	Percentage	Mean (kg)	Std.Dev.
5-49kgs	226	59.63	26.45	6.25
≥50kgs	153	40.37	56.05	16.23
Total	379	100	38.39	18.45

Source: survey result, 2013

Focus group discussants revealed that farmers applied fertilizer in order to reduce poverty and improve their livelihoods. Farmers shared the experience of other successful farmers through field visits. By observing the benefits of these farmers, it was evident that they applied fertilizer to enhance the productivity of their land. They further said that there was an attempt at the *wereda* and *tabia* level to change the mind set and attitude of farmers towards fertilizer application. However, some of the farmers stated that they were frequently contacted and forced by the *tabia* administrators and extension agents to use chemical fertilizer. Then, they promised to purchase a certain amount of the input to avoid the possible confrontations with the *tabia* administrators and extension agents. In Ethiopia, the main focus of the extension agents is on delivery of inputs such as chemical fertilizers and improved seeds (Ragasa et al., 2013, p. 461).

The extension agents and administrators were not interested in farmers' use of natural fertilizers such as compost and animal dung. The farmers who did not take chemical fertilizers because they wanted to use natural fertilizers were considered defiant. The report of BoARD (2011, p. 14) stated that it is against technology for farmers to believe that compost can be a substitute for chemical fertilizers. Yet, the finding of a study conducted in Tigray region showed many advantages of compost over chemical

fertilizers. According to Edwards et al. (2010, p. 46), soils treated with compost resists wilting for about two weeks longer compared to soils treated with chemical fertilizers. If the rain stops early, compost can get enough yields without applying new compost for up to four years.

The selling price of chemical fertilizer varied based on the location of the *weredas* and farmers' cooperatives. The distance and accessibility of the areas influenced the selling price of the inputs. Because the majority of the farmers in the study areas used chemical fertilizer below the stated benchmark (Table 5.8), the average total cost obtained from the respondents was consistent with the intensity of fertilizer application. On average, the selling price per quintal of fertilizer in the two districts was 1390.75 Birr. The average total cost from the respondents who applied chemical fertilizer was computed to be 1163.75 Birr. This indicated that the overall utilization of fertilizer by farm operators was less than a quintal. As the average landholding size (owned and rented) was 0.69 hectares, the minimum utilization and cost should have been 138 kg (200kg*0.69ha) and 1919.24 Birr respectively. Hence, the intensity of fertilizer application was somewhat lower than the standard set by the region. In combination with other related factors, this may be one of the factors which results in the reduction of agricultural production and productivity.

The fertilizer transaction caused tensions and disagreements between the farmers on one hand and the extension agents and administrators on the other. Extension agents and *tabia* administrators wanted to sell all of the chemical fertilizers which were sent to the area. They were interested in their performance report to the higher officials rather than attending to the real problems of the farm operators. It was common to hear from farmers that the use of chemical fertilizers was imposed on them. Moreover, farmers made their own risk analysis in terms of the cost and benefit of input utilization. In the highly uncertain future of rain-fed agriculture, households were afraid of losing their harvest while, at the same time, incurring additional fertilizer costs.

The distribution of fertilizer to farmers was carried out mainly in the months of May and July. These months were critical times for farmers to purchase inputs such as chemical fertilizers. According to the responses of focus group discussants from Ganta Afeshum district, there was a fertilizer selling arrangement called "70/30". This arrangement dictated that, from the total value of fertilizer supplied to the area, 70 per cent should be sold for cash and the remaining 30 per cent in the form of loans. If the *tabia* administrators believed the households were unable to afford direct cash payments, they would get the input in the form of loans. However, the overall loan of the *tabia* did not exceed the ceiling of 30 per cent. There was no visible justification for the loan ceiling because it is unrealistic to assume the proportion of farmers who could not afford a direct cash payment was30 per cent in all villages and *tabias*.

The Bureau of Agriculture and Rural Development of Tigray reports on the total numbers of Productive Safety Net Program (PSNP) beneficiaries and the total population size of the two districts but reports from the Bureau of Planning and Finance of Tigray region showed a different story. In 2011/12, the proportion of PSNP beneficiaries to the total farm population in Kilte Awlalo and Ganta Afeshum was 67.06[7] and 64.31[8] per cent respectively. These were the percentages of farmers unable to fill their annual food requirement. Assuming the households who are unable to make direct cash payment for chemical fertilizer to be 30 per cent, is unrealistic.

In its plan for the year 2012/13, the Bureau of Agriculture and Rural Development of the region revealed that the sales of chemical fertilizer, improved seeds and chemicals were intended to be fully paid for in cash (BoARD, 2012b, p. 5). As smallholders were highly cash constrained, in the absence of credit, it is highly likely that they would reduce or totally avoid the application of chemical fertilizers. Other studies also confirmed that if farmers did not have enough money, they would not use inputs. For instance, in the Sidama Zone of Ethiopia, 53 per cent of the farmers did not use chemical fertilizers

[7]79,220 PSNP beneficiaries/118,141 population

[8]64,818 PSNP beneficiaries/100,786 population

because they did not have the money for them (Moges, &Holden, 2007, p. 551). In the study conducted in Amhara region, Bewket (2011, p. 65) stated that farmers in Ethiopia were unable to use chemical fertilizers to restore the fertility of land because of the high cost of chemical fertilizers and the lack of government subsidies to make them affordable. Smallholders in Ethiopia facing scarcity of cash should be given access to credit in order to encourage them to use inputs and the input supply should be ensured (Gebremedhinet al., 2009, p. 775).

Table 5.8: The average cost per quintal and the average total cost of respondents on chemical fertilizer

Districts	**Cost**	**Respondents**	**Mean (Birr)**	**Std.Dev.**
Kilte Awlalo	Average cost/quintal	230	1404.66	801.14
	Average total cost	230	1246.97	755.71
Ganta Afeshum	Average cost/quintal	149	1369.29	161.31
	Average total cost	149	1035.25	504.67
Both districts	Average cost/quintal	379	1390.75	631.91
	Average total cost	379	1163.75	675.59

Source: survey result, 2013

As indicated in Table 5.9, the majority (60 percent) of the respondents did not use improved seeds. The average improved seed area of those farmers (40 per cent) was 0.38 hectares. The farmers were interested and motivated to use improved varieties such as wheat and potatoes but there was not enough improved seed supply for farmers to benefit from it. Most of the respondents stated that the improved seeds sent to the *tabias* could not satisfy even the demands of a single village. In our focus group discussion, respondents said that they were unable to get the improved variety of seeds. Previously, they had been supplied with a selected variety of potato from which they obtained a surprising yield. However, after a year, they were unable to get it. Even the administration and extension agents could not communicate with them in advance to keep seeds for them from the improved variety. If they were aware of this problem, they

could have used the exchange system within the farming community where farmers exchange seeds between themselves. But they sold all of their harvest and they could not get the improved variety again. Furthermore, farm operators said that they had requested the supply of tested varieties of potatoes called Jaloni and Gudena. Regardless of their interest and choice, they could not get these improved varieties. They said that they did not understand the reason why their requests were not met. Li et al. (2010, p. 468) also found that if farmers obtained satisfactory yields from improved seeds applied in previous years, the future demand for new varieties is lower. They further stated that, in applying improved seeds, farmers were more concerned about their own selection and practical production experience rather than government and expert advice.

Table 5.9: Improved seed utilizationand average improved seed area (ha) by districts

Improved seed utilization	**Kilte Awlalo**			**Ganta Afeshum**			**Both districts**		
	No	**Yes**	**Total**	**No**	**Yes**	**Total**	**No**	**Yes**	**Total**
Respondents	140	106	246	99	55	154	239	161	400
Per cent	57	43	100	64	36	100	60	40	100
Mean (ha)	-	0.43	106	-	0.28	55	-	0.38	161
Std.Dev.	-	0.32	106	-	0.18	55	-	0.29	161

Source: survey result, 2013

The dissatisfaction of farmers with the supply of improved seeds is relevant when we look at the report from the Bureau of Agriculture and Rural Development of the Tigray region. This report indicated that the plan of the region in the 2011/12 production year was to supply a selected seed (vegetable) of 13,303 quintals whereas the demand of all districts was 310,323 quintals (BoARD, 2012a, p. 40). The supply planned by the region was justfour per cent of the demand from all districts. Furthermore, Bishaw, Struik and Van Gastel (2010, p. 283) observed that the improved seed supply for all crops from the formal sector in Ethiopia was only five per cent.

The paradox is that farmers were forced to apply chemical fertilizer by the administrators and extension agents without receiving a supply of the responsive variety of improved

seeds. The application of fertilizer would only have the required results if the fertility of land and responsive variety of seeds were used. Respondents stated that, if supplied, the improved seeds of potato provided a satisfactory yield and it was economically sound to apply fertilizer for them.

The majority of the respondents stated that the fear of exclusion from the productive safety net program was the main reason for farmers to utilize the inputs (Table5.10). Those farmers who purchased the inputs unwillingly or for fear of losing public benefits were forced to sell them in the market place even though selling inorganic fertilizer was forbidden and farmers who were engaged in this practice would be punished. The selling price of fertilizer in the secondary market was much lower than the original price from the cooperatives.. The farmers were interested using improved seeds. However, they did not get the seed they requested and were forced to use seeds they were not interested in.

When the farmers were asked why they did not use chemical fertilizer, the majority (81 per cent) identified the selling price of the input as being high and beyond their capacity. Besides, it would also be more risky and costly when there was little rain. Other farmers used animal dung and compost instead of inorganic fertilizers.

Table 5.10: Reasons for applying chemical fertilizers and improved seed

Reasons	Respondents	Per cent
Not applied	21	5.25
Increase productivity of land	128	32.00
Fear of denial of credit opportunities	38	9.50
Fear of safety net exclusion	137	34.25
Fear of irrigation scheme exclusion	34	8.50
Land productivity & fear denial of credit opportunities	11	2.75
Land productivity & fear of safety net exclusion	12	3.00
Land productivity & fear of irrigation scheme exclusion	13	3.25
Fear of denial of credit & safety net exclusion	2	0.50
Fear of safety net exclusion & irrigation schemes	1	0.25
Forced purchase	3	0.75
Total	**400**	**100**

Source: survey result, 2013

The annual average crop production of the respondents was 8.73 quintals per household. The average production per capita was 1.59 quintals (Table 5.11). The per capita share would be reduced when the grain crops used for different purposes such as seed, sales, wages in kind, animal feed and others. The average production and average production per person results do not fulfil the standard food requirements of the respondents. According to Desalegn (2009, p. 40), on the basis of a minimum daily requirement of 2400 calories per person, a standard accepted by the FAO and WHO, a moderately healthy peasant family of five would have to consume 13 quintals of food grain annually. This standard food requirement is almost 2.6 quintals per year per person.

At the national level, a similar finding of average production per capita per annum for the rural area was obtained by Gudeta. After a 2.5 percent allowances for animal feed, 11 percent post-harvest loss and a 6 percent average requirement for seed, the average production per person per annum was 1.42, 1.13 and 1.06 quintals in the imperial, military and EPRDF regimes respectively (Gudeta, 2009, p. 6).

The extension agents stated that farmers were contributing to the reduction in agricultural production and productivity in the study areas. The farmers were focusing on the benefits obtained from the safety net and they provided insufficient care to the land they possessed. They further alleged that farmers lacked the interest to purchase pesticides and insecticides. This lack of interest was irrational as they would incur a cost of 100 Birr to save crops which were estimated to be worth 10,000-15,000 Birr. Furthermore, they considered controlling crop and livestock diseases as the sole responsibility of the government.

On the contrary, the focus group discussants demonstrated that there was not enough supply of insecticides and pesticides. The price of these chemicals was also beyond the capacity of farmers. The experts repeatedly told them that using chemicals to control crop diseases was dangerous as the chemicals destroyed the fertility of the land and bee colonies. As a solution, the extension agents advised them to control insects using traditional ways such as spraying the urine of cattle and mixed dung on their crops.

The negative consequences of insecticides and pesticides were widely known and documented (Desneux, Decourtye, & Delpuech, 2007, p. 82; Kibuka-Sebitosi, 2010, p. 730). These chemicals may enter into the food supply chain and lead to the contamination of ground water, and there is a negative impact on bee colonies and honey production as well. In this case, there is no ready-made solution to avoid the utilization of these chemicals. The effectiveness of urine and mixed dung was not scientifically tested and the extension agents use a "one-size-fits-all" approach. Crop diseases are different so they need different prescriptions rather than recommending the spraying of urine and mixed dung to all crop related problems. In addition, the highly promoted chemical fertilizers by extension agents are not without negative consequences on the environment (Desneuxet al., 2007, p. 82; Kibuka-Sebitosi, 2010, p. 730).

Table 5.11: Average annual crop production, estimated value and sells income

Production	Respondents	Mean	Std.Dev
Average production (quintals)	400	8.73	7.2
Average production/capita/year (quintals)	400	1.59	1.38
Average production/capita/day (quintals)	400	0.004	0.004
Average value of production(Birr)	400	6850.5	5640.81
Average sells income (Birr)	214	3187.81	4500.21

Source: survey result, 2013

The figure shows that differences in levels of education of farmers did not result in differences in volumes of crop production in the study area (Figure 5.1).This means the traditional farming systems do not appear to require a formal education. This might be the reason for the absence of a pattern of production variation among educated and illiterate farmers in the study area. Above all, the education level of the household heads used in the multiple regression results of crop income was also insignificant (p-value=0.851) as indicated by the model.

Findings of different researchers from various countries have shown the positive relationships between farmers' education levels and agricultural production. As Chowa et al. (2012, p. 8) clearly indicated, knowledge and information obtained through education enables farmers to adopt new technology, access inputs and properly market their agricultural products.

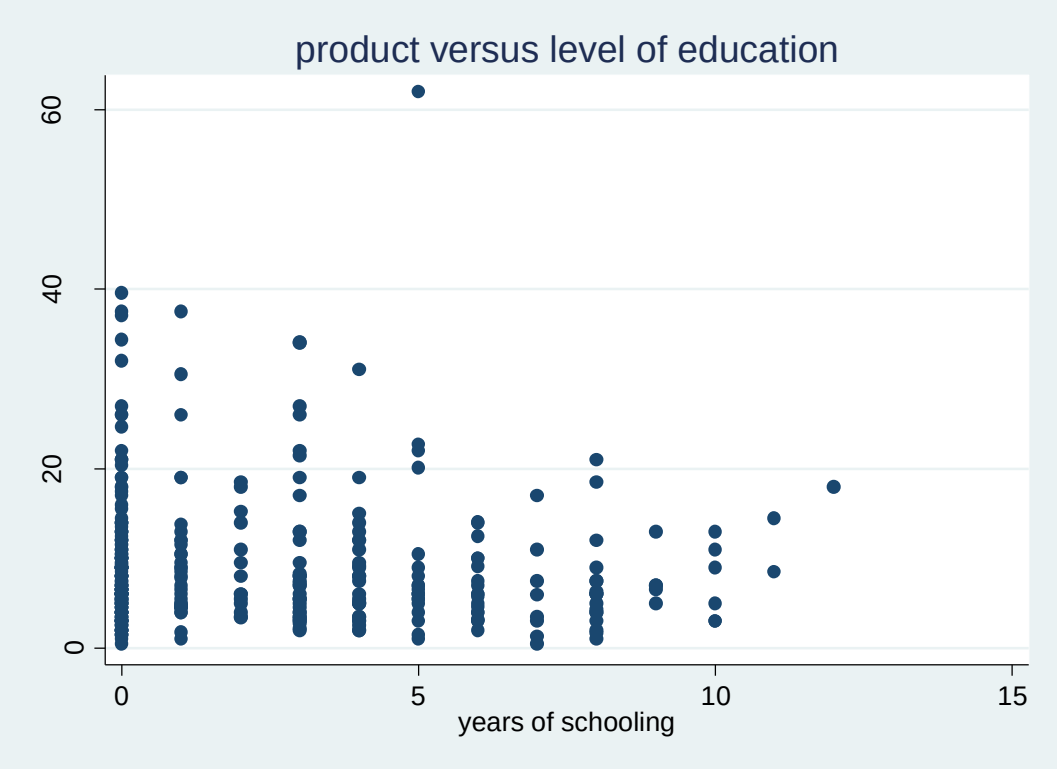

Figure 5.1: Agricultural production and educational level of respondents
Source: survey result, 2013

Table 5.12 below shows how the farm income of the farmers was computed. The average farm income (crop and livestock) of respondents was found to be 22,767.62 and 3936.50 Birr per household/year and per capita/year respectively. The average annual per capita farm income is smaller than the graduation benchmark of the Productive Safety Net Program. The PSNP graduation benchmark in Tigray is set to be 5600 Birr per capita per year. The value of productive assets such as crop production (irrigation and rainfed) and livestock including the bee colonies were the major assets in the process of computation for comparison.

Table 5.12: The average farm income (crop and livestock) of respondents per household, per capita and per capita per day

Farm income	Respondents	Mean	Std.Dev
Average farm income (Birr) per household	400	22,767.62	13,128.91
Average farm income (Birr) per capita per year	400	3936.50	2464.62
Average farm income (Birr) per capita per day	400	10.78	6.75

Source: survey result, 2013

Almost all respondents applied crop rotation (97.75 per cent) while only 25 per cent of the respondents applied intercropping (Table 5.13). The farmers were asked to state the types of crops that were succeeding one another in the process of crop rotation. In most of the responses, the crop rotation carried out was among cereal crops. The farmers' awareness of the importance of crop rotation was found to be shallow. Their justification for applying crop rotation was to protect crops from pests. It is true this is one of the advantages of crop rotation, however, they did not know the different root depth of crops for improving the soil structure and getting the required nutrients. They failed to mention that the best economic return from rotation could be achieved if legume crops were included because these crops increase the fertility of land by adding nitrogen to the land.

Table 5.13: The application of crop rotation and inter-cropping of respondents

	Responses	observations	Per cent
Crop rotation	Yes	391	97.75
	No	9	2.25
Inter-cropping	Yes	101	25.25
	No	299	74.75

Source: survey result, 2013

This is the very reason that they did not follow any scientific and defined order in the application of crop rotation. Crop rotation was also not on the agenda of extension agents. They were simply campaigning about the utilization of chemical fertilizers to fulfil their quotas and to please their superiors. Therefore, the extension agents did not

appear to have interest in advising farmers about increasing soil nitrogen availability that would lead to a reduction in the amount of nitrogen needed from the application of chemical fertilizer. Good crop rotation practices reduce losses of soil and water and serve to maintain or increase yield (Tulu, 2011, p. 57).

In addition to crop rotation, some farmers were observed to be practicing intercropping. Farmers stated that they frequently intercropped cereal crops and peppers. Most farmers also believed that intercropping was best suited to irrigation rather than rain-fed agriculture. The farmers who practiced intercropping were not supported by the advice of the extension agents. If farmers are to get the required benefits from intercropping, the support of extension agents is vital. For instance, Guvenc and Yildirim (2006, p. 31) were of the opinion that the varieties to be selected for intercropping needed to be complementary in the utilization of resources. This cannot be easily achieved without the support of professionals such as extension agents.

Zero-grazing is one of the practices in Tigray region that is believed to contribute to environmental restoration. Respondents were asked about the practice of zero-grazing in their *kushet* or *tabia*. The majority (84.75 per cent) responded positively that zero-grazing was practiced in their areas. They also mentioned many critical advantages in practicing zero-grazing. For instance, it enhanced the care for animals as well as protecting them from falling off the cliffs and hills that may cause damage and death. Similarly, zero-grazing reduced exposure to transmittable disease from other flocks. Moreover, as the animals would be in the compound, farmers benefitted from their dung as a source of organic fertilizer and compost. The practice of zero-grazing also resolved the conflict that had arisen among farm operators due to crop damage by animals.

The farmers further stated that zero-grazing controls land degradation and indigenous plants are restored. The terracing constructed to protect erosion was effective and the wastage of grass was reduced through the cut and carry approach. It was easy for the farmers to send their children to school and they were getting improved milk and meat production from their animals.

However, a few farmers stated that they did not get any benefits from zero-grazing. They were only practicing it because they were forced to do so. They believed zero-grazing was difficult to apply because it forced farmers to reduce the number of animals they possessed. The livestock population they possessed before the introduction of zero-grazing and after was incomparable. Other studies have supported the livestock population reduction as a result of zero-grazing. For instance, Demurger et al. (2010, p. 534) showed that the practices of preserving the forest and biodiversity of northern China led to a reduction of the size of goat herds and farmers shifted to chickens and ducks.

Some farmers said they did not apply the practice of zero-grazing in their communities. They mentioned different reasons for failing to implement it. There were many discussions for the sustainable implementation of zero-grazing in their communities. These farmers said the ordinary farmers were honest and committed to implementing it, however, the administrators tried to take advantage by sending their own animals to the grazing land. Because of this, the farmers violated the practice of zero-grazing. Others stated that there was not enough feed to keep animals in the compound and farmers had to travel more than an hour to fetch water for the animals which made the implementation of zero-grazing difficult.

The above discussions showed that most of the farmers appreciated the contribution of zero-grazing to protect the environment, crops and rangeland. There was an agreed regulation in almost all of the *tabias* considered in the study. The farmers who practiced free-grazing would be fined 50 Birr per animal. If the farmers violated for a second time, they would be taken to the *tabia* Social Court but, the enforcement mechanism of the punishment on violators was weak. The administrators of the *tabias* and their relatives were found to be above the regulation of zero-grazing.

Respondents were asked to state if they experienced any negative impacts from zero-grazing on the livestock population. Most of the respondents did not face any negative consequences of zero-grazing on their livestock population (Table 5.14). On the contrary,

some respondents stated that the negative impact of zero-grazing was the reduction of the livestock population. Some of the negative impacts mentioned by respondents were the shortage of feed and drinking water. Fetching water for animals was difficult as the water points were far from the dwelling units. Farmers were obliged to sell their animals to reduce the burden. They further believed that if the livestock was always around the house and there was no movement, their bodies would become weak affecting the health of the animals.

Table 5.14: Negative impacts of zero-grazing on the livestock population

Responses	Observation	Per cent
No	272	68
Yes	83	20.75
Not applicable	43	10.75
I do not know	2	0.5
Total	400	100

Source: survey result, 2013

In the last production season, 29 per cent of the respondents did not get enough rainfall (Table 5.15). The number of households who faced food deficits was approximately 43 per cent. This indicated that even some of those respondents who had enough rain faced food deficits. The small landholding size and low productivity of land could be the major contributing factors for the food deficit even given enough rainfall. The household heads responded that the duration of time for the deficit extended from a minimum of a month to a maximum of 10 months. Thus, the majority (43 per cent) of the respondents faced a food deficit of two months and the average deficit was found to be 2.65 months.

Table 5.15: The conditions of rainfall and food deficit in the last production season (2011/2012)

Conditions	Responses	observations	Per cent
Enough rain	Yes	285	71.25
	No	115	28.75
Food deficit	Yes	171	42.75
	No	229	57.25

Source: survey result, 2013

As indicated in Table 5.16, the majority (60 per cent) of the respondents took credit from different sources. When respondents were asked to state the purpose of the loan, 68.2 per cent said it was to purchase chemical fertilizers and seeds. The main source of credit for the majority of respondents was the cooperatives. Moreover, DECSI and the bureau of agriculture were the second and third respectively. The farmers' cooperatives played the role of purchasing, storing and distributing of fertilizer and improved seeds. It is obvious that, as the primary purpose of the loan was for fertilizer and seeds, the cooperatives were the responsible institutions for the service.

Table 5.16: The conditions of households' credit in the last production season by gender

	Gender		
Credit	Female	Male	**Total**
Yes	65	174	**239**
No	41	120	**161**
Total	**106**	**294**	**400**

Source: survey result, 2013

The interest rate charged by the multipurpose cooperatives was lower than the interest rate of DECSI. The interest rate of the farmers' cooperatives and DECSI was 15 and 18 per cent respectively. Although farmers believed that the interest rate of DECSI was high, it was the only microfinance institution operating in rural areas. DECSI uses a group based model in which members are jointly accountable for each other's loans. The

institution believes that the group lending approach is a helpful tool to minimize the problems of adverse selection and moral hazards associated with information asymmetry and subsequently reduces the number of non-performing loans. Although group lending was serving as collateral to the lending institution, the farmers were not comfortable with the approach. They were in favour of individual lending rather than group lending.

A significant percentage (40 per cent) of respondents also did not take credit. There were many reasons for farmers being reluctant to apply for credit schemes. According to Aune and Bationo (2008, p. 120), farmers were afraid of risks such as drought, pest attacks and unstable prices for their product. In the study area, the focus group discussants said that settling any previous loans was the prerequisite to ask for and take another loan. It was difficult for them to settle their loans on time because the interest rate was high and it was compounded when the agreed repayment time had passed. They added that some farmers were also taking loans without properly identifying the purpose of the loan. They would use it for household consumptions and face difficulties during the repayment period.

The number of loans requested and borrowed was 2412.88 and 2377.40Birr respectively (Table 5.17). To verify the statistical significance of the mean difference of the loan requested and borrowed, the paired t-test was used. The null hypothesis (Ho) states that the loans requested and borrowed are equal. Three different corresponding alternative hypotheses are presented. Hence, the third hypothesis was significant at 5 per cent level significance or 95 per cent confidence level. The mean requested amount of money was greater than the mean borrowed amount of money by respondents which was statically verified at 5% significant level.

Farmers were asked to state the means they utilized to make the repayment of their loans. They stated that selling livestock (17.57 per cent), selling vegetables and fruits (13.39 per cent) and food-for-work/safety net (11.72 per cent) were the three most frequently used means of settling loans. Because the farmers were forced to limit the numbers of livestock they possessed because of the introduction of zero-grazing regulations, future livestock sales as the most used means of settling loans may not be sustainable.

Table 5.17: The mean requested and borrowed loan of respondents (paired t-test).

Variable	Obs.	Mean (Birr)	Std. Err.	Std. Dev.	[95% Conf.Interval]
Amount requested	217	2412.9	168.96	2488.91	2079.861-2745.907
Amount borrowed	217	2377.4	165.03	2431.04	2052.126-2702.674
Difference	217	35.5	20.13	296.56	-4.195686-75.16426

Mean (diff) = mean (amount requested-amount borrowed) t= 1.7626

Ho: mean (diff) =0 degree of freedom= 216

Ha: mean (diff) <0 Ha: mean (diff)!=0 Ha: mean (diff) >0

Pr (T<t) =0.9603 Pr (T<t) =0.0794 Pr (T<t) =0.0397

Source: survey result, 2013

The farmers were asked to mention three months in which they frequently made their loan repayments (Table 5.18). They responded that the months of December, January and February were ranked as the first, second and third respectively. Respondents also paid 15 per cent average interest rate for the loans. There were farmers who did not know the interest rate of their loans. In this case, they were asked to tell the amount borrowed and the total amount paid while settling their loans. There were five respondents who did not settle their loans.

The majority (69 per cent) of the respondents stated that the most frequent loan repayment months were around harvest time, when they sold crops and made the repayments. It was also the time for honey production and the selling prices of livestock were reasonably high. Farmers who settled their loans in the main harvest season (September to February) said that the repayment periods were convenient.

Table 5.18: The most frequent months of loan repayment

	Most frequent month		Second frequent		Third frequent	
Months	**Obs.**	**Per cent**	**Obs.**	**Per cent**	**Obs.**	**Per cent**
Sep.	37	15.81	18	7.69	5	2.14
Oct.	7	2.99	37	15.81	17	7.26
Nov.	5	2.14	8	3.42	37	15.81
Dec.	45	19.23	5	2.14	7	2.99
Jan.	43	18.38	42	17.95	4	1.71
Feb.	11	4.70	41	17.52	38	16.24
Mar.	13	5.56	17	7.26	38	16.24
Apr.	15	6.41	12	5.13	12	5.13
May	15	6.41	14	5.98	24	10.26
June	22	9.40	18	7.69	16	6.84
July	4	1.71	19	8.12	16	6.84
Aug.	17	7.26	3	1.28	20	8.55
Total	234	100	234	100	234	100

Source: survey result, 2013

Some of the respondents (31 per cent) who settled their loan in the months of April to August responded that these periods were inconvenient to settle loans because these were the months in which farmers were in need of money for seeds and fertilizers. These months were not a harvest time and there was nothing to be marketed. Some respondents argued that the issue was not about the convenience of the months. They said they did not have any preferred months for loan repayments because they were poor the whole year. Whenever the month of repayment may be, "if you are poor, you remain poor regardless of the convenience of the months of repayment", they added.

As stated above, the convenient months for loan repayments ranked from one to three which were in the main harvest time known as *Meher* season. The farmers were cognizant to the fact that, in this period, the supply of agricultural products was in excess. Hence, they would not get reasonable prices for their products. Though farmers were

aware of this situation, they did not have any other options other than selling their agricultural products right after harvest.

In each *tabia*, there were multipurpose cooperatives with the aim of providing services to the farmers. These cooperatives were expected to purchase the agricultural products of farm operators at reasonable prices in the harvest time and sell them when the demand for crops improved. However, there were no farmers' cooperatives engaged in such a service. Instead, the cooperatives were mainly good at distributing fertilizers when the order came from the administrators and extension agents.

Extension service

The farmers were asked about the support they obtained from the extension agents and whether the number of contacts was enough. As indicated in Table 5.19, the majority of the respondents (88.75 per cent) had contacts with the extension agents. The average number of contacts for all respondents was23 times in a year. Most of them believed that the contacts they made in the year were enough. On the other hand, farmers were expected to provide free labour for 20 days in soil and water conservation activities every year. This mass mobilization work was considered by farmers as a request for professional support by the extension agents. The individual based number of visits of extension agents to solve the specific problems of farmers was minimal. Therefore, a significant number of contacts were not related to the core profession of extension agents. This was highlighted in the discussions with the extension agents as my key respondents. They stated that there were many unrelated assignments coming from the administrators of the *tabia* and the *wereda*. They were assigned to list down the names of party members of the governing party and the status of their membership fees; they were asked to process the repayment of cooperatives and attend a series of meetings which were unrelated to the major tasks of the extension agents. They added that the extension agents were obliged to be members of the ruling party.

Table 5.19: The support and advice of extension agents and whether these contact were enough

	Yes		No		
	Obs.	Per cent	Obs.	Per cent	Total
Advice	355	88.75	45	11.25	400
Contact enough	337	84.25	63	15.75	400

Source: survey result, 2013

It is the right of the individuals to become party members based on their freewill and without any pressure upon them. The major problem associated with becoming partisan is that once the experts are party members, they provide priority to the political duties assigned to them and their core responsibilities became secondary. In line with this, a farmer whom I talked to in the field during the survey told me the following:

> *These days it is difficult to differentiate the politicians and the extension agents. They both tell us to double the productivity of cultivable land. Yet the extension agents failed to guide and show us how to double the productivity of land we possessed (Farmer, Tigray region, 2013).*

On the contrary, some respondents (15.75 per cent) stated that the number of contacts they made with the extension agents was not enough. They provided many reasons for the insufficient contact between farmers and the extension agents. These included the fact that their landholding sizes were too small to have the contact; there was no individual based contact arrangement except in rare meetings; extension agents met farmers when they wanted to nag them to purchase fertilizer and not for any other business. In essence, they were unable to mention any support obtained from the extension agents. It seemed that the extension agents did not have a planned program to guide farmers.

In each *tabia*, there were four extension agents. These agents were natural resources, irrigation, crop and livestock experts. These extension agents had their own priorities and objectives in their areas of expertise. Hence, when asked how they reconciled their

different objectives and if there were times when their own expertise contradicted with the requirements by the farmers, the answers they provided were different and somewhat strange. They said each of the experts was assigned to a different rural village known as a *Kushet*. The one who was assigned to a particular *Kushet* was expected to assume all of the responsibilities of extension agents, meaning, a livestock expert in a particular *Kushet* assumed the responsibilities of a crop, irrigation and natural resources extension agent.

The extension agents were not assuming responsibilities based on their areas of expertise. This mixing of roles could leads to the intermingling of responsibility and accountability. The extension agents were engaged in advising farmers in the *Kushet* on subjects out of their specialization areas. They tried to justify this by saying that if the livestock expert faced a problem which was beyond his/her capacity, he/she could contact and seek support from the expert in the area. Nevertheless, the argument was that all of the supervision and advice which was related to crop, irrigation and natural resource management were beyond the capacity of the livestock experts.

Some respondents (15.75 per cent) stated they did not have a smooth relationship with the extension agents. They provided some of the causes for the disagreements with the experts. They said the experts made personal contacts with the farmers who were also *tabia* administrators and that they did not have the interest to contact and support ordinary farmers. Furthermore, they criticized the extension agents as simply taking their salaries without supporting farmers. They did not appear to have the capacity to create a mutual understanding with farmers.

Regression models

In order to identify the impact of variables on crop and farm income, a regression model was used. In the farm income, the model estimated the values of both crop and livestock income. Some basic assumption tests were carried out and are attached in the appendices section.

To analyse the regression model, some basic assumptions needed to be tested. One of the assumptions that needed to be tested was the normality test (Appendix6). After some of the variables are transformed to the logarithmic scale using the ladder and gladder commands, the problem of normality is solved.

The Shapiro-Wilk W test result is also insignificant to reject the null hypothesis that the distribution is normal. In order to test multicollinearity among explanatory variables, the Variance Inflation Factor (VIF) test was conducted (Jenber, 2011, p. 22). The Variance Inflation Factor result indicated that there was no multicollinearity problem among the explanatory variables. Because the value of VIF for each independent variable is less than 10, this shows that multicollinearity was not a problem (Appendix7). The model specification test (Appendix8) is checked using the Ramsey RESET test and linktest (Gebru, Nega, & Hagos, 2011, p. 79; Jenber, 2011, p. 22).

The problem of hetroscedasticity or non-equality of the error variance is tested using the Cook-Weisberg test for hetroscedasticity (Gebru et al., 2011, p. 79). The test fails to reject the null hypothesis of a constant variance. So, there is no problem of hetroscedasticity. The Ramsey and link tests results have also accepted the assumption that the model has no omitted variables. The linearity assumption is tested using a two way scatter plot of each of the independent variables with the dependent variable. The scatter plots indicated that there is no problem of linearity. The endogeneity test is checked using Hausman endogeneity test (Gebru et al., 2011, p. 94). From this test, we fail to reject the null hypothesis of no endogeneity (p-value=0.101).

According to the regression results shown in Table 5.20, land holding size is the determinant factor for crop income in the study area. The result indicates that, as the landholding size increases by 10 per cent, crop income increases by 4.6 per cent. In practice, increasing landholding size is not possible as the study areas are among the most densely populated and highly fragmented lands. The only possible option for farmers to increase their landholding size and crop income was through renting the land of others.

The age variable is significant at 5 per cent significance level. The result indicates that, holding other variables constant, as the household age increases by a year, the income from crop production increases by Birr 0.49 per cent. This implies that the older the head of the household, the more experience he/she has in managing the land.

The possession of an ox is the critical asset in the rural areas. As it was hypothesised, for a smooth management and timeous cultivation of land, a household needs a pair of oxen. Hence, the result indicates that an additional ox brings a 21.82 per cent increase in the crop income. If farmers have at least a pair of oxen, they will be able to cultivate and sow their land at the appropriate time. In addition, they can cultivate more land by renting from households who do have plough oxen. In the study area, 90 (22.5 per cent) of the farming households did not have an ox at all.It was only 141 (35.25 per cent) farmers who possessed two or more than two oxen. Along the same argument, Rahmato (2009, p. 39) reported that it is not hard to imagine what a debilitating handicap the shortage of farm oxen can be especially in the predominantly plough-based farming Zones of the country.

In relation to fertilizer utilization, it is significant at 10 per cent level of significance. As fertilizer use increases, towards the standard, by 10 kilograms per *Tsimad,* the income from crop production increases by 1.1 per cent.

Improved seed is also another significant variable of the regression model. The result indicates that farmers who utilized improved seeds got 13.3 per cent more crop income compared to farmers who did not use them.

Irrigation application is another important determinant factor of crop income. The model result shows that increasing irrigated land by a hectare leads to an increase in crop income by 122.85 per cent. In a highly fragmented land, intensification and multiple harvests in a year through irrigation improves the crop income.

Plot soil quality is also a determinant factor for crop income at 10 per cent significance

level. Though farmers possess several fragmented plots in different areas, they were asked to provide the overall assessment of their plots as fertile or infertile. Thus, the dummy variable result shows that farmers who rated their plots as fertile got 9.21 per cent more crop income compared to plots rated as infertile.

The distance of the village from the *wereda* market is also a determinant variable at a significance level of 5 per cent. However, unlike the other variables, it is with the unexpected sign. The hypothesis was the shorter the distance, the better estimated value of crop production. The assumption was that farmers who are near to the *wereda* market can access inputs when they are scarce at the village and *tabia* level. The result and the unexpected negative correlation might be because the farmers frequently visited the town and the time they devoted to their plots could be minimal.

Finally, the average distance of all plots possessed by the respondents from the homestead is significant at a 10 per cent level. The result indicates that increasing the average distance of the plots leads to a decrease in the estimated crop income. This is a logical result as farmers might have a frequent presence and care for plots which are located at nearby areas.

Table 5.20: Multiple regression results of factors that affect crop income

Source	Ss	df	Ms	Number of observations=400	
Model	134.05	17	7.89	F(17, 382)	=29.47
Residual	102.22	382	0.27	Prob>F	=0.0000
Total	236.27	399	0.59	R-squared	=0.5674
				Adj. R-squared	=0.5481
				Root MSE	=0.51729

Logprodbirr	**Coefficient**	**Std. Error**	**t-value**	**p>|t|**
logtotalland	0.4556041	0.0530779	8.58	0.000***
age	0.0049338	0.0024441	2.02	0.044**
gender	0.1123358	0.0738673	1.52	0.129
educlevel	0.0020256	0.0107618	0.19	0.851
adultequiva	-0.0178051	0.0314847	-0.57	0.572
oxenown	0.2181638	0.0410122	5.32	0.000***
fertitotal	0.0010886	0.0006174	1.76	0.079*
imprseed	0.1330467	0.0574453	2.32	0.021**
irriown	1.228522	0.2550004	4.82	0.000***
amountborro	1.21e-06	0.0000134	0.09	0.928
contactmonth	-0.0027899	0.009755	-0.29	0.775
overall	0.0920765	0.052751	1.75	0.082*
enoughrain	-0.006585	0.0590054	-0.11	0.911
villawerema	0.0174823	0.00623	2.81	0.005***
zerograze	0.1138066	0.0758726	1.50	0.134
disaverage	-0.0024491	0.0012982	-1.89	0.060*
croprotation	0.2875437	0.1932248	1.49	0.138
_cons	7.58064	0.280271	27.05	0.000***

***Significance at 1%**significance at 5% *significance at 10%

Source: survey result, 2013

The basic assumptions of the multiple regression model of farm income are also checked before the interpretations of the results are started. The multicollinearity test (Appendix9)

is checked using the Variance Inflation Factor and all the values are less than 10. The model specification test (Appendix10) is also checked using the Ramsey RESET test and linktest. Moreover, the hetroscedasticity problem is solved using the robust command and obtaining the robust standard errors.

The farm income regression result (Table 5.21) indicated that the landholding size, possession of oxen, amount of fertilizer, improved seeds, irrigation, soil quality, village distance to district market, average distance of plots from the homestead and crop rotation were found to be determinant factors. Furthermore, all the independent variables are with the expected signs except the village distance to the district market variable.

The landholding size is one of the variables which positively affect farm income of farmers. The landholding size result indicates that, as the landholding size increases by one hectare, farm income increases by 5096.76Birr.

Similar to the crop income results, the possession of oxen is the most significant variable. The result indicated that as the possession of oxen increased by one, the household farm income would increase by 8709.04Birr.

Improved seeds come out to be significant and have a positive effect on the farm income of farm operators. Farmers who applied improved seeds get, on average, 3139.27Birr higher income compared to non-users.

The application of fertilizer is also significant indicating a one kilogram/*Tsimad* increase leads to 26.24Birr increase in farm income. The result of the irrigation variable indicates that, as the irrigated land increases by a hectare, farm income increases by 3105.50Birr.

The soil quality of the plots is also a significant variable to determine farm income in the study area. The result indicated that farmers who have fertile lands get a farm income of 2017.23Birr more compared to farmers with infertile lands. In a similar vein, Gebremedhin et al. (2009, p. 784) found that due to the soil fertility advantage, yield on

good quality soils is higher than infertile soils.

The distance of the village from the *wereda* market is significant variable with results contrary to the expectation. The result indicates that households who are far away from the district market get more farm income than households near to the market. This unexpected result is consistent with the crop income results. The possible reason could be that farmers who frequently visit the town might have less time to take care of their crops and livestock.

The average distance of plots from the homestead is also a significant determinant of farm income at the level of 5 per cent. The result indicates that as the walking time to plots from the homestead increases by one minute, farm income decreases by 46.42Birr.

Crop rotation is also a determinant variable at the 5 per cent significance level. The result indicates that households applying crop rotation get 4068.14Birr more farm income compared to households who do not apply it.

Some important variables such as the amount of money borrowed and the number of visits by extension agents were insignificant in the study area. The assignments of extension agents to tasks which were unrelated to their core responsibilities could be the reason for this result. In the study conducted in Ghana, Adeoti et al. (2012, p. 244) found that the effect of visits by the extension agents on the farm income was insignificant. The possible justification they provided for this was that it is not the number of visits that bring changes to farmers' income but it is the quality of extension services provided to them.

Table 5.21: Farm income (crop and livestock) multiple regression results

			Number of observations	=400
			F(17, 382)	=42.36
			Prob>F	=0.0000
			R-squared	=0.6370
			Root MSE	=8084.5
Farm income	**Coefficient**	**Robust Std. Error**	**t-value**	**p>|t|**
totalland	5096.76	1342.79	3.80	0.000***
age	10.92	37.04	0.29	0.768
gender	1320.82	1078.45	1.22	0.221
educlevel	71.97	171.23	0.42	0.674
adultequiva	910.93	561.25	1.62	0.105
oxenown	8709.04	721.22	12.08	0.000***
fertitotal	26.24	10.19	2.57	0.010***
imprseed	3139.27	989.71	3.17	0.002***
irritotal	3105.5	1409.19	2.20	0.028**
amountborro	-0.0386	0.2665	-0.15	0.885
contactmonth	36.35	142.64	0.25	0.799
overall	2017.23	857.17	2.35	0.019**
enoughrain	-287.24	939.38	-0.31	0.760
villawerema	179.69	97.49	1.84	0.066*
disaverage	-46.42	20.33	-2.28	0.023**
zerograze	153.36	1094.17	0.14	0.889
croprotation	4068.14	1679.13	2.42	0.016**
-cons	-4526.74	3209.98	-1.41	0.159

*** Significance at 1% ** significance at 5% * significance at 10%

Source: survey result, 2013

5.4 THE MAJOR CHALLENGES OF THE HOUSEHOLD HEADS IN MARKETING THEIR PRODUCE

The major agricultural marketing challenges related to the distance to the *wereda* and the regional markets; the source of market information and the most frequent month that the farmers take their products are presented in this subsection of the study. In addition, the support of farmers' cooperatives and extension agents are also presented and discussed.

The average village distance from the regional city and *wereda* market is 77.52 and 7.22 Kilometres respectively (Table 5.22).The average cost of transport per person and per quintal to the *wereda* market is 5.76 and 10.24 Birr respectively. The regional market was accessed by only 17 per cent of the respondents. As there were not enough surpluses to be marketed, farmers did not have the incentive to travel a long distance to the regional market. Moreover, respondents travelled, on average, a round trip of3 hours and 38 minutes to access the district market.

Table 5.22: Distance of the *Kushet* (rural village) from the district and regional market centres.

	Obs.	Mean (km.)	Std. Dev.
Village distance from Mekelle (regional city)	400	77.52	37.22
Village distance from the *wereda* market	400	7.22	4.49
Village distance from asphalt road	390	4.49	3.07
Village distance from gravel road	277	2.26	1.78

Source: survey result, 2013

Farmers were asked to mention three months which they frequently took their agricultural products to the market (Table 5.23). They responded by ranking the months of December, January and February as the first, second and third in that order. This finding is consistent with the previous finding of respondents' periods of loan repayments. The harvest season was the preferred period for selling of agricultural products and loan repayments. In these months, farmers were widely engaged in social

festivities. These all create pressure on the farmers to sell their products right after harvest.

Table 5.23: The most frequent months for respondents to sell their agricultural products

Months	The most frequent month		The second frequent month		The third frequent month	
	Obs.	**Per cent**	**Obs.**	**Per cent**	**Obs.**	**Per cent**
September	6	2.08	1	0.35	5	1.74
October	12	4.51	3	1.04	-	-
November	31	10.76	13	4.51	3	1.04
December	120	41.67	27	9.38	11	3.82
January	66	22.92	123	42.71	32	11.11
February	9	3.13	61	21.18	91	31.60
March	8	2.78	11	3.82	41	14.24
April	9	3.13	10	3.47	9	3.13
May	15	5.21	13	4.51	38	13.19
June	7	2.43	17	5.9	36	12.50
July	3	1.04	7	2.43	15	5.21
August	1	0.35	2	0.69	7	2.43
Total	**288**	**100**	**288**	**100**	**288**	**100**

Source: survey result, 2013

In the main harvest time, the selling prices of crops become lower because of the excess supply. The issue of marketing is left to the farmers themselves without the required support. If farmers are advised to use inputs to boost production, they need equally important advice and support in marketing their agricultural products. However, the marketing issue is ignored by both extension agents and farmers' cooperatives.

Respondents were also asked about the means of transport mainly used while taking their products to market. For the majority (43.75 per cent) of the respondents, the most

frequent means of transport for their products to the market were on foot and pack animals. Moreover, on foot was the second most frequent (27.08 per cent) means of taking the product to the market. A significant number of respondents (11.46 per cent) also used pack animals to access mainly the district markets. This indicates that respondents relied on foot and pack animals as major means of transport. The sales of meagre quantities of agricultural products do not qualify for conventional motor vehicles as a means of transport. According to Sieber (1999, p. 206), pack animals as a means of transport are categorized as the intermediate means of transport between the traditional method of foot or head loading and the conventional motor vehicles. Sieber added that agricultural transport is frequently by foot which is time consuming and energy that could be used productively in the field is lost through walking.

Farmers were asked to state the source of information about when they should take their products to market. Though there were varieties of information sources used by respondents to sell their products, the dominant one was information from neighbours. Thus, neighbours were the major source of market information (70.06 per cent) for farmers in the study area (Table 5.24). This is the traditional way of getting market information. In the study conducted in Greece, Charatsari and Lioutas (2013, p. 118) found similar findings—that for the majority of the respondents, other farmers were the major sources of information. The remaining 111 respondents stated that they did not get and seek any market information before taking the products to the market. Farmers were also asked the duration of time they waited to sell their products. On average, they waited for 2.03 hours to get buyers for their agricultural products.

Table 5.24: The respondents' sources of prior information

	Source of information	
	Obs.	Per cent
Government office	1	0.56
Buyers	15	8.47
Brokers	2	1.13
Fixed/mobile phone	8	4.52
Neighbours	124	70.06
Buyers and phone	8	4.52
Buyers and neighbours	9	5.08
Brokers and phone	1	0.56
Brokers and neighbours	1	0.56
Phone and neighbours	8	4.52
Total	177	100

Source: survey result, 2013

In relation to the existence of buyers, the majority of the respondents (68.75 per cent) said that they had enough buyers for their agricultural products (Figure 5.2). Some respondents stated that there was not enough demand for their agricultural products. For instance, they did not get enough buyers for their tomato and pepper products.

The farmers said that the existence of enough buyers should be seen in relation to the reasonableness of the offered prices. However, all farmers were taking their produce in the same season and the supply exceeded demand. As a result, the prices offered by traders were much lower compared to the costs incurred by the farmers. Furthermore, respondents were asked if they paid commission for agents or brokers in search of buyers to sell their agricultural products. Almost all (99 per cent) responded that they did not pay any commission to agents and brokers.

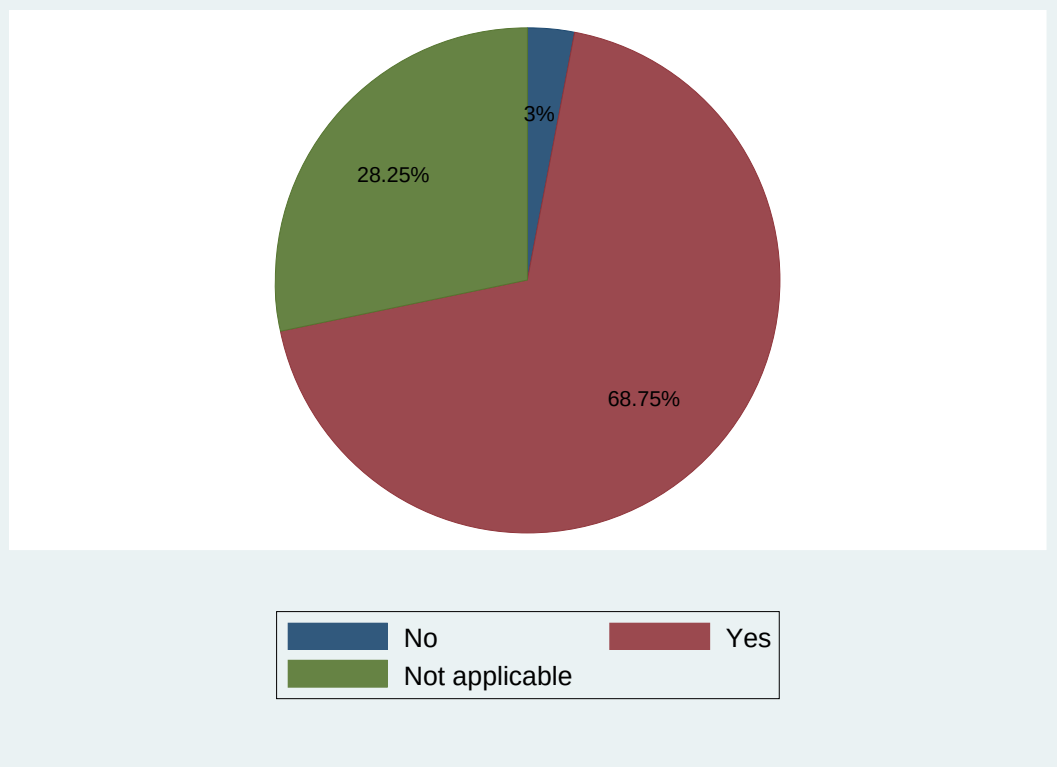

Figure 5.2: The existence of enough buyers for all of the agricultural products
Source: survey result, 2013

Farmers were asked if there was any support provided by the farmers' cooperatives. As indicated in Figure 5.3, the majority of the respondents (47.5 per cent) stated that the farmers' cooperatives helped them to get agricultural inputs. As it is costly for the farmers to travel to the market places, it is an advantage to get agricultural inputs in their *tabias*. The role of the cooperatives as agricultural input distributors was confirmed during the focus group discussion sessions. The roles of the farmers' cooperatives were narrowly defined by farmers. They understood the major responsibility of the cooperatives was to distribute agricultural inputs specifically fertilizers and consumer goods. They added that the major consumption items needed by farmers such as edible oil and coffee were not in the store at all times.

There was also a lack of appropriate management and leadership for the cooperatives to be effective. The other critical task of cooperatives such as buying and storing of products in the peak period for farmers to get a reasonable price was ignored. The

cooperatives did not engage in these critical services which stabilize the supply of agricultural products in the market. There were also many respondents (17 per cent) who stated that there was no advantage obtained from the farmers' cooperatives.

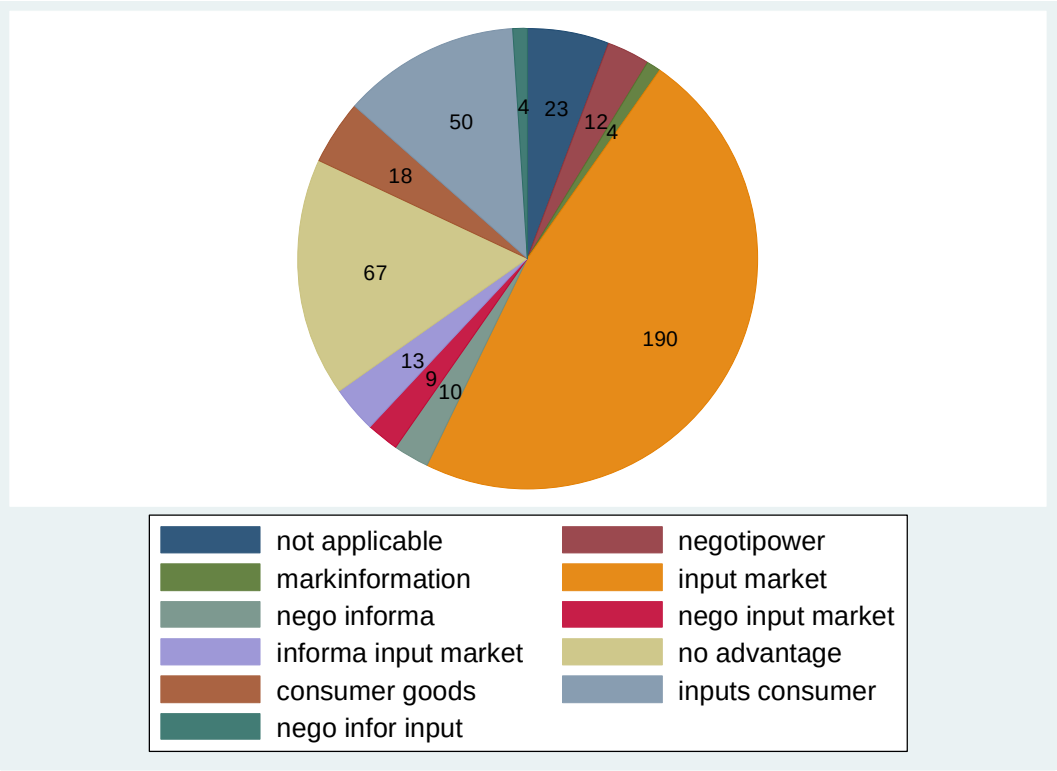

Figure 5.3: The advantages obtained from the farmers' cooperatives in the *tabia*
Source: survey result, 2013

5.5 THE MAJOR DETERMINANT FACTORS OF FARM OPERATORS TO PARTICIPATE IN OFF-FARM ACTIVITIES AND THEIR IMPACTS ON THE OFF-FARM INCOME

This subsection focuses on the factors affecting off-farm participation and income of households. The contribution of off-farm income to total farm income and the purpose of farmers to participate in the employment is presented. To investigate the impact of the factors influencing on/off-farm participation and income, the Probit and Tobit models were used respectively.

As indicated in Table 5.25, the majority (88 per cent) of the households participated either on someone else's land or in some other form of off-farm activities. The number of households that participated in agricultural wage employment was small. This is an expected result for the level of remuneration from agriculture related employment is lower compared to the other off-farm employments. In addition, the small landholding size and subsistence nature of farming would not require labour beyond the labour available in the household. The majority of the households participated in non-agricultural wage employment. The average income was also higher than that of the other off-farm employments. Farmers had better employment opportunities in the non-agricultural sectors such as masonry, construction and cash-for-work. However, the study conducted by Babatunde and Qaim (2009, p. 9) in Nigeria showed that self-employed income is the highest followed by the agricultural wage income.

Table 5.25: the average annual income of households from off-farm activities

Off-farm activities	**Obs.**	**Mean (Birr)**	**Std. Dev.**
Agricultural wage income	15	2686.67	2768.93
Non-agricultural wage income	327	6852.48	4839.62
Self-employed income	125	5683.44	6896.68
Off-farm total income	**352**	**8498.55**	**6315.05**

Source: survey result, 2013

As indicated in Table 5.26, the average off-farm income of households was more than that of the crop income. However, the importance of off-farm employment has not gained the required focus by the government at different hierarchies. Policy documents such as the recently launched Growth and Transformation Plan do not include issues related to off-farm employments. This finding is supported by previous related studies in Ethiopia. Beyene (2008, p. 141) found that, regardless of the high employment potential of the non-farm sector, it is not covered by government policies and strategies.

The land administration and land use proclamation of the region does not encourage farmers to participate in long term off-farm activities. In this proclamation, it is clearly stated that farmers are not allowed to be out of their locality for more than two years. Farmers are therefore restricted from long term off-farm employment for fear of land confiscation. The existence of many landless farmers in the rural areas could be one of the driving forces for the restriction. But, the duration of two years is not sound as it prohibits a relatively long term off-farm employment of farmers.

Table 5.26: The average and the share of farm and off-farm income of all households

Source of income	Obs.	Mean (Birr)	Std. Dev.	Per cent
Farm income	400	22,767.62	13,128.91	75.27
Crop income	400	6850.50	5640.81	22.65
Livestock income	400	15,917.12	9914.8	52.62
Off-farm income	400	7478.73	6536.7	24.73
Farm and off-farm income	**400**	**30,246.34**	**15,159.74**	**100**

Source: survey result, 2013

Farmers were engaged in off-farm employment in different areas (Table 5.27). The location of off-farm activities for the majority of respondents was found to be in the village (*Kushet*).This is because a large proportion of farmers participated in the Productive Safety Net Program (PSNP) of the government at the *Kushet* level. This is one of the major public works aiming at soil and water conservation. The restriction of the government could also be one of the reasons for the majority to participate in off-farm

activities available in nearby areas without leaving their localities for long.

Table 5.27: The location of employment for off-farm participant households

Location of off-farm activities	**Respondents**	**Per cent**	**Cumulative**
This village	148	42.05	42.05
Other village in the *tabia*	13	3.69	45.74
This *wereda*	23	6.53	52.27
This village and *tabia*	47	13.35	65.63
This village and *wereda*	98	27.84	93.47
This village and neighbouring *wereda*	2	0.57	94.03
Tabia and *wereda*	5	1.42	95.45
This village, *tabia* and *wereda*	16	4.55	100.00
Total	**352**	**100.00**	

Source: survey result, 2013

As shown in Figure 5.4, the majority (57 per cent)of the respondents indicated that they did not have any fear of land confiscation even though they were away from their locality for long periods of time. However, the rural land administration and land use proclamation No. 136/2007 Article 12, of the Tigray region, states that farmers are not allowed to be out of their *tabia* for more than two years otherwise their land would be confiscated and redistributed to landless farmers in the *tabia*. On the other hand, if some of the family members are in their localities, the share of the absentee member would be annexed and redistributed to others. The reason that farmers said that they do not have any fear of confiscation could be because of the information gap of the above proclamation. In addition to this finding, 43 per cent of the respondents stated that they were afraid of land confiscation when they were away from their localities for off-farm employment or other purposes. Contrary to this response, the majority of the respondents stated that they had the confidence to be away from their localities for more than a year at a time (Table 5.28 below).

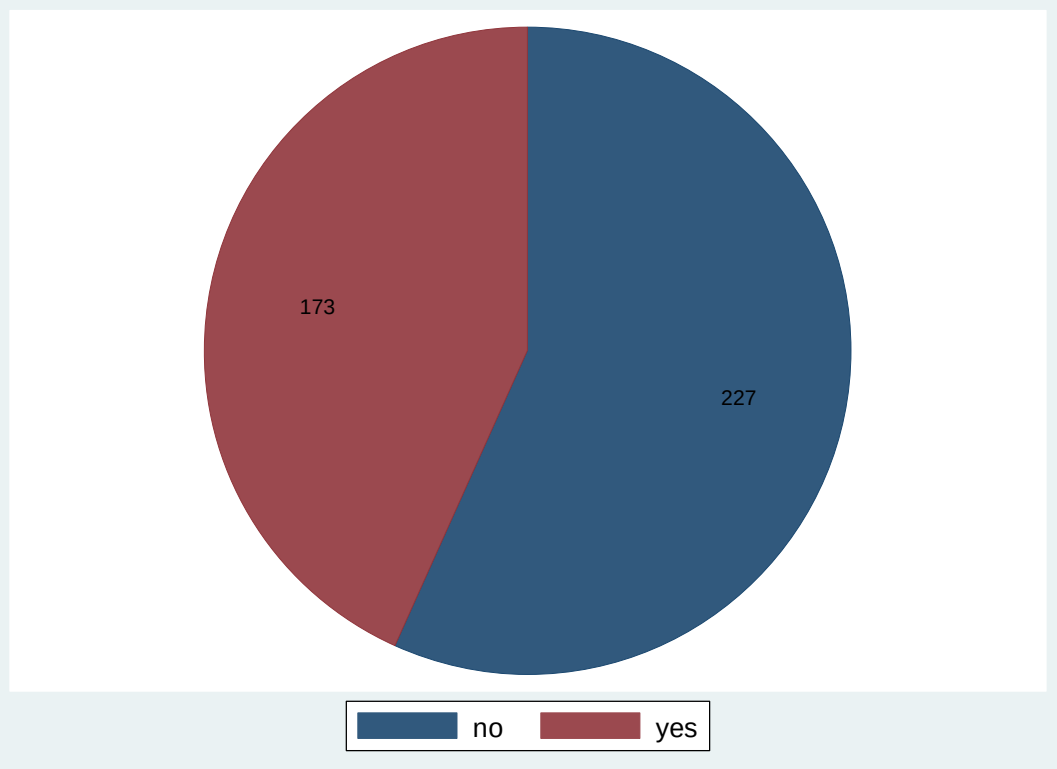

Figure 5.4: Fear of land confiscation if farmers are away from their locality
Source: survey result, 2013

As indicated in Table 5.28, the majority (78.61 per cent) of the respondents did not have the confidence to be away from their *tabias* for more than a year. During the focus group discussions, the farmers said there were many different pressures when they were away from their locality even for months. The *tabia* officials stated that farmers should not be away from their locality as they were required to participate in the soil and water conservation activities. In addition to the cash-for-work, farm households participated in soil and water conservation activities for 20 days a year for free. Failing to participate in these conservation activities jeopardized the land use right of farmers.

The fear of land confiscation and the annual free labour contribution restricted farmers from seeking long term off-farm employment opportunities beyond their *tabias* and *weredas*. The farmers were allowed to rent out their land for up to three years or up to 20 years if the agreement is to use mechanized methods of production (Tigray, 2007, p. 5). The land proclamation further states that the farmers are not allowed to rent out all of the

plots they possess. They could rent out up to half of their land but the remaining half would have to be retained and cultivated by the landholders themselves. It then follows that if farmers are allowed to rent out their land for a specified period of time, there was no sound justification to restrict them to retaining half of their landholding size. In a similar context, Adenew and Abdi (2005, p. 8) observed that farmers ought to be given an improved land tenure security beyond ownership of land so that they can freely decide how to use their land.

Table 5.28: Farmers' estimated numbers of days to be away from their locality for off-farm employment without fear of land confiscation

Numbers of days	Respondents	Per cent	Cumulative
1- 30	19	10.98	10.98
31-180	49	28.32	39.3
181-365	68	39.31	78.61
366-730	33	19.08	97.69
731-1095	4	2.31	100.00
Total	**173**	**100.00**	

Source: survey result, 2013

In China, the land use rights of farmers could be revoked if they did not cultivate their land or rent it out to other farm households (Shi et al., 2006, p. 441).Shi et al. further explained that, in some areas of China, the land rental market is absent or undeveloped for farmers to rent out their land and participate in off-farm activities without any fear of confiscation. However, in the study areas and Tigray region as a whole, the land rental market is well developed as a result of the small landholding size of households and the existence of many landless farmers.

Farm households also explained the reason why they participated in the off-farm activities. The response from the majority was mainly the existence of off-farm employment opportunities. Secondly, their landholding size was too small to feed their families. The non-farm employment that farmers considered to be a good opportunity

was the participation in the cash/food-for-work projects. This was evident as the village (*kushet*) was the location of off-farm employment for the majority of the respondents.

Respondents were asked why they did not participate in off-farm employment (Figure 5.5). Most of the households stated that they did not have the required physical capability to be engaged in these activities. It was observed that many of these respondents were household heads who were more than 60 years old. The households also mentioned the absence of off-farm opportunities as the second reason for not participating in the off-farm employment.

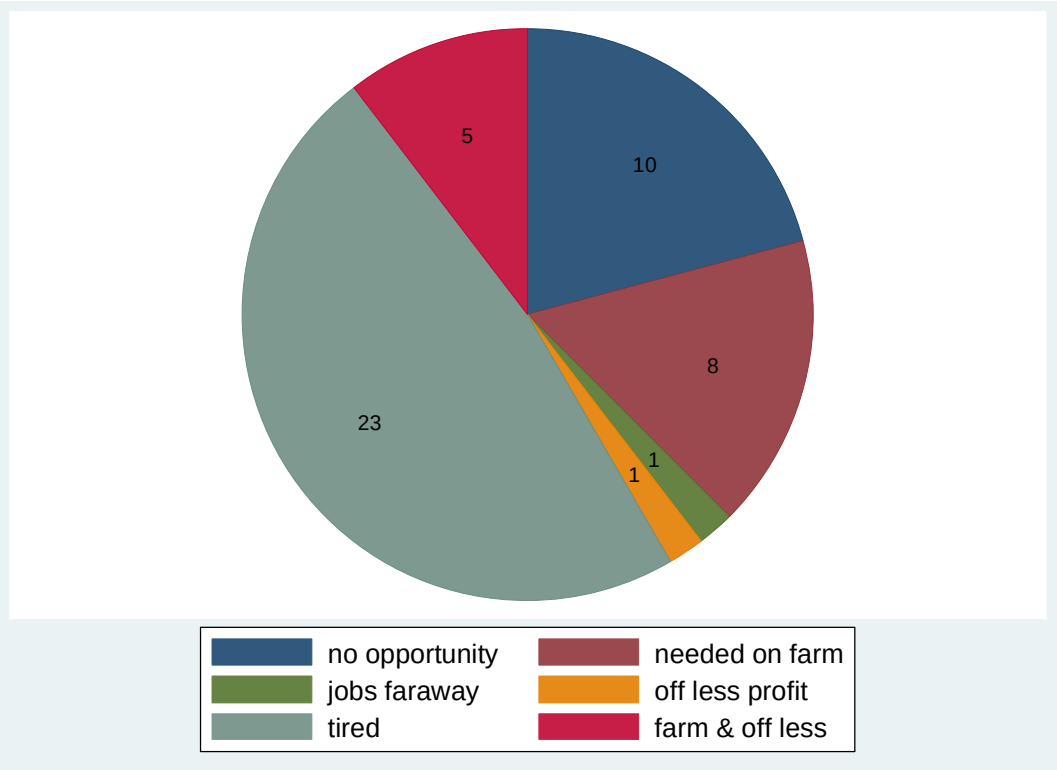

Figure 5.5: Major reasons for households who do not participate in off-farm employment
Source: survey result, 2013

The farm and off-farm income of the households was grouped in similar ranges to see whether the increase in farm income leads to an increase in off-farm income or vice versa. As indicated in Table 5.29, the highest proportion (86.08 per cent) of the respondents, who participated in the off-farm wage employment, were in the first and

lowest income (300-13,680 Birr) category. This implies that the off-farm participation in the study areas was as a result of push factors rather than pull factors. In this case, farm household heads tried to diversify their income to compensate for the low income from the farming sector. According to Bezemer and Headey (2008, p. 1347) a distress push rural diversification is helpful for survival but its contribution to poverty reduction is minimal.

This finding is, however, different from other researches in the area that found a U-curve relationship between off-farm income share and total income of households. This means the poor and the rich were highly involved in off-farm activities for different purposes. In this study, the off-farm participation of respondents who were in the highest total income category was minimal. Households which had insufficient farm income were very active in the off-farm activities.

Table 5.29: The number of households in each farm and off-farm income group

	Farm		**Off-farm**	
Total income group (Birr)	**Respondents**	**Per cent**	**Respondents**	**Per cent**
[300-13,680]	108	27	303	86.08
[13,681-27,061]	151	37.75	40	11.36
[27,062-40,441]	105	26.25	8	2.27
[40,442-53,822]	30	7.5	1	0.29
[53,823-67,203]	6	1.5	0	0
Total	400	100.00	352	100.00

Source: survey result, 2013

As indicated in Table 5.30, the majority (76.50 per cent) of the respondents did not have access to electricity. Rural areas located along the routes of electric poles erected to connect different towns have better access to electricity. Those respondents who had access were asked about the opportunities they obtained from it. They said it was like a transformation from dark to light, as electricity saved them from the smoke of kerosene lamps. Furthermore, it allowed them to access mills in nearby areas and for students to

study comfortably for long hours. In the same line, Kanagawa and Nakata (2008, p. 2024) documented the contribution of rural electrification to education in a study conducted in the rural areas of India. They found that the literacy rate for children above six years old in the study area increased by 11.9 per cent compared to the literacy rate before access to electricity.

It is evident that the households did not use the electricity to create more opportunities in the form of off-farm employment and income. In the study conducted in rural Rwanda, Bensch et al. (2011, p. 581) found similar results among households with access to electricity and did not use it for income generating activities. Respondents said that lighting has become a critical benefit of access to electricity.

In relation to whether households had a radio, as indicated in the same table, many respondents (61 per cent) did not possess radios. This figure is not encouraging as the majority of the farm households were expected to be able to afford and possess radios. Manyozo (2007, p. 11) stated that a radio is the only affordable and reliable means of sharing information and knowledge for people in the developing countries who do not have access to electricity, telephone, internet and television.

Table 5.30: Farm households' access to electricity and possession of radio

	Yes		**No**		
	Respondents	**Per cent**	**Respondents**	**Per cent**	**Total**
Access to electricity	**94**	**23.5**	**306**	**76.50**	**400**
Possession of radio	**156**	**39.00**	**244**	**61.00**	**400**

Source: survey result, 2013

The farmers who possessed a radio were asked to state the advantages they obtained from it. These included listening to news related to agriculture and the best practices of other farmers in the area of irrigation. Above all, they obtained information related to the importance of giving birth in health centres, educating children and reducing dependency on food aid.

To identify the determinant factors of farm households participating in off-farm activities, a Probit model was estimated and the coefficients and marginal effects are reported in Table 5.31.The model results showed that irrigation, age, amount of money borrowed, village distance to the *wereda* market, fear of land confiscation and access to electricity were significant variables in determining farm households' participation in off-farm activities. Moreover, the sign and relationship of all significant independent variables to the dependent was as expected except the village distance to the *wereda* market and access to electricity variables as explained below.

The estimation result revealed that as the irrigated land increases, the probability of farm households' participation in off-farm employment decreases. If the irrigated land increased by one hectare, the probability of off-farm participation decreased by 26.6 per cent. Irrigation increases the intensity and frequency of harvests in a year. Hence, as the size of irrigated land increases, the household would not have extra time for off-farm employment. The intensification and multiple harvests in a year improve crop production and income. As a result, distress-push participation of farm household heads in off-farm activities is expected to be minimal.

In the study conducted in China, Shi et al. (2006, p. 451) found a similar result that the probability of participation in the migrant work and local off-farm employment was minimal for farmers with relatively large areas of irrigated land. In addition, Fanta and Upadhyay (2009, p. 582) also found that irrigation increases in Tigray, the agricultural productivity, income and the need for households to participate in the food/cash-for-work becomes lower than those households without access to irrigation.

The age of the household head was also found to be a significant variable that affects the probability of participation negatively. This means that, as the age of the household head increases, the probability of off-farm participation decreases by 0.32 per cent. This result is consistent with the finding of other researchers. For instance, Babatunde and Qaim (2009, p. 12) found that off-farm activities require physical fitness and older people are at

a disadvantage.

Although the level of significance is weak, the amount of money borrowed by the household head was found to reduce the probability of off-farm participation. Thus, if a household obtained a 1000 Birr credit, the probability of off-farm participation would decline by one per cent. This indicates that farmers are engaged in off-farm activities to fulfil the cash requirements in credit constrained conditions.

Farmers could not take credit from the formal banks as they could not pledge the collateral required. Unlike other countries, in Ethiopia, land cannot be used as collateral as it is a public asset. According to Hallward-Driemeier and Gajigo (2013, p. 8), insecure property rights limit the opportunity for credit as farmers are prohibited from putting forward their land as collateral.

The distance of the village from the *wereda* market was another significant variable that determined off-farm participation with an unexpected sign of effect. It was hypothesised that distance to the *wereda* would have a negative impact on off-farm employment and income. However, the result indicated that as the distance of the village to the *wereda* market increases by 10 kilometres, the probability of the household to participate inoff-farm employment increases by 6.3 per cent. The reason for this unexpected sign could be the fact that the majority (59 per cent) of the household heads were engaged in off-farm activities in their villages and *tabias*. Out of the total off-farm employment participants, respondents who said the *wereda* was the location of their employment were only 6.5 per cent.

Farmers' fear of land confiscation when they are away from their localities for off-farm employment was another determinant variable in the study area. The model results indicated that the probability of off-farm participation for households who feared land confiscation was 7 per cent lower than those who did not have the fear of confiscation. In the rural land administration and land use proclamation of the region, farmers are allowed to be out of their community for, at most, two years.

Access to electricity was also an off-farm employment determinant variable at 5 per cent level of significance. Access to electricity was expected to encourage small businesses and other non-agricultural activities in a community. However, in the study area, households did not use it for income generating activities. In addition, the direction of influence of the variable is contrary to the prior expectation. The average farm income of those households who had access to electricity was more than those who did not have access. This may indicate that access to electricity in rural areas is affected by the location and the ability to pay. Hence, access to electricity is positively related to farm income and farm income is negatively related to off-farm employment. This could be the reason for the access to electricity having a negative impact on the off-farm participation.

Table 5.31: The determinant factors for farm operators to participate in off-farm activities (Probit model)

Off-farm participation	**Coefficients**	**Marginal effect**	**z-value**	**p>|z|**
Irritotal	-1.6845	-0.2660	-3.26	0.001***
Age	-0.0207	-0.0033	-2.68	0.007***
Gender	-0.1766	-0.0264	-0.70	0.485
Adultequiva	0.1574	0.0249	1.64	0.101
Readwrite	0.2692	0.0423	1.29	0.197
Amountborro	-0.0001	-0.00001	-1.76	0.078*
Villawerema	0.0397	0.0063	1.92	0.055*
Fearconfisca	-0.4266	-0.0704	-2.27	0.023**
Radioposse	-0.1299	-0.0209	-0.63	0.529
elecaccess	-0.4633	-0.0862	-2.01	0.044**
Number of obs.=400	LR chi2 (10)=47.49***	Pseudo R2=0.1618		

*** Significance at 1% ** significance at 5% * significance at 10%

Source: survey result, 2013

The marginal effect of the censored expected value of the Tobit model was used to identify the effect of each of the explanatory variables on the total income obtained from

off-farm activities (Table 5.32). The availability and size of irrigated land negatively influenced the probability of off-farm participation and off-farm income of the respondents. The model result indicated that, for household heads who had already participated in the off-farm activities, a one hectare increase in irrigated land reduces off-farm income by 7854.05 Birr. As indicated in the participation model, access to irrigation needs high levels of household labour and therefore there would not be excess time for off-farm employment.

The age variable is also negatively and statistically significant at one per cent level. This implies that, as the age of the household head increases by a year, the income from the off-farm income decreases by 84.19 Birr. This result is logical; as the household heads get older they do not have the required physical capability to be engaged in off-farm activities.

The family size of the household (adult equivalent) had a positive impact on the off-farm income of farmers. The result showed that, once the household was engaged in alternative employment, an increase of the households by one member increases off-farm income by 1019.97 Birr. The larger family size means availability of enough labour for the purpose of farm and off-farm employment. Household heads with large families are pushed to the off-farm activities to complement their farm income.

Another variable found to have a significant effect is education. It influenced income positively. That is, educated household heads got 1213.62 Birr per year more from off-farm income compared to illiterate household heads.

Access to electricity was another determinant variable at the 10 per cent level of significance. It was hypothesized that access to electricity would boost off-farm participation and income of farmers. However, similar to the Probit model, the direction of influence of the variable is contrary to the prior expectation. The results indicated that off-farm income of household heads that had access to electricity was 1488 Birr less than those households which did not have access. This finding may be due to the fact that rich

farmers had access to electricity. As the off-farm participation in the study areas was distress push, the probability of participation and income of rich farmers who had access to electricity from off-farm employment, was found to be less.

Possession of a radio was also a variable that influenced income from off-farm employment positively. This implies that it is serving household heads as a source of information to seek varied livelihood alternatives. Households which possessed radios were found to obtain 1807.80 Birr more from off-farm income compared to households without radios.

Table 5.32: The off-farm income determinant factors of respondents (Tobit model)

	Marginal effect		
Off-farm participation	**(dx/dy)**	**z-value**	**p>|z|**
Irritotal	-7854.28	-3.93	0.000***
Age	-84.19	-3.18	0.001***
Gender	916.48	1.15	0.252
Adultequiva	1019.97	3.07	0.002***
Readwrite	1213.62	1.85	0.064*
Amountborro	-0.1489	-1.04	0.301
Villawerema	-51.86	-0.78	0.435
Fearconfisca	-257.04	-0.43	0.664
Radioposse	1807.80	2.69	0.007***
elecaccess	-1245.24	-1.78	0.076*
Obs. Summary: 48 left-censored observations at offtotalbirr<=0			
352 uncensored observations			
0 right-censored observations			

*** Significant at 1% * significant at 10%

Source: survey result, 2013

5.6 A CRITICAL ASSESSMENT OF AGRICULTURAL PRODUCTION IN THE REGIONAL STATE OF TIGRAY

The above stated results are related to the survey data collected from the two districts Kilte Awlalo and Ganta Afeshum of the Eastern Zone. This subsection deals with the overall critical assessment of agricultural production at the regional level. It is a document analysis mainly from the Central Statistics Agency of Ethiopia and the Bureau of Agricultural and Rural Development of Tigray region. In addition to these documents, other relevant materials were reviewed. The major issues addressed in this subsection are: crop production, livestock and natural resources activities of the region.

5.6.1 Crop production

According to Beyene et al. (2005, p. 64), agriculture is one of the vital economic activities in the regional state of Tigray. The Central Statistical Agency of Ethiopia (2011/12, p. 13) has estimated that the total farm households and members of farm households in Tigray region in the year 2011/12 to be 998,148 and 4,943,064 respectively. Increasing crop production is critical for ensuring food security, industrial input supply and improving export earnings (MoFED, 2013, p. 27). More than half of the soils in Tigray region are shallow, having very low organic matter and are extremely deficient in both nitrogen and phosphorus (Beyene et al., 2005, p. 64). The Tigray region is also a drought prone area and ensuring food security is a challenging endeavour, given these poor natural resources.

Crop production of seven years of the Tigray region has been taken and discussed (Table 5.33). As indicated in the table, crop production increased with the exception of the 2009/10 production year. According to the CSA (2013b, p. 17), grain crops were utilized for the purpose of household consumption, seeds, sales, wages in kind, animal feed and others. In the Tigray region, 68.82 percent of the total crop production is used for the purpose of household consumption (CSA, 2012d, p. 19). In the 2011/12 production year, 10,267,169.08 quintals were utilized for the purpose of household consumption.

Moreover, there were 4,943,064 members of farm households in the same production year. When the total production is divided by the total members of farm households, the result is 2.08 quintals per person per year. As indicated in the previous section, on the basis of a minimum daily requirement of 2400 calories per person, a standard accepted by the FAO and WHO, a household with a family of five would have to consume 13 quintals of food grain annually (Desalegn, 2009, p. 40). This standard food requirement is 2.6 quintals per year per person. The computed quintals per year per person of Tigray region is lower than the standard accepted by the international organizations indicating food insecurity in Tigray region.

As indicated in the same table, the crop productivity of the region is also compared with the level of productivity at the national level. In all the years considered, except the production year of 2010/11, the productivity of the region is lower than the productivity at the national level. In the seven years analyzed above, the average crop productivity of the Tigray region and that at national level is 14.22 and 14.78 quintals/ha respectively. Furthermore, by the end of the Growth and Transformation Plan (2014/15), the crop productivity target of the country was expected to reach 22 quintals per hectare (MoFED, 2010, p. 47; MoFED, 2013, p. 29).Based on this benchmark, the region is expected to increase its productivity by 7.78 quintals per hectare[9]to reach the national benchmark of 22 quintals per hectare at the end of the Growth and Transformation Plan. Looking at the productivity change observed in the seven years considered, it will not be easy for the region to reach the benchmark of 22 quintals per hectare in the remaining years. This is because the productivity change from the production year of 2005/06 to 2011/12 was only 5.24 quintals per hectare[10].

[9]22quintals/hectare-14.22 quintals/hectare=7.78

[1010] 17.17 quintals/hectare (2011/12)-11.93 quintals/hectares (2005/06)=5.24

Table 5.33: Cultivated land and crop production of Tigray National Regional State (*Meher*and *Belg* seasons) and crop productivity at the national level.

Year	Tigray region			National
	Cultivated land (ha.)	Production (quintals)	Crop productivity (quintals/ha.)	Crop productivity (quintals/ha)
2005/06	727,740	8,685,000	11.93	12.76
2006/07	871,470	10,936,840	12.55	13.56
2007/08	887,072	11,838,566	13.35	13.97
2008/09	900,144	12,392,563	13.77	14.41
2009/10	866,225	11,518,131	13.30	15.21
2010/11	839,942	14,654,096	17.45	16.35
2011/12	870,444	14,918,874	17.17	17.18
Average crop productivity (quintals/ha)			**14.22**	**14.78**

Source: Central Statistics Agency of Ethiopia (various reports)

The Bureau of Agriculture and Rural Development report of the region indicated that 473,527 households were food secure in the year 2010/11(BoARD, 2011, p. 14). Furthermore, the bureau planned for 280,999 households to be food secure for 2011/12. This implies that from the total 979,924 households of the region (CSA, 2011b, p. 12), only 225,398 households were expected to be food insecure at the end of 2011/12. In the same year, 436,652 households were food insecure and are still in the PSNP list(Table 5.34).The number of households who are graduating from the safety net program in each year indicated that ensuring food sufficiency will be a difficult task in the near future. For instance, the BoARD planned for 25 per cent of the safety net beneficiaries to graduate at the end of 2011/12 fiscal year (BoARD, 2011, p. 25). However, the actual household beneficiaries who graduated from the program were only 10.05 per cent.

The PSNP document explained that, before a household could be defined as graduating, significant improvements in food availability and asset building were required (MoARD, 2009b, p. 8). A household is said to be food sufficient if the beneficiary is able to fulfil its

food needs for 12 months and be able to withstand modest shocks in the absence of PSNP transfer (MoARD, 2009a, p. 13).Households are expected to graduate from the program voluntarily or based on the benchmarks. Self-graduation occurs when households voluntarily leave the PSNP for other more valuable activities rather than participating in the program (MoARD, 2007, p. 5). In the year 2011/12, the total number of households who graduated from the program on voluntary basis was only 1,041(2.5 per cent). Thus, the majority of the households graduated based on the agreed asset benchmarks or criteria.

In the PSNP document prepared at national level, there are no clearly stated asset benchmarks or criteria for graduating households. Regions are allowed to set their own benchmarks for graduating households (MoARD, 2007, p. 6). Hence, the responsible bodies for graduation such as Development Agents (DAs), *tabia* Food Security Task Force and the *wereda* of Tigray region are using an asset benchmark of 5600 Birr per person per year. This means a household with five family members with total asset holdings of 28,000 Birr is considered a food self-sufficient household and would be proposed for graduation to the *wereda*.

The *wereda* officials and extension agents were asked about the underlying logic behind the graduation benchmark of 5600 Birr per capita per year. They explained that one US dollar has been taken as the benchmark and, at the time the program was launched in 2005, the exchange rate of one US dollar was 15.50Birr. If this was the base for the computation, the average exchange rate in the year 2011/12 was 17.50Birr. The equivalent benchmark for graduation was expected to be 6388 Birr per capita per year. In the study conducted in the Eastern Zone of Tigray, Gebresilassie (2013, p. 4) pointed out that the graduation benchmark for safety net beneficiaries does not consider an adjustment for the change in the rate of inflation and conversion factors.

Table 5.34: PSNP household beneficiaries of Tigray region for 2009/10-2011/12

Households	Year		
	2009/10	2010/11	2011/12
PSNP beneficiaries	441,709	436,652	417,863
PSNP graduation	16,476	33,746	42,012
Graduation (per cent)	3.7	7.7	10.05

Source: Bureau of Agriculture and Rural Development of Tigray

5.6.2 Livestock population and production

Ethiopia is believed to have the largest livestock population in Africa. According to the CSA (2012a, p. 4) livestock products and by-products provide the required animal protein that significantly improves the nutritional status of the people. Livestock assets are also a source of security at times of crop failure as they are near-cash capital stock. In addition, the share of livestock to the gross domestic product (GDP) of the country was 9.5 per cent in the 2011/12 fiscal year (MoFED, 2013, p. 28).

From the various reports of the CSA of Ethiopia, seven consecutive years of livestock population of the region have been reviewed (Table 5.35).The CSA is relatively more dependable and capable institute in gathering data from all regions of the country.

From the survey results of the two districts, respondents stated that free grazing is prohibited in their *tabias*. The zero-grazing approach is applied in all districts of the national regional state of Tigray. Previously, the special feeding treatment was given to plough oxen, milking cows and young stock but the other domestic animals were expected to find their feed roaming in the harvested crop fields (Edwards et al., 2010, p. 41).The free movement of animals in the field has resulted in environmental degradation, destroying plant seedlings and destroying physical structures constructed for soil and water conservation (Edwards et al., 2010, p. 41; Bewket, 2011, p. 56). The availability of feed resources and their nutritional qualities are the most critical factors that make a

difference in the productivity of livestock (Tesfay, 2010, p. 4). In the study conducted in the Ethiopian highlands, Holden et al. (2004, p. 386) found that, in the past ten years, the reduction in fodder production as a result of land degradation led to the reduction of livestock assets.

The livestock production in Tigray follows traditional practices and is hampered by nutritional stress and limited quality of livestock feed. According to CSA (2012a, p. 150), the major sources of livestock feeding in Tigray region are crop residues, green fodder, hay, improved feed, by-products and others. The same source indicated that crop residue and green fodder are the major sources of livestock feed for 42.34 and 37.74 per cent of the livestock holders respectively. For the livestock holders of Amhara and Oromia region, green fodder is the major source of livestock feed.

In the year 2011/12, the total milk production and average daily milk production of the region was 184,361,998 and 1.526 litres respectively (CSA, 2012a, p. 114). The average daily milk production is slightly lower than the national average which was 1.543 litres.

The contribution of livestock to the livelihood of the farm operators has been undermined by many undesirable occurrences. One of these adverse factors was animal disease. It is reported that, from the total cattle population in 2011/12, there were 346,303 diseased cattle. From these, only 122,990 cattle were treated and the rest, 64 per cent, did not get any treatment. Thus, in the same reference period, the numbers of cattle deaths were 200,053 (CSA, 2012a, p. 130-132). In addition, in the Tigray region, the increasing number of farmers and the demand for additional cultivated land has led to the dramatic reduction in common grazing land for animals (Edwards et al., 2010, p. 41).

Table 5.35: The numbers of livestock in the National Regional State of Tigray.

type	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Cattle	2,646,240	2,922,407	3,119,407	3,103,468	3,242,931	3,630,957	3,539,395
Horse	1,894	2,270	*	5,427	*	2,108	3,974
Donkeys	389,556	434,698	462,497	463,492	456,093	568,121	578,273
Mules	7,901	7,247	6,665	7,694	4,920	4,229	3,752
Camel	33,761	33,794	34,448	32,552	32,288	34,205	35,946
Sheep	814,472	972,506	1,388,104	1,376,961	1,149,717	1,255,403	1,121,537
Goat	2,412,633	2,771,267	3,005,463	3,107,994	2,621,227	3,049,486	2,874,520
Poultry	3,131,239	3,474,394	4,262,337	3,829,788	4,266,077	4,308,595	5,003,126
Beehives	182,341	183,771	242,868	255,607	195,662	213,133	219,036

* Unreported

Source: Central Statistics Agency of Ethiopia various publications

Ethiopia is one of the countries on the globe with the largest honey bee population and has a huge potential of honey production in its different ecological and climatic conditions (Kinati, Tolemariam, Debele, & Tolosa, 2012, p. 85). Hence, honey production is a long tradition in Ethiopia and Tigray as it allows farm operators to diversify. It also creates an opportunity for farm households to get additional income from the sales of honey and wax. The Central Statistics Agency classified the beehives into traditional, modern and intermediate (transitional) beehives (Appendix 11).Honey production from the traditional beehives is dominant at the national and regional level. For instance, the production share of the traditional beehives in the harvest year of 2011/12 was 92.6 and 69 per cent at the national and regional level respectively. In addition, 40.4 and 56.06 per cent of the total honey produced was utilized for household consumption and sales respectively (CSA, 2013b, p. 92). Hence, it is serving farm households as a means of additional income and nutrition.

As indicated in Table5.36, the honey production of the Tigray region based on all beehives, has increased from the harvest year of 2005/06 to 2008/09 and relatively

decreased from 2009/10 to 2011/12. In terms of yield, the average productivity of honey of all beehives of the Tigray region is above the national average, with the exception of the 2005/06 production year. In addition, the modern and traditional beehives in the region provide, on average, 15.53 and 9.76kg/hive respectively (CSA, 2012a, p. 80). The natural vegetation recovery in most of the areas in the region has created an opportunity for farmers to be productive in honey production.

Table 5.36: The number of beehives and honey production in the National Regional State of Tigray

	Tigray region			**National**		
	All beehives		**kg/hive**	**All beehives**		**kg/hive**
Year	Number of beehives	Honey production (kg)		Number of beehives	Honey production (kg)	
2005/06	182,341	1,736,711	**9.52**	4,012,515	41,541,383	**10.35**
2006/07	183,771	2,044,166	**11.12**	4,870,679	51,174,267	**10.51**
2007/08	242,868	3,362,018	**13.84**	4,688,278	42,180,346	**9.00**
2008/09	255,605	3,904,848	**15.28**	5,149,244	39,660,647	**7.70**
2009/10	195,662	3,203,088	**16.37**	4,598,226	41,524,967	**9.03**
2010/11	213,133	2,767,634	**12.99**	5,130,322	53,675,361	**10.46**
2011/12	219,036	2,432,652	**11.11**	4,993,815	39,891,459	**7.99**

Source: Central Statistics Agency of Ethiopia (different reports)

Major challenges of agricultural production in the Tigray region

A report of the Bureau of Agriculture and Rural Development pointed out some of the problems that undermine the performance of crop and livestock production in the region. The report stated that the extension agents lacked the required commitment and gave priority to their own private benefits rather than the benefits of the farming communities (BoARD, 2011, p. 4). They were not yet ready to improve their skills to support the farm households especially in the area of irrigation and technology utilization.

The Bureau, in the above report, only stated the problems related to the extension agents working in different *tabias* in the region. It failed to mention that some of the problems might be due to the absence of appropriate interventions by the Bureau itself. For instance, in the survey study, extension agents complained that they were obliged to be involved in activities which were not related to their profession.

The farmers' lack of commitment and doubtfulness in using technological inputswas also mentioned as another problem (BoARD, 2011, p. 9). The report did not attempt to identify the major reasons why farmers were not interested in using inputs. Instead, the report was concerned more about the absence of demand for chemical fertilizers which were stored. The high cost, erratic and unreliable rainfall were some of the factors that made the application of inorganic fertilizers unprofitable (Bewket, 2011, p. 65).The same report acknowledged the supply of poor quality improved seeds to farmers (BoARD, 2011, p. 9). The respondents from the two districts in the survey also reflected the same view. They clearly stated that the supply of improved seeds was not based on the interests and requests of farmers. Despite the farmers' requests, it was difficult for them to get the previously tested and productive improved seeds again.

There were many challenges related to honey production in Tigray. There were incidences of honeybee colonies abandoning their hives and migrating to other locations. In the study conducted in the south-west of Ethiopia, Kinati et al. (2012, p. 90) found that honeybee colonies migrate because of lack of forage, incidence of pests and predators, during harvest, bad weather situations and bee disease.

5.6.3 Natural resource development and conservation activities of the Tigray region

This subsection presents the performance of the region on natural resources and conservation activities. There are afforestation efforts in the region through planting trees as well as soil and water conservation activities as indicated below.

The activities of human beings have modified the environment because the demand for

more production cannot be achieved without modifying it (Alemayehu, Nurhussen, Nyssen, Girma, Zenebe, Behailu, Deckers, & Poesen, 2008, p. 192). However, the demand for more production to feed the increasing population should be ensured in a sustainable way. In Ethiopia, the public mobilization for soil and water conservation was mainly started during the military regime. The mobilization of farm households and the food-for-work projects were geared towards conserving the degraded land through the construction of stone terraces, soil bunds and afforestation (Gebremedhin, & Swinton, 2003, p. 70).

As indicated in Table 5.37, the actual performance of the soil and water conservation in the form of soil bunds and terracing of the region in the years 2008/09 and 2009/10 exceeded its plan (BoARD, 2013, p. 24). The activities were carried out by the communities in the form of free labour contribution, food/cash-for-work and projects. However, the largest proportion of the activities was performed by the free labour contribution of the community for 20 days every year. For instance, 65 per cent of the soil and water conservation activities in the year 2011/12 was planned to be accomplished by the free labour contribution of the community (BoARD, 2011, p. 42). The share of the food/cash-for-work in the same year was planned to be 20 per cent of the soil and water conservation activities.

Table 5.37: Soil and water conservation (SWC) activities (hectares) of the National Regional State of Tigray

Activities	**Years**			
	2008/09	2009/10	2010/11	2011/12
PlanSWC (ha)	261,445	210,000	150,000	177,321
Performance (ha)	287,000	238,564.87	142,214.92	153,862
Performance (%)	109.77	113.60	94.81	86.77

Source: Annual book of Bureau of Agriculture and Rural Development of Tigray (2012/13)

5.7 CONCLUSION

The landholding size was found to be too small to sustain the lives of farmers in the study area. The insufficient landholding size was further exacerbated by the large family size of households. The opportunity to get multiple harvests in a single growing season was limited because the proportion of irrigated land to total cultivated land was minimal. There is also a shortage of water for irrigators forcing the *tabias* to introduce water rationing schemes. The farmers often wait for many days to get water for their crops. Farmers stated that if they refused to purchase fertilizers in the rainy season, they would not be allowed to get water for irrigation.

The majority of the respondents purchased chemical fertilizers. However, fertilizer transactions in the rural areas were full of tensions. The farmers tried to make their own cost and benefit analysis by using the inputs strategically in an uncertain future of rain-fed agriculture, but the extension agents and administrators aimed to sell all of the inputs sent to them from the higher tiers of government. Regardless of the imposition by officials, the actual utilization of fertilizers for more than half of the farmers was below the standard set by the region. On the contrary, the farmers were highly interested in some of the identified and already tested varieties of improved seeds. Unfortunately, the extension agents and *tabia* administrators did not supply those varieties accepted by the farm operators. Farmers wondered why their demands were not fulfilled and the officials failed to understand that chemical fertilizer application should be combined with the responsive improved seed varieties. The farmers were therefore forced to use inorganic fertilizers and there was no room for farmers to present their preferences.

The annual average crop yield of the households in the study area was found to be below the standard set by the international organizations.[11] According to these international organizations, a moderately healthy peasant with a family of five should consume 13 quintals of food grains annually whereas the annual mean crop yield of households was

[11]WHO and FAO

found to be 8.73 quintals per household. Farmers were also expected to use a certain amount of grain for seed and animal feed that further reduced the food grains for household consumption. In addition, the mean annual farm income of farmers was much smaller than the graduation benchmark for safety net beneficiaries.

Crop rotation and intercropping were practiced by farmers in the two districts. The problem was that these practices were not on the agenda of the extension agents and therefore the farmers did not get the required support from them. They applied crop rotation and intercropping without following any scientific methods and without identifying complementary crops. The methods of crop rotation and intercropping are environmentally friendly and such fertility enhancing methods that reduce the amount of chemical fertilizers farmers required should be applied. Paradoxically, the extension agents were found to be favouring and campaigning for inorganic fertilizer as well as serving the interest of the higher officials rather than the interests of the rural communities.

Consequently, the professional support of extension agents was found to be wanting, minimal and negligible in the study areas. They were highly engaged in mobilizing rural communities for the soil and water conservation activities and distribution of fertilizers. In the interview, the extension agents admitted that most of the contacts they made with the farmers were not related to their areas of expertise. They were engaged in unrelated activities such as listing down the total number of party members of the governing party, the status of their membership fees, processing the repayment of credit from the cooperatives and a series of unrelated meetings.

Moreover, in each *tabia*, experts specialized in crops, natural resources, irrigation and livestock are assigned by the government. The intention of this combination was for each expert to support farmers in the fields of their specialization. However, in practice, the extension agents on the ground were found to be different. Extension agents assigned themselves to different *Kushets* of the *tabias* to supervise and advise farmers. A livestock expert who was assigned in a particular *Kushet* was expected to assume the responsibility

of the other professionals in the area of crop production, irrigation and natural resources. Nevertheless, it is obvious that the supervision and advice in the fields of crop production, irrigation and natural resources were beyond the specialization of the livestock expert.

In order to identify the factors that affect the crop and farm income of farmers, the regression model was used. The regression result indicated that landholding size, ownership of oxen, fertilizer and improved seed utilization, irrigated land, plot soil quality, village distance to the *wereda* market, average distance of plots from the homestead and crop rotation were statistically significant determinants of the farm income. In addition, crop income was affected by almost the same variables as the farm income.

Most of the farmers sold their agricultural products during the harvest season. This created a temporary excess of supply in the market and, as a result, farmers could not get reasonable prices for their products. Farmers were forced to use inputs to boost agricultural production. Although the marketing issue deserved equal attention, it was not the concern of extension agents or of farmers' cooperatives. The farmers' cooperatives were mainly engaged in the distribution of agricultural inputs and consumer goods. The cooperatives did not provide the major tasks of buying and storing the agricultural products at the peak period and selling them at the slack period for farmers to get reasonable prices for their yield. Moreover, the primary source of market information for the farmers was found to be their neighbours.

The majority of the respondents also participated in off-farm activities. The numbers of participants in the agricultural wage income were small compared to self-employed income and non-agricultural wage income. This was because the landholding size of households was too small and the demand for additional labour beyond the members of the household is minimal. In addition, the annual average off-farm income of respondents was found to be greater than their average crop income. Yet, the issues of off-farm activities did not get the required attention from the different hierarchies of the

government and the agricultural policy documents.

The rural land administration and land use proclamation of the region restricts farmers from being out of their localities for more than two years. This does not allow them to seek long term off-farm employment for fear of land confiscation. Furthermore, the majority of the off-farm participants were those with the lowest farm income. Hence, the purpose of off-farm participation was for respondents to complement their insufficient farm income. In order to identify the off-farm participation and income determinant factors, Probit and Tobit models were utilized.

The Probit model results indicated variables such as irrigation, age, money borrowed, fear of land confiscation and access to electricity as statistically significant to affect off-farm participation negatively. The distance of the village to *wereda* market was the only significant variable that affected participation positively.

In the Tobit model, irrigation, age, family size (adult equivalent), education, possession of radios and access to electricity were significant variables that affected farmers' off-farm income.

In order to critically review the agricultural production of Tigray, secondary sources from federal and regional levels were consulted. The region is one of the drought prone areas of the country and ensuring food security is a challenging endeavour. According to Beyene et al. (2005, p. 64) crop production of the region was affected by shallow soil which was very low in inorganic matter and extremely deficient in nitrogen and phosphors. The average crop productivity (quintals/ha) of the region is lower than the national average. In addition, the annual food grain consumption of the region is below the minimum daily requirement of 2400 calories per person. There are also many households in the list of the Productive Safety Net Program (PSNP) who are unable to fill the annual food requirements of their families.

CHAPTER 6: SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

The agricultural sector is the basis of livelihood for a large proportion of society in Ethiopia. In the three political regimes in modern Ethiopia, the Imperial, the military and the EPRDF, agriculture has been regarded as a critical sector. As Lefort (2012, p. 686) stated, the current government of Ethiopia is highly involved in the agricultural sector and, through its developmental state theory, has put the highest level of investment into the sector. The Agricultural Development Led Industrialization (ADLI) is the national policy of the country. Regardless of the government's policy attention and investment, there is a long way to go for smallholders to ensure food self-sufficiency.

The aim of this study was to assess the factors that affect agricultural production in Tigray National Regional State, northern Ethiopia. To this end, two districts (Kilte Awlalo and Ganta Afeshum) in the Eastern Zone were investigated. Furthermore, three *tabias* from each district were identified for data collection. Farmers from these *tabias* were the units of analysis for the study. Based on the sample determination formula, data was collected from 400 household heads using questionnaires. The six rural *tabias* selected for household data were: Genfel, Adiksanded, Mesanu, Sasun-Bethariat, Gola Genahti and Buket.

The purpose of this chapter is therefore to present the overall summary of the results of the study, conclusions and recommendations together with highlighting gaps for future research.

6.2 SUMMARY

The recent changes at a global level such as increasing food prices and global economic crises exposed the poor to external shocks. State intervention and input supports have

also been reduced as a result of SAP. It is difficult to replicate the Asian Green Revolution in Africa as the Asian countries had the full support of their respective governments. Regardless of the changing global situations, the success story of the Asian Green Revolution has encouraged governments in African to promote the application of chemical fertilizers, improved seeds and irrigation schemes. However, studies indicated that the chemical fertilizer application of Sub-Saharan countries is lower than the South and East Asian counties. In Sub-Saharan Africa (SSA), the intensity of chemical fertilizer application is 11 kg/ha while in South Asia and East Asia the intensity is 130kg/ha and 271kg/ha respectively.

Regardless of their ideologies, all governments have an interest in intervening in agricultural marketing and pricing. The purpose of the intervention is for farmers to get the reasonable prices and to create conducive environment for the national food security of their nations. However, the weak market linkages, asymmetric information and high transaction costs are some of the market challenges for governments and farmers. Farmers are establishing farmers' cooperatives to reduce the impact of these challenges. Regardless of the objectives, some cooperatives are highly inclined to input distribution rather than marketing services of agricultural products. In addition, farmers are engaged in off-farm activities in order to augment their income from the agricultural sector. Studies indicated that the diversification of farmers to off-farm activities could be as a result of the push and pull factors. If the purpose of off-farm participation is to complement an insufficient farm income, it is as a result of push factors. On the other hand, if the off-farm participation is for a better income, it is as a result of the pull factors.

The specific objectives of the study wereto investigate major factors affecting agricultural production and income, agricultural marketing challenges, factors that influence off-farm labour participation and income and to undertake a critical review of agricultural production at a regional level. These specific objectives were taken as a theme to present the main finding of the paper in Chapter 5. The summary of these results was also made considering the specific objectives as a theme as shown below.

The major factors affecting agricultural production and farm income of the farming households

The landholding size (0.53ha) of farm households in the study area was too small to fulfil the food requirements of their families. The small landholding size was further aggravated by the large average family size (6.21) per household. The limited opportunity for irrigation schemes forced farmers to depend mainly on rain fed agriculture. The study demonstrated that, from the total land possessed by respondents, 11 per cent were irrigated. This is slightly lower than the 11.27 per cent irrigated land at the regional level.

The majority (94.75 per cent) of the respondents applied chemical fertilizers. The intensity of fertilizer application was lower than the standard set at a regional level. For all types of soils, crops and agro-ecologies, 200kg/ha or 50kg/*Tsimad* was the standard recommended in all areas of the region. For 60 per cent of the respondents, the amount of fertilizer applied was 26.45kg/*Tsimad*. Fertilizer transactions were composed of confrontations between farmers on one side and extension agents and *tabia* administrators on the other.

Farmers were interested in using improved seeds if these varieties were based on their choices. Respondents stated that the supply of improved seeds was insufficient and the supplies were not based on their preferences.

Respondents applied inputs with different purposes. For most of the respondents (34.25 per cent), the fear of exclusion from the Productive Safety Net Program was the main reason for applying chemical fertilizers and improved seeds. The annual average crop yield of respondents did not meet the standard set by the WHO and FAO. The annual average production of respondents was found to be 1.59 quintals per person per year. The standard annual food requirement, with 2400 calories per person per day, is 2.6 quintals per person.

Crop rotation and intercropping were practiced by farmers in the study areas independent of any advice from extension agents who did not consider them but were only interested in their own agendas. The professional support by extension agents was minimal in the study area. The average annual number of contacts between respondents and extension agents was 23. From these contacts, there is a mandatory free labour mobilization for soil and water conservation activities for 20 days. The free labour mobilization was interpreted by farmers as being used by the extension agents for professional support. The agents acknowledged that most of their activities were not related to their professions. They were ordered to list the names of party members of the ruling party and the status of their membership fees, process credit repayments to the cooperatives and attend a series of unrelated meetings.

The regression model used to identify the factors that affect crop and farm income of respondents indicated that, as the landholding size increases by one hectare, farm income increases by 5096.76 Birr. The possession of an ox was a critical asset in the rural areas and increasing the possession of oxen by one increases farm income of the household by 8709.04 Birr. The farmers who adopted improved seeds got 3139.27 Birr higher farm income compared to non-users. The application of fertilizer was also significant indicating that an increase of fertilizer by one kilogram per *Tsimad*, towards the standard set in the area, increased the farm income by 26.24 Birr.

The result of the irrigation variable indicated that increasing irrigated land by one hectare increases farm income by 3105.5 Birr. Farmers who possessed fertile land got a farm income of 2017.23 Birr more compared to farmers with infertile land. The distance of plots from the homestead is another determinant variable. As the walking time from the homestead to plots increased by one minute, the farm income decreased by 46.42 Birr. The farmers applying crop rotation got 4068.14 Birr more farm income compared to farmers who do not practice it.

The regression model has been used to identify the impact of the identified variables on

crop income of farm households. The model result indicates that plot size, age, possession of oxen, fertilizer intensity, improved seed, size of irrigated land, average plot distance from homestead, village distance from the *wereda* market and crop rotation have found to be statistically significant determinant variables.

The major challenges of the household heads in marketing their produce

For the majority of the respondents, the *wereda* was the market place to sell their products. Only 17 per cent of the farmers accessed the regional market (Mekelle).The most frequent month for respondents to market their agricultural products was January. They were obliged to sell their agricultural products for loan repayments and social festivities right after harvesting. This leads to a lower selling price of products as a result of excess supply in the market.

The farmers' cooperatives were expected to support farmers in receiving the products in the peak period and selling them in the slack seasons but the marketing issues were not the concern of the cooperatives and extension agents. Cooperatives were input distributors especially of chemical fertilizers. The absence of appropriate leadership and management of cooperatives led them to be ineffective in serving farmers. In taking their products to the market, respondents mainly depended on foot and pack animals. Their neighbours were the major source of information for respondents regarding markets for the products.

The major determinant factors for farmers' participation in off-farm activities and their impacts on the off-farm income

Most of the respondents (88 per cent) participated in off-farm activities in the study area. The non-agricultural off-farm employment rate was higher in the majority of participants who had a higher average income. The average off-farm income of the respondents was greater than the crop income. Regardless of its contribution, off-farm employment got the required attention in the policy documents of the country. The land administration and

land use proclamation of the region restricts farmers from being away from their localities for more than two years. As a result, farmers would not seek long term off-farm employment for fear of land confiscation. In line with this, 43 per cent of the respondents admitted that they were afraid of land confiscation when away from their localities. The contradiction was that farmers were allowed to rent out half or less than half of the land in their possession. These provisions prohibited farmers from renting out all of their landholdings and seeking off-farm employment out of their localities.

Most of the respondents (86.08 per cent) who participated in off-farm employment were in the two lowest farm income categories. This indicates that off-farm employment participation in the study areas was as a result of push factors rather than pull factors. Access to electricity was one of the facilities that enhanced off-farm participation by farm operators. In the study area, 23.5 per cent of the respondents had access to electricity. Lighting was the major advantage stated by farmers rather than opening opportunities for off-farm activities.

To identify the determinant factors for farmers to participate in off-farm activities and their impact on the off-farm income, Probit and Tobit models were used. The model results indicated that, if the irrigated land increased by one hectare, the probability of off-farm participation would decrease by 26.6 per cent. In terms of income, if irrigated land increased by one hectare, off-farm income would reduce by 7854.05 Birr.

As the household age increased by a year, the probability of off-farm participation and income decreased by 0.32 per cent and 84.19 Birr respectively. The access and amount of credit available to farmers reduced both the probability of off-farm participation and the income.

Access to electricity was a significant variable that influenced the probability of off-farm participation and income negatively. Fear of land confiscation by farmers who were away from their localities was another participation determinant variable. The probability of off-farm participation for the households who fear land confiscation was 7 per cent lower

than those who did not fear it.

Some variables were not statistically significant to determine the probability of off-farm participation in the Probit model. However, this research found significant variables that influenced the off-farm income of the households. As the family size of the household (adult equivalent) increased by one member, the off-farm income increased by 1019.97 Birr. Households who were literate and possessed a radio had a higher off-farm income compared to households who were illiterate and without radios.

Review of agricultural production in the National Regional State of Tigray

Studies indicated that more than half of the soil in Tigray region is shallow with very low organic matter and deficient in both nitrogen and phosphors. During the seven years analyzed, the crop productivity of the region has been compared to the crop productivity at the national level and found to be 14.22 and 14.78 quintals per hectare respectively. Based on the minimum daily requirement of 2400 calories per person, every member of a household should consume around 2.6 quintals per year. When the total production of the region is divided by the total members of the farm households, the result is 2.08 quintals per person per year. This is lower than the accepted standard by international organizations such as WHO and FAO.

The insufficient crop production resulted in a large proportion of farmers being on the list of the Productive Safety Net Program (PSNP). The number of household heads graduating from the program are also far below the expectations of government officials. In the year 2011/12, the BoARD of the region planned for 25 per cent of the beneficiaries to graduate from the program but only 10.05 per cent of household heads graduated from the program.

6.3 CONCLUSIONS

The central focus of this thesis was to investigate the factors affecting agricultural production in Tigray region, Northern Ethiopia. The landholding size of respondents was found to be too small to fulfil the annual food requirements of households. This was exacerbated by the large family size of farmers and the dependence on rain fed agriculture which was erratic. The proportion of irrigated land to the total cultivated land was small and that hindered farmers from achieving multiple harvests in a year.

The majority of the respondents used chemical fertilizers but the intensity of chemical fertilizer application was much lower than the recommended standard at the regional level. The recommended amount of fertilizer per hectare for all soil types, crops and agro-ecologies was also lower than the recommended standard. The soil conditions of the whole region varied. There were soil variations among *tabias* and even among plots in the same *tabia*. In addition, the supply of improved seeds was insufficient and the supplied ones were not the preference of the farmers.

The chemical fertilizer transactions were found to be full of tension in the study areas. Extension agents and *tabia* administrators were preoccupied with achieving the quotas set for chemical fertilizer sales to farmers. Hence, farmers were forced to purchase fertilizers for the sake of fulfilling the sales targets set at the *wereda* level. The study also indicated that, for the majority of the respondents, the fear of exclusion from the Productive Safety Net Program (PSNP) was the reason for purchasing fertilizers.

Farmers used the farming practices of crop rotation and intercropping without enough support from the experts. These farming methods were practiced by farmers without having the scientific knowledge to manage the succession of crops in the crop rotation and the complementary crops in the intercropping. Even though these farming methods were believed to be environmental friendly and sustainable, they were not promoted by the extension agents. Most of the contact between extension agents and farmers was during the annual free labour mobilization for soil and water conservation activities and

chemical fertilizer distribution. The professional advice of extension agents to farmers' specific problems was found to be minimal. In addition, extension agents were engaged in activities which were not related to their field of study. They were involved in listing down the names of party members of the ruling party and the status of their membership fees and attending a series of unrelated meetings.

The Regression model was used to identify the determinant factors of farm and crop income of respondents. The farm income model result showed that variables such as landholding size, possession of oxen, improved seeds, fertilizers, irrigated land, land fertility and crop rotation were statistically significant variables that affected the farm income positively. This implies that a unit increase of these variables increases the farm income of the farmers. On the other hand, the average distance of plots from the homesteads was a determinant variable which affected farm income negatively. The model results for crop income also indicated that land size, age, possession of oxen, fertilizer intensity, irrigated land, average plot distance from homestead, village distance from *wereda* market and crop rotation were found to be statistically significant variables.

For the majority of the respondents, the district was the market place for their agricultural products. This was because the volume of sales was small and the district market was the preferred market for their agricultural products. The sales of products right after harvest for loan repayments and social festivities led to lower selling prices due to temporary excesses of supply in the market. The farmers' cooperatives were expected to play a role in receiving the products of the farmers to regulate the excess supply in the market during the harvest season but these cooperatives did not provide any market support to farmers. The utilization of information and communication technologies, as sources of market information, was found to be minimal. Mainly, neighbours were serving as sources of market information for farmers to take their products to the market.

It was found that most of the respondents participated in and diversified their source of income from off-farm activities. Despite the contribution of off-farm activities, they were not the focus of the regional and federal policy documents. The land administration and

land use proclamation of the region restricts farmers from being away from their communities for not more than two years. In addition, farm households were allowed to rent out half or less than half of their landholdings. The provisions restricted farmers from renting out their plots and engaging in long term off-farm employment for fear of land confiscation. The land registration and certification was believed to allow farmers to make any decisions regarding their land with the exception of selling it. But there were unnecessary state interventions that might lead to the insecurity of land rights.

The highest income earners from off-farm activities were those respondents who were at the lowest farm income category. This indicated that off-farm participation in the study area was as a result of push factors rather than pull factors. This implies that income from this sector serves to fill insufficient income from the farm sector. In addition, access to electricity did not create opportunities for off-farm employment and lighting was regarded as the major advantage of electricity.

The Probit and Tobit model results showed that size of irrigated land, household age, credit amount and access to electricity were statistically determinant variables that influenced off-farm participation and income negatively. In addition, respondents' fear of land confiscation and village distance to the *wereda* market were determinants of off-farm participation. Other variables such as family size, education level and possession of radio were also off-farm income determinant variables.

The nutrient content of soil and depth were some of the agricultural production challenges in Tigray region. It was indicated that more than half of the soil of the region is shallow, low in organic matter and deficient in both nitrogen and phosphors. The average crop productivity of the region was lower than the national productivity level. The annual crop production (2011/12) per person of the region was also below the internationally accepted standard of the daily 2400 calories implying food insecurity in the region. The insufficient crop production in the region resulted in a large proportion of farmers who were Productive Safety Net Program (PSNP) beneficiaries.

6.4 RECOMMENDATIONS

Based on the findings, the following recommendations are made:

- The small landholding size of the area necessitated the intensification of agriculture through the use of chemical and natural fertilizers. However, farmers should not be forced to apply chemical fertilizers. The primary responsibilities of the agricultural experts should be to train and demonstrate the advantages of chemical fertilizers. The decision to use chemical or natural fertilizers should be left to the farmers themselves.
- The extension agents and administrators' attitudes that farmers are change resistant and do not know what is best for them should be changed. Farmers are rational, eager and highly committed to making livelihood changes and feeding their families. Therefore, the "It is only we who cares about you" attitude of government officials in the rural areas should be restricted.
- It is costly and unprofitable for farmers to adopt chemical fertilizers unless they are combined with access to improved seeds and irrigation. Officials should accept that farmers' resistance to chemical fertilizers is a rational decision in the absence of improved seeds and moisture.
- The recommended amount of chemical fertilizer application per hectare for all areas and crops in the region is the same. This blanket recommendation should be revised so that the amount of fertilizer used considers the variation in ecologies and crops.
- The assignment of crop, natural resource, livestock and irrigation experts at the *tabia* level is a good move to improve the production and productivity of the agricultural sector. In practice, the engagement of the extension agents on unrelated activities to their professions and assigning themselves permanently to different *Kushets* has not improved the agricultural production in the area. It is recommended therefore that each of the experts should set a clear plan to meet and advise farmers in the area of their specialization. The primary task of experts should be to advice and support farmers and the primary task of an irrigation expert should be in irrigation related activities. To be specific, the average

number of household heads in the six *tabias* surveyed was 1440. Each of the experts should have an annual schedule to reach out and attend to the specific problems of these households in the areas of their specializations.

- Some farming methods that help to enhance agricultural production and reduce farmers' costs were ignored. Methods like crop rotation and intercropping were practiced traditionally by farmers without the guidance of professionals. Hence, to improve agricultural production and ensure sustainable agriculture, farmers should be guided in the succession of crops in crop rotation and the complement of crops in the case of intercropping.
- Farmers are forced to sell a proportion of their agricultural products right after harvesting to repay loans. This could create a temporary excess of supply and a reduction in the selling price of agricultural products. The farmers' cooperatives should play a role in purchasing the products of the farmers at reasonable prices in the harvest season and resell them in slack seasons. By doing so, cooperatives could support farmers to get the right price during the harvest period and, at the same time, address their urgent cash needs for the loan repayments.
- Farmers engage in different types of off-farm activities in order to augment their farm incomes. Regardless of the contribution of off-farm activity, it did not get the required focus from the regional and federal policy documents. These issues undermine the benefits farmers could get from off-farm activities. It is therefore the responsibility of officials in all hierarchies to give off-farm employment equal coverage and attention as the crop and livestock products in policy documents at the regional and federal level because the participation of farmers in off-farm employment boosts their ability to adequately finance their farming activities.
- It was found that the land administration and land use proclamation of Tigray region restricts farmers from being away from their localities for more than two years and from renting out, at most, half of their landholding sizes. These restrictions limited the opportunities of farmers for long-term off-farm employment for fear of land confiscation. It is recommended that the absence of farmers from their localities should be relaxed at least up to four years to complement their farm income without fear of losing their landholding. This is

possible as long as the land is not idle. In the case of the restriction to the proportion of land to rent out, this should be the decision of the farmers themselves. The land certificate provided to them should ensure the right to make any decision related to their land with the exception of land sales.

- The Bureau of Agriculture and Rural Development of Tigray criticized the extension agents and farmers for being passive in solving the challenges related to crop, livestock and natural resources. However, the BoARD and other government officials should take their own share of responsibilities. The farmers are the major players in this respect and they should participate with respect and dignity to make the right decisions about their problems. Any prescription without the participation and willingness of the rural community cannot bring the required change.

6.5 AREAS FOR FURTHER RESEARCH

There are other relevant issues that are not addressed in this study. Hence, the following areas of future research are recommended.

The focus of this study was on rural respondents who are land owners. There is a need for research to investigate the livelihood of landless farmers in the study areas. It is also expected that landless farmers are to be involved in off-farm employment and renting of other farm households. It is therefore recommended to investigate the effect of off-farm activities as an alternative source of income for these farmers. In addition, there is a renting out restriction which limits the opportunities for landless farmers to rent land. The effect of this policy should be investigated. Moreover, it is recommended that the study be repeated in other districts of Tigray region and other regions of the country.

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APPENDIX 1: HOUSEHOLD SURVEY ON FACTORS AFFECTING AGRICULTURAL PRODUCTION

Information to be given to respondents

Mr. Bihon Kassa Abrha is currently studying at the University of South Africa (UNISA). This research is in partial fulfillment for the award of his Doctor of Literature and Philosophy at UNISA. The purpose of the study is to investigate factors affecting agricultural production of household farm operators from two selected districts. Investigating these factors that affect the agricultural production is helpful for policy makers in their attempt in improving the agriculture sector and the livelihood of farm operators.

This interview is completely confidential, strictly for academic purpose. Therefore, everyone participating in the survey will be anonymous and the information you provide can never be traced back to you. Your valuable input is highly appreciated.

Questionnaire ID:_____

Section I. Socio-economic Characteristics

Q1.Address:

Wereda name _____

Tabia name _____

Village (*Kushet*) name _____

Q2. Kindly state the sex, age and educational level of your own and your household members (**starting with the household head**)?

No	Gender Male=1 Female=0	Age (years)	Are you able to read and write? Yes=1 No=0	Education level	If he/she is not present, where & why?	
					Where? Code (a)	Doing what? Code (b)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Code (a): Current residence

This village or *tabia* ----------1

Rural area, this *wereda* ----------2

Rural area, this Zone ----------3

Other rural area ----------4

Urban area, this *wereda* ----------5

Regional city, Mekelle ----------6

Other urban area ----------7

Specify _____

Code (b): reason for absence from the village

Visiting----------1

Family reasons (funerals, caring for sick family, etc) ------2

Looking for work----------3

Away for business ----------4

Away for schooling ----------5

Married into other household ----------6

Working elsewhere ----------7

Do not know ----------8

Other ----------9

Specify

_____ _

Section II. Factors affecting agricultural production and agricultural income of the farm households

Q3. What is the size of cultivable land possessed by the household?

1. Owned land _____(*Tsimad*)[12]
2. Rented in _____ (*Tsimad*)
3. Total land size_____(*Tsimad*)

[12] One *Tsimad*=0.25 hectares

Q4. Household's plot characteristics

No.	Item	Plot	Description
1	Plot distance from homestead (walking minutes)	Plot 1	_____(minutes)
		Plot 2	_____(minutes)
		Plot 3	_____(minutes)
		Plot 4	_____(minutes)
		Plot 5	_____(minutes)
2	Slope of the plot Code: flat=1 Medium=2 Steep=3	Plot 1	Code:_____
		Plot 2	Code:_____
		Plot 3	Code:_____
		Plot 4	Code:_____
		Plot 5	Code:_____
3	Plot soil quality Code: fertile=1 infertile=0	Plot 1	Code:_____
		Plot 2	Code:_____
		Plot 3	Code:_____
		Plot 4	Code:_____
		Plot 5	Code:_____
		Overall	Code:_____

Q5. From the total land size you possessed (own and rented), how many *Tsimads* are irrigated? 1. Own _____(*Tsimad*) 2. Rented _____ (*Tsimad*)

Q6. What is your source of water for irrigation?

1. Check Dams ☐
2. River diversion ☐
3. Communal Wells ☐
4. Private Wells ☐
5. other, specify _____

Q7. If there were irrigation related problems, please state them.

1. _____

2. _____

3. _____

4. _____

5. _____

Q8. Did you use fertilizer inputs in your own or rented land in the recent harvest year (2004 E.C.)?

1. Yes ☐ 0. No ☐

Q9. If your answer for question number 8 is yes, how many kilograms of inputs did you use in your own and rented land?

1. Own _____(kg) 2. Rented _____ (kg) 3._____ (kg/*Tsimad*)

Q10. What was the cost of fertilizer inputs used?

1. Unit price_____ (Birr/quintal). 2. Total cost _____(Birr).

Q11. Did you use improved seeds in your own or rented land in the recent harvest year?

1. Yes ☐ 0. No ☐

Q12. If your answer for question number 11is yes, in how many *Tsimad* of land did you use improved seeds? _____(*Tsimad*).

Q13. What motivated you to apply chemical fertilizer and/or selected seeds in your own and rented land?

1. To increase the productivity of land ☐
2. Fear of denial of credit opportunities ☐
3. Fear of exclusion from safety net ☐
4. Fear of exclusion from irrigation schemes ☐
5. other, specify _____

Q14. If you did not use fertilizer inputs, what are the possible reasons?**(Multiple answers are possible)**

1. High selling price ☐
2. Late arrival of fertilizer to the purchasing points ☐
3. Scarcity of fertilizer supply ☐
4. No credit arrangement ☐
5. Risky if shortage of rain ☐
6. I used animal dung and compost ☐
7. Other, specify_____

Code (a): Types of Crop

1. Maize
2. Sorghum
3. Finger Millet
4. White Teff
5. Black and mixed Teff
6. Kerkaeta
7. Wheat
8. Oats
9. Barely
10. Rice
11. Horse bean
12. Field pea
13. Lentils
14. Haricot bean
15. Dokoko
16. Chick Peas
17. Cow Peas
18. Adagurra
19. Vetch
20. Soya bean
21. Sesame
22. Niger seed
23. Linseed
24. Sunflower
25. Ground nuts
26. Fenugreek
27. Beet root
28. Coffee
29. Eucalyptus
30. Pineapple
31. Mango
32. Onion
33. Garlic
34. Cabbage
35. Pumpkin
36. Spinach
37. Lettuce
38. Carrot
39. Tomato
40. Apple
41. Avocado
42. Orange
43. Banana
44. Papaya
45. Lemon
46. Cactus
47. Zeitun
48. Potato
49. Pepper
50. Sugarcane
51. Hops
52. Ginger
53. Others

Q15. Agricultural production and estimated values

No.	Types of Crop (code a above)	Total production (quintals)	Total production estimated value (Birr)	Gross income from sales (Birr)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				

Q16. Do you practice crop rotation? 1. Yes ☐ 0. No ☐

Q17. If your answer for question number 16 is yes, which crops?

1. _____
2. _____
3. _____
4. _____
5. _____

Q18. Do you practice inter-cropping? 1. Yes ☐ 0. No ☐

Q19. If your answer for question number 18 is yes, which crops?

1. _____ with _____
2. _____ with _____
3. _____ with _____
4. _____ with _____
5. _____ with _____

Q20. Types of livestock and estimated values

No.	Type of livestock	Number owned	Livestock estimated value (Birr)	Gross income from sales (Birr)
1	Oxen			
2	Cows			
3	Bull			
4	Heifer			
5	Calves			
6	Donkey			
7	Mule			
8	Horse			
9	Camel			
10	Goats			
11	Sheep			
12	Poultry			
13	Pigs			
14	Honey bees (colony)			
15	Other, specify_____			
	Total			

Q21. Did your village or *tabia* apply the practice of zero-grazing?

1. Yes ☐ 0. No ☐

Q22. If your answer for question number 21 is no, what are the major constraining factors for the village or *tabia* to apply the practice of zero-grazing?

1. _____
2. _____
3. _____
4. _____
5. _____

Q23. If your village or *tabia* has applied the practice of zero-grazing, what are the advantages you get from it?

1. _____
2. _____
3. _____
4. _____
5. _____

Q24. Is there any negative impact of zero-grazing on the livestock population?

1. Yes ☐ 0. No ☐

Q25. If your answer for question number 24 is yes, what are these negative impacts?

1. _____
2. _____
3. _____
4. _____
5. _____

Q26. Did you get enough rain in the last production season?

1. Yes ☐ 0. No ☐

Q27. During the last production season, did your household suffer any shortage of food to eat?

1. Yes ☐ 0. No ☐

Q28. If your answer for question number 27 is yes, for how many months did you face problems of fulfilling the food needs of the household? _____ (months)

Q29. Credit related questions

Have you ever taken credit in the recent harvest time? Yes=1 No= 0	Why did you want to obtain a loan? **(multiple answers are possible)** 1= buy beehives 2= buy dairy cattle 3= agricultural input 4= household consumption 5= fertilizer and selected seed 6= others, specify_____	How much money did you request to borrow?	How much money did you allow to borrow?[13]	Sources of credit **(multiple answers are possible)** 1=DECSI 2= Bureau of agriculture 3= Bank (commercial) 4= money lender 5= relative/ friend 6= traders 7= women's association 8= cooperative 9= community support organizations (e.g. Equb, Iddir) 10. food security package loan 11. other, specify
Code:	Code:	_____(Birr)	_____(Birr)	Code:

[13] If credit is in kind, give estimated cash value

Q30. How do you repay the loan? **(Multiple answers are possible)**

1. Selling vegetables and fruits ☐
2. Selling crops ☐
3. Selling livestock ☐
4. Transfer from family members ☐
5. from own saving ☐
6. Income from food for work/ safety net ☐
7. other, specify _____

Q31. Which months do you repay your loans? (Start from the most frequent month of repayment).

1. _____ month
2. _____ month
3. _____ month

Q32. What was the interest rate you paid per year for the loan that you have taken? _____ (percent).

Q33. Do you thinkthe most frequent month of loan repayment is convenient to you?

1. Yes ☐ 0. No ☐

Q34. If your answer for question number 33 is yes, what are the major reasons?

1. _____
2. _____
3. _____
4. _____
5. _____

Q35. If your answer for question number 33 is no, what are the major reasons?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Q36. Did you get an advice or any support from the extension agents in the last production season?

1. Yes ☐ 0. No ☐

Q37. If your answer for question number 36 is yes, what was the average number of contact? 1. _____ (times a month) 2. _____ (times a year)

Q38. Do you think the number of contacts with the extension agents were enough?

1. Yes ☐ 0. No ☐

Q39. If the answer for question number 38 is no, what are the possible reasons for the extension agents' contact with the farmers to be insufficient?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Q40. Do you have a smooth relationship with the extension agent?

1. Yes ☐ 0. No ☐

Q41. If your answer for question number 40 is no, what are the possible causes for the disagreement?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Section III. Agricultural marketing related questions

Q42. Distance of the village from the district and regional market centers

No.	Item	Description
1	Village distance from Mekelle	_____kms
2	Village distance from *wereda* market	_____ kms
3	Village distance from Asphalt road	_____ kms
4	Village distance from Gravel road	_____ kms
5	Average transport cost per person to *wereda* market	_____ Birr
6	Average transport cost per quintal to *wereda* market	_____ Birr
7	Average transport cost per person to Mekelle	_____ Birr
8	Average transport cost per quintal to Mekelle	_____ Birr

Q43. How long did you travel, on the average, to reach to the district market? _____ (hours)

Q44. If you have a product to be marketed, when do you mostly take it to the market? **(Start from the most frequent one)**

1. _____ month
2._____ month
3. _____ month

Q45. What was the means of transport?

1. on foot ☐
2. Pack animal ☐
3. Vehicle ☐
4. Other, specify_____

Q46. How long did you spend, on the average, in the market to search buyers for your produce? _____(hours)

Q47. Did you have prior price information before taking your agricultural products to the market? 1. Yes ☐ 0. No ☐

Q48. If your answer for question number 47 is yes, from where did you get the market information? **(Multiple answers are possible)**

1. Government offices ☐
2. Buyers ☐
3. Brokers ☐
4. fixed/mobile phone ☐
5. other, specify _____

Q49. Did you get enough buyers for all of your agricultural products?

1. Yes ☐ 0. No ☐

Q50. If your answer for question number 49 is no, list the agricultural products that you did not get enough buyers.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Q51. Did you pay a commission for agents or brokers in search of buyers to your agricultural products? 1. Yes ☐ 0. No ☐

Q52. If your answer for question number 51 is yes, how much money did you pay for the agent/ broker in the recent harvest time? _____ (Birr)

Q53. Is there farmers' cooperative at the village or *tabia* level?

1. Yes ☐ 0. No ☐

Q54. If you are a member of the farmers' cooperative, what advantages did you get?

1. An improved negotiating power ☐
2. Better market information ☐
3. Agricultural inputs ☐
4. Other, specify_____

Section IV. The determinant factors for off-farm labour participation and its impact on the households' income

Q55. Did you work off the household's land either on someone else's land or in some other form of employment?

1. Yes ☐ 0. No ☐

Q56. If your answer for question number 55 is yes, give the following details

Employment	**Type of activity**	**Yearly income (Birr)**
Agricultural wage employment	Being involved in the farm labour market	
Non-agricultural wage	Masonry	
	Thatcher	
	Hair cutting or dressing	
	Construction	
	Cash-for-work	
	Others, specify_____	
Self-employment	Weaving/spinning	
	Hand craft	
	Trade in grain/general trade	
	Trade in livestock	
	Traditional healer/religious teacher	
	Transport (by pack animal)	
	Stone/ sand mining	
	Fuel wood/charcoal selling	
	Selling food and drink (Enjera, tea, Kolo, Arqi, sewa)	
	Other, specify_____	
Total off-farm income		
Other off-farm related income	Remittance	
	Gift	
	Pension	
	Other, specify_____	
Grand total off-farm income		

Q57. When you involved in off-farm labour market, could you tell me the location of your employment? **(Multiple answers are possible)**

1. This village (*Kushet*) ☐
2. Other village in the same *tabia* ☐
3. This *wereda* (district) ☐
4. This neighbouring *wereda* ☐
5. Regional capital—Mekelle ☐
6. Another regions of the country ☐
7. Migration to foreign country ☐
8. Other, specify_____

Q58. Did you afraid of land confiscation if you are away from your location for a long period of time?

1. Yes ☐ 0. No ☐

Q59. If your answer for question number 58 is yes, what is the reasonable time that you can be away for off-farm activity without endangering your possession? _____(days)

Q60. What was the major reason for you to participate in off-farm employment? **(Multiple answers are possible)**

1. Proximity to urban area ☐
2. Availability of off-farm opportunities ☐
3. Education level ☐
4. Favourable demand for goods/ services ☐
5. Excess labour in the household ☐
6. Land too small to support the household ☐
7. other, specify _____

Q61. If you did not participate in any of the off-farm activities, what were the possible reasons?

1. No employment opportunities ☐
2. Needed on farm ☐
3. Jobs too far away ☐
4. off-farm work is less profitable than farm work ☐
5. I am retired ☐
6. I cannot sell or rent my land ☐
7. other, specify _____

Q62. Do your village or *tabia* has access to electricity?

1. Yes ☐ 0. No ☐

Q63. If your answer for question number 62 is yes, what opportunities did you get from it?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Q64. Did your household possess radio? 1. Yes ☐ 0. No ☐

Q65. If your answer for question number 64 is yes, what services did you get from it?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Thank you so much!

APPENDIX 2: QUESTIONS FOR THE FOCUS GROUP DISCUSSIONS

Q1. Did most of the farmers apply agricultural inputs (Inorganic fertilizer and selected seeds) in the previous production season (2004 E.C)?

Q2. If most of the farmers have applied inorganic fertilizer, what initiated them to do so?

Q3. Did the farmers purchase the inorganic fertilizer on credit bases or in cash?

Q4. If the inorganic fertilizer is obtained on credit arrangements, what were the major requirements expected from the farmers at the time of the credit settlement?

Q5. If there were farmers who did not use inorganic fertilizers, what are the possible reasons for them to refuse in applying inorganic fertilizers? What alternative did they use?

Q6. Do farmers have the right to refuse using agricultural inputs without losing any public benefits provided by the government? If the answer is no, what public benefits could be denied?

Q7. What do you think are the major challenges or problems of farmers in using inorganic fertilizer and selected seeds?

Q8. How do you evaluate the accessibility of the village or *tabia* to irrigation?

Q9. What are the alternative sources of irrigation for the village or *tabia*?

Q10. What are the major irrigation related problems in the community?

Q11. How do you solve or respond to the irrigation related problems?

Q12. What types of credit arrangements are available for farmers in the community?

Q13. What are the major credit related problems in the community and how do you solve them?

Q14. What are the most serious agricultural production problems in the community?

Q15. How do you solve the most serious agricultural production problems?

Q16. Do you practice crop rotation and inter-cropping? Why or why not?

Q17. Have environmental conditions in terms of soil, water, plant and animal resource degradation improved or worsened in the *tabia* in the last five years?

Q18. How strict is the rules of zero-grazing in your *tabia*?

Q19. What should be done by farmers, developmental agents, administrators, financial institutions and others to enhance agricultural production and income?

Q20. Are there agricultural cooperatives at the village or *tabia* level?

Q21. What are the major supports provided by these agricultural cooperatives?

Q22. In your view, what are the major weaknesses of agricultural cooperatives?

Q23. For farmers to access a reliable market and get reasonable price for their products, what are the real contributions of cooperatives, *tabia* administration, development agents and credit and saving institutions?

Q24. When and why do farmers participate in off-farm employment?

Q25. Do farmers have the confidence on their land use right when they are away for off-farm activities for a long period of time?

Q26. If they are skeptical to be away from their village for off-farm activities, what experience made them to be doubtful of their land use rights?

Q27. Rural land administration and land use proclamation 136/2007 of the region states that a household heads are not allowed to be out of their village for two years. Do not you think this is a constraint for households to participate in off-farm activities for long?

Q28. What is the need for this restriction in the proclamation as long as there are other family members in the village who are engaged in the farm activities?

Q29. Do you have Farmer Training Centre (FTC)?

Q30. What are the major problems of demonstration sites in the area?

APPENDIX 3: INTERVIEW QUESTIONS FOR THE EXTENSION AGENTS AT THE TABIA LEVEL

Q1. You are expected to advice farmers as per your expertise. Then, how do you reconcile your programs among each other? Were there times that you contradict among each other to achieve your own objectives specifically to your assignments?

Q2. What were the plans you designed or given to you by the district in 2004 E.C?

1. crop expert
2. livestock expert
3. natural resource

Q3. How did you evaluate the achievement of the planned activities (crop, livestock and natural resource)?

Q4. Were the assignments given to you related to agriculture? If not what additional assignments did you have?

Q5. Did you have any mechanism to provide a direct advice for farming wives in addition to male and female household heads? How?

Q6. What are the major constraining factors for agricultural productivity and production? (Farmers, experts and others)

Q7. Do you have a Farmer Training Centre (FTC)?

Q8. What are the major problems of demonstration sites in the area?

Q9. On the average, how many households are under your supervision and guidelines?

Q10. Is there any quota given to the extension agents for farmers to join to different packages?

Q11. If there is a quota system, what will be the consequences if the quota given was not fulfilled?

Q12. Do farmers have an equal chance to participate in the package program?

Q13. What should be done by all agents at the *tabia* and *wereda* level to enhance agricultural production and income?

APPENDIX 4: INTERVIEW QUESTIONS FOR THE EXTENSION AGENTS AT THE DISTRICT AND REGIONAL LEVEL

Q1. It is illegal for farmers to sell chemical fertilizer which they bought from the cooperatives. What are the justifications presented by the authority for punishing farmers selling their own fertilizer?

Q2. Farmers are applying chemical fertilizer which is below the standard stated by the region. Given this situation:

a) What are the major reasons for the farmers to apply below the standard?
b) What are the possible consequences for fertilizer utilization below the standard on the productivity of land?
c) What are the scientific justifications for the benchmark of 200 kg/ha?
d) What about the differences in location and crops to be grown?

Q3. From where did the farmers mostly get fuel for water pumps (*tabia*, *wereda* or regional city)?

Q4. The irrigation potential of different *tabias* is different. Why then one irrigation expert is assigned in each of the *tabias* regardless of the potential?

Q5. Wheat is one of the improved varieties of seeds requested by the farmers. What is the yield difference between the indigenous wheat and the improved wheat varieties per *Tsimad*?

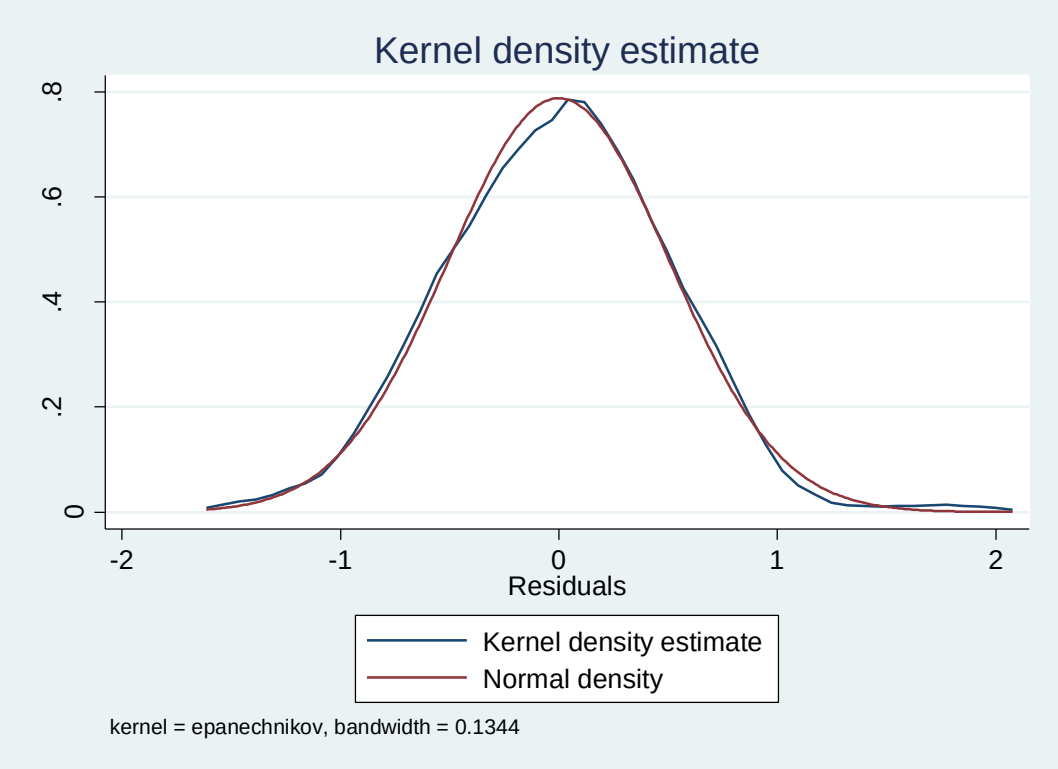
APPENDIX 5: SAMPLE FRAME TABIAS AND KUSHETS

Wereda	Tabia	Kushet	Total households	Sample households
Kilte Awlalo	Genfel	Endaslassie	439	20
		Gerehatsera	56	3
		Adi-Arbaa	36	2
		Endagabir	21	1
		Dongolo	675	31
		Korir	407	18
		Total	**1634**	**75**
	Adikesanded	Awda	225	10
		Mahberehiwot	217	10
		Laelay Wukro	520	24
		Bahra	235	11
		Belesa	202	9
		Felegsha	180	9
		Metseko	363	17
		Guwanga	279	13
		Total	**2221**	**103**
	Mesanu	Adengur	457	21
		Addis Alem	342	16
		Laelay Agulae	447	21
		Birki	217	10
		Total	**1463**	**68**
	Kilte Awlalo(total)		**5318**	**246**
Ganta Afeshum	Sasun-Betehawariat	Betehawariate	486	23
		Sasun	348	16
		Heli	326	15
		Total	**1160**	**54**

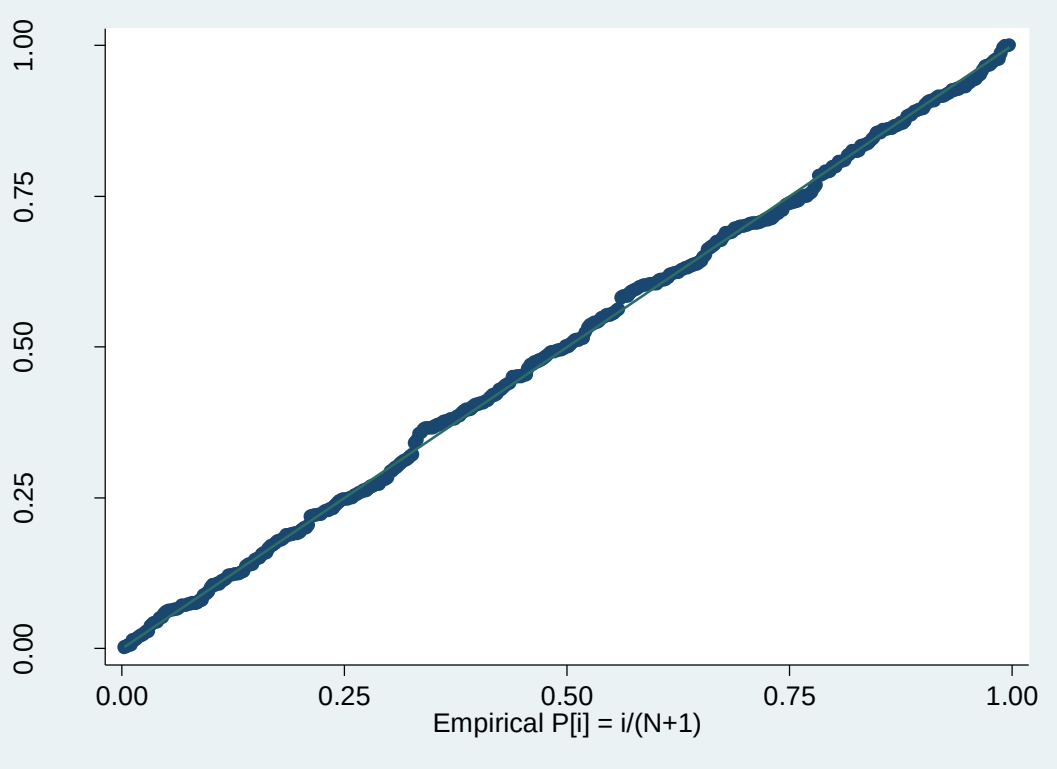
		Tesrek	227	11
		Wueyo	286	13
	Gola-Genahti	Gola	272	13
		Zinba Adi	396	18
		Total	**1181**	**55**
		Gulem	160	7
		Maekel Buket	115	5
	Buket	Betmekae	174	8
		Maybea	331	15
		Nihibi/Mefases	201	10
		Total	**981**	**45**
	Ganta Afeshume (total)		**3322**	**154**
	Grand total		**8640**	**400**

APPENDIX 6: THE NORMALITY TEST RESULT FOR THE CROP INCOME MULTIPLE REGRESSION

a) Kernel density normality test



b) Normal probability plot



APPENDIX 7: MULTICOLLINEARITY TEST RESULT FOR THE CROP INCOME REGRESSION MODEL

```
. vif
```

Variable	VIF	1/VIF
fertitotal	1.82	0.548741
logtotalland	1.80	0.555455
oxenown	1.62	0.615691
gender	1.59	0.629458
irriown	1.54	0.649648
adultequiva	1.53	0.653907
educlevel	1.41	0.710463
age	1.40	0.716654
contactmonth	1.23	0.811049
disaverage	1.23	0.813164
amountborro	1.20	0.831853
imprseed	1.19	0.842930
villawerema	1.17	0.856207
zerograze	1.11	0.899135
croprotation	1.09	0.914161
enoughrain	1.07	0.937989
overall	1.03	0.966355
Mean VIF	1.35	

APPENDIX 8: MODEL SPECIFICATION TEST RESULT FOR THE CROP INCOME REGRESSION MODEL

```
. ovtest

Ramsey RESET test using powers of the fitted values of logprodbirr
       Ho:  model has no omitted variables
                 F(3, 379) =      0.80
                  Prob > F =      0.4964

. linktest
```

Source	SS	df	MS		
Model	134.288785	2	67.1443926	Number of obs =	400
Residual	101.980334	397	.256877416	F(2, 397) =	261.39
				Prob > F =	0.0000
Total	236.269119	399	.592153181	R-squared =	0.5684
				Adj R-squared =	0.5662
				Root MSE =	.50683

logprodbirr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_hat	1.836568	.870764	2.11	0.036	.1246826	3.548453
_hatsq	-.0487171	.0506444	-0.96	0.337	-.148282	.0508477
_cons	-3.575023	3.735405	-0.96	0.339	-10.91867	3.768625

APPENDIX 9: THE MULTICOLLINEARITY TEST RESULT FOR THE FARM INCOME MULTIPLE REGRESSION

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
   totalland |      1.85    0.539400
  fertitotal |      1.73    0.579381
     oxenown |      1.60    0.623061
      gender |      1.60    0.624055
 adultequiva |      1.51    0.660441
   educlevel |      1.41    0.709871
         age |      1.39    0.720885
   irritotal |      1.34    0.744226
  disaverage |      1.24    0.804932
 amountborro |      1.21    0.827135
    imprseed |      1.20    0.835703
 villawerema |      1.17    0.854714
contactmonth |      1.16    0.860578
   zerograze |      1.11    0.897363
croprotation |      1.10    0.912557
  enoughrain |      1.06    0.940612
     overall |      1.04    0.958898
-------------+----------------------
    Mean VIF |      1.34
```

APPENDIX 10: MODEL SPECIFICATION TEST RESULT FOR THE FARM INCOME REGRESSION MODEL

```
. ovtest

Ramsey RESET test using powers of the fitted values of farmincome
       Ho:  model has no omitted variables
                 F(3, 379) =      0.26
                  Prob > F =      0.8522


. linktest
```

Source	SS	df	MS		
Model	4.3820e+10	2	2.1910e+10	Number of obs =	400
Residual	2.4954e+10	397	62857592.3	F(2, 397) =	348.57
				Prob > F =	0.0000
Total	6.8775e+10	399	172368263	R-squared =	0.6372
				Adj R-squared =	0.6353
				Root MSE =	7928.3

farmincome	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_hat	1.057893	.1343968	7.87	0.000	.7936749	1.322112
_hatsq	-1.21e-06	2.70e-06	-0.45	0.654	-6.52e-06	4.10e-06
_cons	-556.7007	1561.547	-0.36	0.722	-3626.637	2513.235

APPENDIX 11: THE NUMBER OF BEEHIVES AND TOTAL HONEY PRODUCTION OF THE NATIONAL REGIONAL STATE OF TIGRAY

	All beehives		**Traditional**		**Modern**		**intermediate**
Year	Number of beehives	Honey production (kg)	Number of beehives	Honey production (kg)	Number of beehives	Honey production (kg)	Number & (production)
2005/06	182,341	1,736,711	165,956	1,447,624	14,942	269,547	1,444
2006/07	183,771	2,044,166	167,883	1,748,054	15,889	296,112	*
2007/08	242,868	3,362,018	207,110	2,566,076	33,824	776,764	*
2008/09	255,605	3,904,848	209,719	2,743,990	41,714	1,122,196	4,174(38,662)
2009/10	195,662	3,203,088	157,496	2,382,789	35,135	790,342	3,031(29,958)
2010/11	213,133	2,767,634	166,504	1,706,607	43,548	993,263	3,081(*)
2011/12	219,036	2,432,652	169,048	1,649,966	47,817	742,570	2,171(40,117)

Source: Central Statistics of Ethiopia (different reports)

CURRICULUM VITAE

Bihon Kassa Abrha was born on January 28, 1964 at the village called Awleo, which is located near the town of Hawzien, in the National Regional State of Tigray, Ethiopia. In August 2001, he obtained his Bachelor's of Arts in Management and Public Administration from Addis Ababa University (AAU). From 2001 to 2004 he served as a full time teaching staff at Mekelle University, College of Business and Economics. In September 2005 he joined Addis Ababa University for his graduate studies in the department of Regional and Local Development Studies. He obtained the degree of Master of Arts in Regional and Local Development Studies in August 2006. Right after graduation, he started his teaching post at the Mekelle University, Tigray region, Ethiopia.

At this time, he is an Assistant Professor in Development Studies and teaching post graduate students in the Development Studies program. He has taughtcoursessuch as Regional Growth and Development, Local Economic Development,Development Finance, Urbanization and Urban planning, and Public Policy and Strategic Managementin the post graduate program. He has also prepared a teaching material for the course Public Policy and Strategic Management which was evaluated by three scholars.

Besides teaching, he participated in research and community services. He has also joint publications in different Journal Articles in the areas of: Determinants of Land Allocation to Irrigation and its Wealth Effects; Adoption and Impact of Agricultural Technologies on farm income; Determinants of vegetable channel selection in rural Tigray; Urban and Per-Urban Agriculture: An Important Form of Land Use, Employment Opportunity and Food Supply and The role of small urban towns in improving rural livelihood. In addition, he has also a publication ofMaster thesis based book entitled "Household water supply and factors affecting consumption level".

He was also one of the committee members that drafted the community policing of the National State of Tigray region. He participated in the University affairs being a member of the Recruitment and Promotion Committee of Mekelle University. Finally, in January 2010, Bihon joined the renowned University of South Africa (UNISA),in the Department of Development Studies for his PhD.