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COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF MANAGEMENT

ASSESSMENT OF FACTORS AFFECTING AGRICULTURAL PRODUCTION: EVIDENCE FROM SMALLHOLDER FARMERS OF SOUTHERN TIGRAY, NORTHERN ETHIOPIA

BY: BERIHUN KASSA

A THESIS SUBMITTED TO MEKELLE UNIVERSITY DEPARTMENT OF MANAGEMENT IN PARTIAL FULFILLMENT OF MASTER OF ARTS DEGREE IN DEVELOPMENT STUDIES (REGIONAL AND LOCAL DEVELOPMENT STUDIES)

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Declaration

I, Berihun Kassa hereby declare that the thesis entitled "Assessment of Factors Affecting Agricultural Production: Evidence from Smallholder Farmers of Southern Tigray, Northern Ethiopia" is my bona fide and original work that has not been submitted earlier for award of any degree, diploma or fellowship to any other universities to the best of my knowledge and belief; and that all the sources of materials used for this thesis have been dully acknowledged.

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Certification

This is to certify that this thesis entitled "Assessment of Factors Affecting Agricultural Production: Evidence from Smallholder Farmers of Southern Tigray, Northern Ethiopia" submitted in partial fulfillment of the requirement for the award of the degree of MA, in Development studies to the College of Business and Economics, Mekelle University, through the Department of Management, done by Mr. Berihun Kassa Hailu, ID.No, CBE/PR: 068/05 is an authentic work carried out by him under our guidance. The matter embodied in this thesis has not been submitted earlier for award of any degree or diploma to the best of our knowledge and believe.

Bihon Kassa (Assistant Professor)_____ _____

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Kibrom Aregawi (MBA, MPP) _____ _____

Co-advisor Signature Date

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Abbreviations

ADLI	Agricultural Development Led Industrialization
BoARD	Bureau of Agriculture and Rural Development
BoFED	Bureau of Finance and Economic Development
CAADP	Comprehensive Africa Agricultural Development Program
CCBSE	Cooperative Community -Based Seed Enterprises
CSA	Central Statistical Agency
DAs	Development Agents
E.C	Ethiopian Calendar
EWs	Extension Workers
FAO	Food and Agricultural organization
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
Ha	Hectare
HH	Household
Hr	Hour
HYV	High Yielding Varieties
IFPRI	International Food Policy Research Institute
IPM	Integrated Pest Management
IPMS	Improving Productivity and Market Success
Kg	Kilo gram
Km	Kilo meter
m.a.s.l	meter above sea level
MDG	Millennium Development Goal
Mm	millimeter
MoARD	Ministry of Agriculture and Rural Development of Ethiopia
MoFED	Ministry of Finance and Economic Development of Ethiopia
NEPAD	New Partnership for African Development
NFEs	Non-Farm Enterprises

OFEs	Off-Farm Enterprises
OFP	Off-Farm Participation
OLS	Ordinary Least Square
OV	Omitted Variable
PADEP	Peasant Agricultural Development Extension Program
PADETES	Participatory Agricultural Demonstration Training Extension System
PASDEP	A Plan for Accelerated and Sustained Development to End Poverty
PSNP	Productive Safety Net Program
REST	Relief Society of Tigray
SDPRP	Sustainable Development and Poverty Reduction Paper
SG-2000	Sasakawa Global 2000
SNNPR	Southern Nations Nationalities and Peoples Regional State
SSA	Sub-Saharan Africa
STATA	Statistical Package
TLU	Tropical Livestock Unit
USA	United States of America
VIF	Variance Inflation Factor
WB	World Bank

Abstract

As a backbone of Ethiopian economy, from the inception, agriculture is subsistent and encountered different backbreaking challenges. Stemming from this logical ground, this study considered the determinants of agricultural production; with due emphasis on determinants of crop production, effect of off-farm participation on agricultural production and agricultural marketing determinants nexus production. Cross sectional data, supplemented by interview and FGD, was collected through semi-structured questionnaire administered on 270 randomly selected smallholder farmers. Descriptive statistics and econometric techniques mainly OLS and Probit regression models were employed to analyze the data. Results showed that, majority of the respondents were male-headed and productive labor force who reluctantly use chemical fertilizer, HYV, row spacing; credit rationed, EWs non-visited and association members. With irrigation presence and these all positive applications, crop production was found to be increased. Besides, farm income was found to be determined significantly by age, family size, land size, plot distance, plot slope, fertilizer use, row spacing, credit access and membership to an association; where age and steep plot slope carried negative sign. Farm households do participate in off-farm activities as an alternative for dwindling farm income and small arable land size; where their crop yield was far lower than non-participants. Their probability of participation was significantly determined by gender, age, education, family size, TLU, draft animals, location and amount of credit taken; where age, TLU and location dummies hold negative sign. Transportation facilities, selling soon after harvest due to inventory credit problem; and producing non-marketable products were among the main determinants of agricultural marketing. It is therefore, recommended that, irrigation water need to be availed, contractual agreement to show productivity of HYV need to be facilitated, fertilizer should be employed on the basis of soil information, collective financing of EWs need to be introduced; inventory credit should be given; and farmers need to be trained on most effective non-farm activities.

Key words: *Agriculture, Production, Off-farm, Marketing, Ordinary Least Square, Probit*

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CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

It is indubitable that, for every country in the world, agriculture is an indispensable sector that accelerates economic growth and development (Enu &Attah-Obeng, 2013). Likewise, agriculture is the dominant sector and main stay of the worlds' population especially, in developing countries (Bechdol et al., 2010; Arega, 2010 & Kaya et al., 2008). To feed the rapidly growing population, therefore, smallholder farmers need to be productive using the existing limited land acreage by employing agricultural inputs.

Indeed, more than any other developing region, Africa's economic development highly relies on agriculture and agro-industry sectors; and determined by the production potential of the land under cultivation (Mugera & Ojede, 2011; Arega, 2010; Nin-Pratt & Yu, 2008; Henao & Baanante, 2006). As an important breakthrough, under the umbrella of New Partnership for Africa's Development (NEPAD), the Comprehensive Africa Agricultural Development Program (CAADP) has had distinguished the priceless importance of smallholder agriculture in accelerating African overall economic growth and development (Tesfaye et al., 2012). In the same line of reference, in Africa, agriculture shares 25% of the total Gross Domestic Product (GDP) by participating 65% of the total population.

In Africa, better than other economic sectors, a GDP growth of agricultural sector is paramount importance in reducing poverty, rising farm income and invigorating non-farm activities (WB, 2008); lowering food prices (Henao & Baanante, 2006); eradicating inequality (Enu & Attah-Obeng, 2013). Due to this, since 1970s and 1980s, there had been different food security and poverty reduction reforms. Despite these reforms, agricultural production and its contribution in reducing poverty is still insignificant and sluggish (Olajide, 2011 & WB, 2008). According to Shimelles (2008), high population growth rate and lack of technological change coupled with different internal and external factors has had aggravated the stagnation and gloominess of agricultural production in Africa. Moreover, African agriculture is seriously inhibited by the political or institutional factors, lack of agricultural technologies, agro-ecological factors, poor investment in research and development and global trade reforms that Africa's production and productivity could not cope up with the

rapidly shrinking world (Arega, 2010 & Nin-Pratt & Yu, 2008); land insecurity and conflicts (IFPRI, 2011; Shimelles et al., 2009 & Odhiambo et al., 2004).

More particularly, in Sub-Saharan Africa (SSA), smallholder agriculture is an input for poverty reduction and food security (FAO, 2009); source of foreign exchange and engine of development (Shimelles et al, 2009); income and employment (Olajide, 2011) and rural regeneration (Bosshaq et al., 2012). Stemming from its immense contribution, if there is to be a developed agricultural sector and transformed smallholder agriculture, farming at any scale should be considered as a business and farmers as entrepreneurs (Nwanze, 2011); portfolio entrepreneurs (Shimelles, 2008); and entrepreneurs through diversification (WB, 2008). If so is done, the linkage between production, processing, marketing and finally with consumption will be invigorated and agriculture will be well developed (Nwanze, 2011).

Contrary to what has to be done, in the region, worse than the continent at large, agriculture is too murky; as a result, food production, security and undernourishment are serious challenges (Shimelles, 2008); 72.9 % of the population live on less than US$2 per day, 27.5 % consume inadequate calories, and 23.6 % of children under five are underweight (IFPRI, 2011). These challenges are the result of different backbreaking bottlenecks. These include slow development of input and output markets and associated market services, slow progress in regional integration, governance and institutional shortcomings and conflicts (FAO, 2009); global market price (Shimelles, 2008); climate and trade policy (Odhiambo et al., 2004); poor market facilities and road transportation (Salami et al., 2010) and limited credit facilities and inefficient use of resources (Olujenyo, 2008); application of fertilizer lower than the world average (Asenso-Okyere & Samson,2012; Bationo et al., 2006; Ariga et al., 2006 & Crawford et., 2005) and declining soil fertility (Yanggen et al., 1998).

As part of developing countries in general and SSA in particular, Ethiopia will never be an exception and predominantly relied on agriculture. According to Tesfaye et al. (2012) and MoFED (2003), since 1990s as a national strategy, Ethiopia has espoused Agricultural Development-Led Industrialization (ADLI) which predominantly advocates smallholder agriculture and their transformation in to market oriented production. Supporting this, MoARD (2010) inferred that majority of the country's total production is produced by

smallholder farmers. Besides, Meseret (2012) and WB (2010) posited that, agriculture contributes 90% of the foreign earnings and 70% of the raw materials for industry. The country has designed and implemented different poverty reduction papers including SDPRP, PASDEP and GTP. Increasing agricultural production, therefore, is vital for ensuring food security, providing inputs for industrial sector, invigorating export earnings, GDP and then getting better the income and living condition of the people (MoFED, 2010).

Despite these policy interventions, due to the insufficient rate of production and productivity, according to Meseret (2012) and Askal (2010) persistent poverty and poor nutritional status are common. This is due to different production paralyzing factors like absence of new agriculture issues like finance, logistics, storage, transportation and value chains (Asenso-Okyere & Samson, 2012); lack of an integrated climate data base (Thomson et al., 2011); delays in procurement and distribution of inputs (Salami et al., 2010); lowest land share per household, 0.5 hectare (Dercon & Zeitlin, 2009 and Diao & Nin pratt, 2007).

The Northernmost tip of Ethiopia, Tigray region, is generally regarded as the most degraded part of the country; with erratic and insufficient rainfall, poor soil quality; low availability of infrastructure like inputs and markets (Fetien et al., 2009). Albeit this, recently in the region, yield has been increased as a result of composting water and soil conservation activities, agro-forestry and crop diversification (Kumasi & Asenso-Okyere, 2011). Due to evident topographical variation of the region, Southern Tigray particularly Raya-Azebo and Raya-Alamata districts have fertile soil, agriculture conducive though no remarkable production has yet been registered. Considering these facts, this study was conducted to fill the existing gaps by examining factors affecting agricultural production in Southern Tigray particularly in Raya-Azebo and Raya-Alamata districts.

1.2. Statement of the Problem

Production in a certain region can be increased either by producing higher per unit of land using agricultural inputs or by expanding the area reserved for crop cultivation. Though the former theory has worked in Asia and resulted with Green Revolution, Africa's production has had relied on the later one. In supporting the issue, Asenso-Okyere and Samson (2012) posit that Africa's agricultural growth in the past few years has had resulted from area

expansion rather than productivity and efficient resource utilization. Coming to Ethiopian case in general and Tigray region in particular, to increase production, agricultural intensification has been in place and there were no agricultural extensification before the advent of PASDEP where it has been extended in the GTP plan to increase coverage of terraced arable and non-arable land size from 810,000 hectares in 2010/11 to 1,913,000 hectares by 2015 (BoFED, 2011). Beyond this much expansion, due to its limited size, arable land size could not further be expanded. Furthermore, regardless of the effect in ground, in Ethiopia, there is an agreed up on consensus among researchers in increasing agricultural production using the land already under cultivation by employing agricultural technologies. Despite the consensus, yet, the result in the study area is not remarkable and the population is under food shortage and stretching for food aid; and the area more particularly Raya-Alamata, according to IPMS (2005) cited in Luchia (2010) is one of the drought prone districts of Tigray region; and the Raya-Valley at large is facing persistent drought and famine (Haileselassie, 2005).

Empirically, so far, different technical efficiency and productivity focused as well as soil and water conservation nexus production researches have been carried out in Tigray region. For instance, Gebrehawaria et al.(2012) dealt with technical efficiency of irrigated and rain-fed smallholder agriculture in Tigray; Kumasi and Asenso-Okyere (2011) studied on conservation agriculture and land degradation in the highlands of Tigray; Shumet (2011) has also dealt with the analysis of technical efficiency of crop producing smallholder farmers in Tigray; Fetien et al.(2009) studied on farm diversity and determinants of barley diversity in Tigray; Gebrehawaria and Namara (2008) basically saw irrigation as a poverty reduction strategy in Tigray region and Hailesellase (2005) studied on the technical efficiency of sorghum producing farmers in Raya-Azebo district of Tigray region. Though it was really appreciable and a step forward, the viewers were from technical efficiency and productivity points of view. Their conclusion, therefore, was about productivity and technical efficiency by employing additional inputs and factors of production within the limited land acreage under cultivation. Hence, these studies did pay no attention in addressing the real ground production challenges that the society is facing.

In practical aspects, it is believed that Tigray regional state is doing well to increase agricultural production by supplying the possible agricultural inputs. Since it is part of Tigray

region, input supply will never be off for the study districts. Far beyond this intervention, the study area, Southern Tigray is a promising and lucrative zone with plenty resource reservations basically fertile land resource, ground water, flat plain land and surrounding hilly parts with the opportunity of feeding the runoff rain water for the flat plain land (BoFED, 2011). Despite the overall policy interventions and natural endowments, agricultural production in these districts is not sufficient and the region is facing a persistent drought and famine (IPMS, 2005 cited in Luchia, 2010 & Haileselassie, 2005). As a result of low production rate, the society is not keen to produce for market and their participation is also low. Moreover, according to Barrett (2007) those with access to adequate assets, infrastructure and with appropriate incentives do engage actively in markets; while those who lack the above imperative aspects do not participate. Hence, in the study districts, institutional and physical infrastructure necessary to ensure broad based, low cost access to competitive and well functioning markets are lacking.

According to Babatunde et al. (2010) financial capital appears to be the most limiting factor for farming, so that cash income from off-farm activities can help to expand farm production. In line with this complementarities, examining and identifying the determinants of off-farm participation is sought to be important. Furthermore, in the same line of reference, if off-farm employment shall increase household income and reduce risk due to crop failure, overcoming the constraints and exploiting the potential opportunities is imperative. In the study districts, much can be seen while farmers wonder here and there in search of off-farm activities that could supplement their farm products and income. Though off-farm income can solve liquidity problem and thereby used to purchase and adopt agricultural inputs, their farm activities are really been compromised. Consequently, no corridors of the two districts kept their hands off from stretching for food aid. Why so? It becomes a paradox and needs further investigation. Hence, with the above mentioned gaps, the researcher intended to conduct a research away from productivity and technical efficiency arena basically on identifying & critically examining factors that affect agricultural production in Southern Tigray particularly in Raya-Azebo and Raya-Alamata districts.

1.3. Research Questions

1.3.1. General Research Question

What are the determinants of agricultural production in the study districts?

1.3.2. Specific Research Question

The specific research questions of the study are:

1. What factors do affect crop production in the study districts?
2. Does smallholders' off-farm participation affect agricultural production?
3. What factors do affect agricultural marketing in line with production in the study areas?

1.4. Research Objectives

1.4.1. General Objective

The general objective of this study is to assessing factors that affect agricultural production.

1.4.2. Specific Objectives

The specific objectives of the study are:

1. To identify factors affecting crop production in the selected districts.
2. To examine the effect of smallholders' off-farm participation on agricultural production.
3. To find out factors affecting agricultural marketing in line with agricultural production.

1.5. Scope of the Study

The study basically focused on identifying and analyzing factors that affect agricultural production within the limited land acreage. Besides, the study was delimited to conveniently selected study zone and purposively selected districts: Raya-Azebo and Raya-Alamata where cross-sectional survey data was used from sample respondents selected through simple random sampling technique. Accordingly, any of the analysis, findings and conclusion of the study represents Raya-Azebo and Raya-Alamata districts alone. Furthermore, to examine farm income, the study had used livestock income without addressing livestock issues. The study did not address macro factors affecting agricultural production like inflation, real exchange rate and GDP-per capita.

1.6. Limitation of the Study

Had the research area (zone and districts) selection been depended on simple random sampling technique it would have been better to give equal chance of selection for all zones and districts of the region. Consequently, cross sectional research design was employed to gather data in 2006 E.C production year that could not let the researcher to have a look at macro factors that affect agricultural production and over all livestock production issues.

1.7. Significance of the Study

The study adds an insight to the existing empirical frameworks and can serve as an input for different stakeholders like governmental organizations, policy formulators and decision makers to be shaped with and extrapolating the findings to the nearby sub-districts. Besides, the study may also serve as a point of reference for researchers who are intended to study in the area under investigation.

1.8. Definition of Concepts and Key Terminologies

Smallholder Farmers: are those with limited land size; predominantly rely on family labor; subsistence producers, practice mixed farming and reluctantly use agricultural inputs.

Off-Farm Activity: is similar with non-farm activity indicating all the incomes derived out of one's own farm land regardless of amount gained, inputs used and place of work.

Agricultural Marketing: is of the physical market by which producers could sell their products directly to the consumers and traders by accessing transportation facilities, storage, credit, cooperative services to increase their market access and profitability.

1.9. Organization of the Paper

The thesis is organized in to five parts. The first part introduces background, statement of the problem, objectives, scope, limitations and significance of the study. Relevant literatures were reviewed in the second part. The third part discusses the research methodology employed. Results are presented and discussed in the fourth part. Finally, conclusions and recommendations have been made in the last chapter.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1. Overview of Smallholder Agriculture Nexus Poverty Reduction

As per the Rio + 20 conferences, smallholder farmers and smallholder agricultural production are pertinent to meet Millennium Development Goals (MDGs) particularly reducing hunger and poverty (Vargas-Lundius, 2012). In the same line of reference, production and productivity increment, therefore, will increase or at least bring a positive change in the income of smallholder farmers; increase linkages between rural and urban production requirements and reduce poverty. Schneider and Gugerty (2011) conceive that real income changes, employment generation, rural non-farm multiplier and food price effects are some of the significant changes that increased agricultural production and thereby reduce poverty. Besides, Byerlee et al. (2005) posited that if there is higher agricultural production and growth per worker where there is abundant labor force, poverty reduction rate would be high. Similarly, the finding by Jayne et al. (2010) in Kenya, Malawi, Zambia, and Mozambique tell that, abundant maize production has had increased the income of smallholder farmers and poverty has been reduced.

Asenso-Okyere and Samson (2012) posited that despite the presence of 60% of world's total uncultivated land, Africa is incurring a cost of $30-$50 billion per year for food imports where giving priority for smallholder agriculture can reduce food shortage problems and then poverty. Hence, CAADP has dictated countries to invest at least 10% of their total budget on agriculture with the expected 6% annual agricultural growth. Similarly, Wiggins (2009) and Hazell et al. (2007) posited that, due to their overall plot and environmental knowledge, smallholders' production is pivotal for poverty reduction. Furthermore, in SSA, of the total of 5.6 % poverty reduction, 3.7 % was achieved by agricultural production and productivity using the already unexploited potential of the region (Ivanic & Martin, 2010). According to Kende-Robb (2013) in Kenya; Diao and Pratt (2007) and Samuel (2006) in Ethiopia purport that, agriculture has reduced poverty twice as fast as other sectors.

2.2. Factors Affecting Crop Production and Farm Income thereof

2.2.1. Farm Operators' Household Characteristics

Gender is one of the significant determinants of agricultural production since male-headed and female-headed households (HH) could not have the same capability and endurance in enhancing agricultural production; where the former are stronger (Nyanga et al., 2012); in Kenya, Ekbom et al. (2012) found that female-headed HHs are inefficient and unproductive compared with their counter parts. According to Malek and Usami (2010) male-headed HHs expend more on external inputs at their HH farm enterprises; male-headed HHs are better off to get agricultural information and to take risks (Abay and Assefa, 2004).

According to Adebiyi and Okunlola (2013), in Nigeria, unlike their counter parts, females do more engage in off-farm activities like in selling agricultural products, storing and packing them out. This indicates that, male did pay attention for their farm work and do better adopt farm rehabilitation techniques, inputs for sufficient production. In Tanzania, Lugandu (2013) found that male-headed HHs has had adopted conservation agricultural technologies as compared with female-headed HHs. This does not mean that female-headed HHs are reluctant to adopt agricultural technologies, but their decision is being challenged or influenced by their family members or beyond. Similarly, Uwagboe et al. (2012) posited that different social and institutional factors did hold back female-headed HHs in employing IPM technologies where their effort in agricultural production is being compromised. In Ethiopia, work division culture makes female-headed HHs less effective in production; like taking perishable products to the market unlike males' chat and animals (Tewodaj et al., 2009).

Age is the most decisive factor that determines the productive potential of a certain HH that can be seen differently. According to Adebiyi and Okunlola (2013); Shumet (2011); Anyanwu (2009) and Abay and Assefa (2004) age can be related with farm experience and as age increases farm experience increases and then input adoption as well as production will increase up to a certain age limit. Shumet (2011) in Ethiopia and Amaza et al. (2006) in Nigeria reasoned out that, as agriculture in developing countries is more of labor intensive, after a certain age limit, where farmers' physical strength decreases and their conservativeness increases, production will finally decrease. In Nigeria, Adebiyi and

Okunlola (2013) found that people who are not in their productive age group are less prospected and reluctant to adopt cocoa farm rehabilitation techniques. Besides, Uwagboe et al. (2012) in Nigeria and Shumet (2011) in Ethiopia found that, middle aged farmers (41-60 years) tend to adopt agricultural inputs than younger and older farmers.

Contrary to this, younger and older farmers (Lugandu, 2013); and older farmers (Chiputwa et al., 2011) could better adopt conservation agriculture than the middle age farmers; relatively younger farmers are risk takers for what they adopt and for yield uncertainties (Abay and Assefa, 2004). Whatever other reasons might be, in Kenya, Ekbom et al. (2012) found that older farmers with better accumulated experience are more efficient than younger farmers.

Education is the key factor that determines agricultural production in adopting inputs in general and management demanding practices in particular (Uwagboe et al., 2012). According to Ekbom et al. (2012); Shumet (2011); Chiputwa et al. (2011); Askal (2010); Anyanwu (2009) and Abay and Assefa (2004) educated HH farmers have a better access for agricultural information that is pertinent for decision making on what and when to produce; to adopt and use inputs efficiently thereby increase production. In Nigeria, Amaza et al. (2006) put forward as education is the principal factor that seriously determines food crop production where educated farmers are committed to go to the peripheral areas of the country and exploit the potential reservations.

Adebiyi and Okunlola (2013) and Abay and Assefa (2004) put forward that adopting new inputs by itself could never be a guarantee for increasing agricultural production. The rationale is that, properly utilizing and exploiting the opportunity is the most difficult thing that illiterate farmers are facing. Hence, education is a vaccination that needs to be encouraged so as to adopt and properly utilize agricultural technologies thereby increase agricultural production. Moreover, Thierfelder and Wall (2011) inferred that education as a source of knowledge has had resulted in a brain wash for farmers to reject the traditional agricultural system and adopt the new technique; knowledgeable farmers are keen enough to adopt techniques that control weed, enhance residue management, encourages crop rotation and fertilizer adoption.

Furthermore, Abay and Assefa (2004) has had compared the role played by educated HH head and educational level of literate family members in agricultural technology adoption and increase agricultural production. Hence, they come with the finding that, rather than the significant role played by the educated HH head in adopting agricultural technologies, the educational level of adult HH members is paramount importance. The finding convinces more as the educational level of any adult member in a certain HH increases by one grade, the probability of input adoption increases by 2.8 %; compared with 1.5% increase resulted from the educational level of the HH head. Based on this finding, they conclude that, even if the HH head is illiterate the presence of literate family member plays a significant role in agricultural input adoption by making use of their education positive externalities.

Contrarily, in Tanzania, Lugandu (2013) posited that formal education advancement paves the way for specialization and other off-farm activities that make agriculture less attractive. In the same line of reference, simple reading and writing is much more enough to adopt inputs and conservation agriculture that could be developed through experience. Similarly, education in Asia has had played a role in exiting HHs from agriculture to off-farm activities unlike African case (Jayne et al., 2010). Besides, in Rwanda, a finding by Mpawenimana (2005) reveals a statistically insignificant positive relationship of education with production.

Beyond the shadow of doubt labor is an indispensable input of agricultural production that developing countries are being utilizing. In Palestine, a finding by Abugamea (2008) revealed that a 100% increase in labor will result with 38.1% increase in agricultural production. Consequently, Amaza et al. (2006) concluded that HHs with large family size could have a chance of using family labor if their intention is to ensuring food security.

In Nigeria, a finding by Adebiyi and Okunlola (2013) and Onoja et al. (2012) revealed due to manual and labor intensive nature of cocoa production, unlike their counter parts, those with large family size are advantageous in producing sufficient production and adopting farm rehabilitation techniques. Similarly, Shumet (2011); Askal (2010) and Amaza et al. (2006) purport that HHs with large family size are more advantageous to manage weeding and harvesting practices unlike their counter parts; but dependency ratio need to be kept small (Shumet, 2011). Contrary to these findings, according to Coelli, Rahman and Thirtle (2002)

cited in Askal (2010), in Bangladesh, while producing rice, those with large family size were characterized by poor resource allocation mainly labor and chemical fertilizer unlike those with small family size members and the later were better productive.

It is believed that land size is an indispensable asset of agricultural production increment. According to Teryomenko (2008) the relationship between farm size and production is non-linear in a manner first it increases and then decreases (when land size exceeds the optimal amount). A finding in Rwanda by Mpawenimana (2005) reveals that land holding size is directly related with banana production; and while quantifying a 1% expansion in land size will result in 0.32% increase in agricultural output. Adebiyi and Okunlola (2013) found that those with large farm size tend to adopt cocoa farm rehabilitation techniques; diversify their crops and protect crop failures in time of erratic rainfall (Falco et al., 2010); use crop rotation and fallowing as a mechanism of soil fertility maintenance (Lugandu, 2013). Furthermore, Endrias et al. (2013) purport that those who have large farm size can expand production by exploiting economies of scale; higher input usage and tend to reject the traditional broadcasting method by adopting row-planting method which is pertinent for increasing productivity and led to employ High Yielding Varieties (HYV).

According to Lugandu (2013), from the input adoption view point, small land size owners are obliged to adopt inputs and other land management practices so as to increase agricultural production. Besides, Ekbom (1998) posited that, to sustain their consumption need, small land size owners tend to intensify their production and are more productive unlike their counter parts.

As a resource factor, livestock ownership might affect crop production positively and negatively. In Ethiopia, Shumet (2011) inferred that, since crop production is expected to be supplemented by animal production; livestock endowment has dual influence on crop production in such a way that HHs who possesses a number of livestock could give all their time for livestock production where crop production will be compromised; and could also purchase agricultural inputs thereby become productive; use of animal traction, and use of manure that complements fertilizer use and enhances production (Rios et al., 2008; Kaija, 2007); pack animals could result in ample production by transporting manure from home to the farm land without any cost (Rios et al., 2008).

2.2.2. Physical Environment Nexus Agricultural Production

In this study physical environment includes the most determining factors of production including soil quality, amount of rainfall and insects. Hence, as a natural factor, soil is the most reputable production determinants that determine the overall aspects of agricultural production. Different researchers' findings reveal that, African soil is of poor quality with limited organic matter and incapability of water retention which is aggravated by the continents' high temperature. Moreover, according to Asenso-Okyere and Samson (2012) Africa constitutes 25% of the world's degraded land; where 65% of the land is degraded due to water and soil erosion as well as chemical and physical degradation. According to Thierfelder and Wall (2011) and Kumasi and Asenso-Okyere (2011) conservation agriculture can be taken as a vaccination of soil conservation; since tillage can reduce soil erosion due to minimal disturbance of the soil and used for environmental management and improved water and soil quality; and it can also be used in nearer plot distance (Minale et al., 2012).

Besides, Lugandu (2013); Cassman (2012); Chiputwa et al. (2011); FAO (2008) cited in Nyanga (2011); Thierfelder and Wall (2011); Thierfelder and Wall (2009) and Giller et al. (2009) posited that, through conservation agriculture, soil properties can be improved and then become suitable for agricultural production by keeping the soil covered from the sun, rain water runoff and wind; through minimum soil disturbance and crop rotation. In Zambia, Umar et al. (2011) found that as one modus operandi of soil fertility preservation, conservation agriculture is primarily important in providing stable crop production and food security. In Ethiopia, Shumet (2011) found that soil fertility is the one that best describes agricultural production and technical efficiency of farmers where those with fertile land are endowed with ample agricultural production.

It is conclusive that Africa in general and SSA in particular depends on rain fed agriculture with its erratic nature. According to Asenso-Okyere and Samson (2012) average annual rainfall in dry semi-arid areas of SSA are less than 700 millimeters; and this makes soils poor in nitrogen and phosphorus. Besides, Yanggen et al. (1998) put forward that, SSA is being characterized by low and highly unpredictable levels of rainfall and high temperatures; and these features would ultimately erode the soil organic matter and would result in poor soil

quality and low agricultural production. As a natural determinant factor, in Nigeria, Dim and Ezenekwe (2013) found that a 1 % increase in rainfall will result in 1.14% increase in agricultural output. In the same line of reference, they surmised that, to keep the soil wet, when rain is insufficient, irrigation could serve as a proxy and would increase crop yield.

Though Ethiopian agriculture is predominantly rain fed, Saifu (2004) found the insignificant correlation between cereal production and the annual and seasonal rainfall; and it could not be a factor for crop production failure. Rather than this, the amount of rainfall distribution during the crop growing season or period and the water intake requirement of crops are the determinants of crop production. Furthermore, Woldeamlak (2009) put forward that, there is intra-regional rainfall variability or fluctuation with in a country and among regions that adversely affects crop production. As far as correlation between cereal products and rainfall variability is concerned, it varies from one crop to another depending on their water intake requirement and their preference either in spring or autumn season. Inter-annual and seasonal fluctuations of rainfall as well as temporal distribution of rainfall within a sub-monthly time scale are causes for seasonal fluctuation of crop production and the resultant poor yield.

Pests or insects are natural inhibiting factors that paralyze the production potential of farm land as well as smallholder farmers. According to Olujide and Adeogun (2006), in Nigeria, production has been determined by weeds, pests, diseases and parasites. These diseases, in Nigeria, according to Uwagboe et al. (2012) includes the black pod borer and mired; and in Ethiopia, late blight, early blight, bacterial wilt and potato tuber moth Eshetu et al. (2005). To trim down the challenge, according to Olujide and Adeogun (2006), cocoa farmers in Nigeria, has had employed chemicals, pruning, removal of diseased pods and mistletoe and breaking of pods off-farm; and in part farm hygiene and management technique; and in Ethiopia prefer to grow disease tolerant products (Eshetu et al., 2005). Besides, in Turkey, to decrease pest presence in crops, Saysel et al. (2002) purport that farm rotation practices coupled with irrigation intensification can eliminate pests and would increase production.

2.2.3. Agricultural Technologies, Agronomic Practices Nexus Crop Production

Sasakawa Global 2000 (SG-2000) program has intended to work with smallholder farmers and their respective agriculture ministry's so as to increase agricultural production by employing different agricultural inputs that could even keep soil fertility. The program, therefore, put farmers as the forerunners and drivers in adopting agricultural technologies and promotion of agricultural intensification. According to Galiba et al. (1999); Smaling (1993); Brown and Addad (1994) and Gakou et al. (1995) as cited in Nubukpo and Galiba (1999); and Crawford et al. (2005) when soil degradation become rampant, the program, SG- 2000 has obliged to use organic, mineral fertilizer and the natural phosphate; all to be backed by technological package options.

It is believed that chemical fertilizer, if soil organic matter is not depleted, is an ingredient that feed roots with sufficient nutrients in the nutrient poor soils; and enables to adopt HYV and thereby increase agricultural production. Besides, simultaneously with chemical fertilizer, according to Yanggen et al. (1998), organic fertilizer like crop residues and manure needs to be used since it adds organic matter to the soil and increases the soil structure like soil porosity and friability that increases water infiltration and retention capacity of the soil.

In a certain country, chemical fertilizer adoption can be determined by economic, social, physical and technical aspects of farming (Abay and Assefa, 2004); and these aspects influence the type of crops to be grown and the production method to be used (Sassenrath et al., 2012). Furthermore, in their comparative study of nitrogen balance and agricultural production in Mississippi, Poland and USA, Sassenrath et al. (2012) purport that, if there is a need to ensure sustainable agricultural production using fertilizer, serious considerations need to be given for social, economic and environmental aspects. Excessive use of fertilizer and intensive production system could result in fertilizer contamination; and thereby environment and production potential of the land and soil would further be harmed.

According to Yanggen et al. (1998), in Africa in general and SSA in particular, fertilizer use capacity is being determined by human capital (education, extension and health/nutrition); financial capital (income, credit and assets); basic services (infrastructure, quality controls and contract enforcement, information and government policies); yield response (biophysical

environment, technology and extension) and input/output prices (structure conduct & performance of subsector, competition efficiency and equity). In Madagascar, according to Minten et al. (2006) chemical fertilizer adoption is pertinent for subsistence production but smallholders are not keen enough to pay the estimated value of inputs; as a result inputs are being disseminated through credit and contractual agreement.

In Ethiopia, Peasant Agricultural Development Extension Program (PADEP) has been replaced by Participatory Agricultural Demonstration Training Extension System (PADETES) that merges training and visit agricultural extension system with agricultural technologies. It is aimed at improving agricultural output using HYV, fertilizer, improving farm practices and credit supply and serious follow up of farmers. Similar with the findings of Solomon et al. (2011) in Malawi and Minten et al. (2006) in Madagascar, in Ethiopia, Samuel (2006) found that farmers are too reluctant to use fertilizer as they believe it will damage the crop due to the erratic nature of rainfall. Furthermore, according to Wallace and Knausenberger (1997**)** in Ethiopia, though there are different inhibiting factors like poor marketing capabilities, high transport costs and weak extension services, lack of credit coupled with unpredictable rain fall has had aggravated the adoption of chemical fertilizer. Despite these restraining factors, different researchers including Endrias et al. (2013) have found the significance of chemical fertilizer in increasing crop production and productivity.

Biologically, technologies can more be represented by HYV and row planting. The application and profitable use of HYV is not yet developed well. According to Solomon et al. (2011) HYV is given for smallholders with the intension of increasing their income that enable them reduce food shortage and starvation. According to Eshetu et al. (2005) due to awareness problem about the vitality of HYV, farmers in Eastern Hararghe, Ethiopia, prefer to adopt seeds that are already deformed, diseased, mixed origin and unmarketable. Further, farmers face a problem even in keeping the seeds being used without losing its originality and health from one harvesting season to another. Hence, to get rid of such a back driving condition, Cooperative Community-Based Seed Enterprise (CCBSE) schemes need to be strengthened to provide and distribute HYV; linked with different market oriented supply schemes; warehouse services and market information need to be availed.

In their research in Tigray and Amhara regions of Ethiopian highlands, Benin et al. (2003) found that, HYV are considered as complimentary for indigenous seeds. This is due largely to the in hospitability of the physical environment and poor market infrastructure network. In line with the HYV, as a production shifter, row planting method is found to be significant for increasing crop production. Row planting need to be backed by integrated soil fertility management practices and use of hybrid seeds that further accelerates the yield potential of the land under cultivation (Endrias et al., 2013). Besides intercropping also called companion planting is one mechanism to save space via growing different crops at the same time with the assumption that crops can grow well together and yield will increase (Chomba, 2004).

Crop rotation is one of the nearest and easily be done agronomic practices that could potentially increase soil fertility and even kill weed and pests. In theory and practice, according to Chiputwa et al. (2011) in Zimbabwe and Chomba (2004) in Zambia, nitrogen fixation crops do maintain soil fertility much better than cereal crops. Thence, rotating legumes after cereals and vice versa improves soil fertility and break weed and pest life that pave the way for increased crop production. Furthermore, he concluded that crops rotated need to have different soil requirement.

Irrigation and irrigation technologies are important ingredients for accelerating agricultural production. It can be taken as an input to stabilize crop yield and patterns; it is an asset that can be exploited when rainfall is insufficient; it also enhances cropping intensity by letting to produce twice or more per year; and it also paves the way to use HYV (Datar and Del Carpio, 2009). Though it is pertinent for production, its adoption and expansion can be influenced by extension services, education, water price, cost of irrigation equipments and farmland size (Genius et al., 2013).

In areas where water is scarce and irrigation water distribution is difficult, drip irrigation, as a water saving technology, is a vaccination that cures the problem by lessening cost of entry in to irrigation agriculture and saves water. The water is to be filled by hand or other means; it paves the way for producing vegetables both for home use or commercial purpose and solves the problems of traditional water channel system (Upadhyay et al., 2005). In the same line of reference, after the introduction of drip irrigation and all the necessary interventions, 100%

of drip users become consumers and sellers of vegetables along with their daily meals. In Ghana, in their Focus Group Discussion (FGD) and informants interview results Asuming-Brempong et al. (2013) asserted that farmers have taken water from the water source to their tomato and pineapple farms through head loads and trucks to keep it in larger containers for later hand and pump irrigation use. Besides, the advantage of irrigation can be seen in effect when irrigation water is distributed fairly. In Asia, where water distribution is fair, according to Lipton (2007), poverty has decreased by 20% compared with the effect rain fed agriculture on poverty. Hence, inequitable water distribution, theft and paying bribe for canal mangers are some of irrigation related corruptions.

2.2.4. Institutional Factors Vis-à-vis Crop Production

Beyond the shadow of doubt, institutional factors are crucial to get access for agricultural inputs and thereby increasing agricultural production. These could include credit, Extension Workers (EWs) or Development Agents (DAs) and agricultural cooperatives. To start with credit, it enables smallholder farmers to purchase agricultural inputs and even to hire labor during the weeding and harvesting times. In line with this, Adebiyi and Okunlola (2013); Shumet (2011) and Chiputwa et al. (2011) put forward that credit is worth enough for farmers in such a way that credit availability turns off the cash limitation and allow farmers to purchase inputs on time and produce stable production.

Smallholder farmers, according to Anyanwu (2011) are lacking agricultural production techniques and inputs due to credit rationing or liquidity constraint; as a result agricultural production become liable to dwindle. Though banks could subsidize credit, unlike Asian banks, African banks are hesitant to lend smallholder farmers due to the erratic nature of agriculture and the resultant risk of repayment, uncoordinated agricultural value chains, poor infrastructure in the rural areas and unwillingness of farmers' to be coordinated (Asenso-Okyere and Samson, 2012). In some instances, however, according to Yanggen et al. (1998), those who are better in non-farm incomes and employment earnings and in better agro climates have better credit access that let them to purchase inputs. If farmers first adopt agricultural technologies and then produce a remarkable output, they further need to adopt different inputs that still need to be backed by credit and market linkage Hazell et al. (2007).

Moreover, in Rwanda, a finding by Mpawenimana (2005) infers that since majority of banana producers were unable to afford fertilizer price, credit facility had enabled them to purchase all the required inputs and thereby increase production.

More than any other stakeholders, extension service being activated by DAs is paramount importance for enhancing agricultural production. DAs are too nearer to farmers; key role players in instigating farmers to use agricultural inputs; disseminate the required information. Adebiyi and Okunlola (2013); Genius et al. (2013) and Chiputwa et al. (2011) and Anderson and Feder (2004) infer that the role of DAs is transferring information from the global and local knowledge base to farmers and thereby shaping their activities. Due largely to this, in developing countries, investing on DAs is pertinent in increasing farmers' income, livelihood status; guiding on how, where and when to use inputs. In addition, Genius et al. (2013) also allege that extension services and farmer-farmer contact are basic points that determine technology adoption and diffusion; and both are mutually supportive. Likewise, according to Wondimagegn et al. (2011) as a risk aversion mechanism, more extension visited farmers are more probable for production specialization. In line with this, according to Adesina and Baidu-Forson (1995), one challenge of agricultural technology adoption in developing countries is poor contact between EWs and farmers; where farmer-farmer contact is serving as source of information and agents of technology transfer. Worse than this, Idrisa et al. (2008) and Anderson and Feder (2004) purport that EWs tend to select farmers with large farm size, better income and socially privileged with the assumption that these people could better adopt inputs and could also subsidize them with some incentives. According to Hu et al. (2012); Tewodaj et al. (2009) and Ozor et al. (2007) unsatisfactory contact between EWs and farmers is due to unstable source of financing agricultural inputs; where cost-sharing financing EWs is advocated by Ozor and Madukwe (2004) cited in Ozor et al. (2007).

Farmers' associations or agricultural cooperatives are pertinent to stood on the side of smallholders and ensure their needs; provide inputs in an affordable price and disseminate all the necessary information that need to be used in agricultural activities. Accordingly Bernard et al. (2013) surmised that in Tigray majority of farmers got their fertilizer from cooperatives; but not commercialization of outputs which is better in Southern Nations Nationalities and Peoples Region (SNNPR). According to Uwagboe et al. (2012)

membership to an association is an engine to invigorate the potential of a group in such a way that one group could influence the other to use all the recommended activities and thereby reduce costs incurred for information dissemination. Members of the cooperative are within the society for the society; as a result members can be taken both as users and service providers (Tewodaj et al., 2009). Their roles include importing inputs and distributing with an affordable price; exporting of agricultural commodities; provide members with renting machinery services; purchasing agricultural products from the members; giving members transport access for their products, storage services and credit facilities (Bezabih, 2009). Agricultural cooperatives in Harar in collaboration with Ethiopian/ Harerghe Catholic Secretariat, according to Dessalegn et al. (2008) had identified market linkages, marketable commodities; storages, local markets are launched; export markets to Dire Dawa, Kombolcha and Jigjiga have had facilitated.

2.3. Effect of Off-farm Participation on Agricultural Production

As engine of economic growth and poverty reduction, in developing countries, agriculture should be integrated with sectors that have direct or indirect linkages. Off-farm is one among the activities that could affect agricultural production positively or negatively. According to Rios et al. (2008) a higher the off-farm income is the larger will be the capital endowments and thereby high will be production and productivity. Conversely, as the income from off-farm increases, HHs may not give time for agriculture that minimizes crop yield.

The impact of agriculture on Off-Farm Enterprises (OFEs), according to Haggblade et al. (2010), can be seen as opportunity and challenge. As an opportunity, modern agricultural inputs in general can result with ample production and productivity of marketable commodities that results with trade linkage; the requirement of agricultural inputs and marketing facilities by itself induces OFEs. As a challenge, those who live in arid areas where production is sluggish, tend to participate in OFEs and diversify their income sources. Similarly, in Burkina Faso, Zahonogo (2011) purport that the decline in farm income and farm production let farmers to participate in Non-Farm Enterprises (NFEs); and increment in farm production and income do the opposite.

According to Asenso-Okyere and Samson (2012) and Diao and Nin Pratt (2007) as form of income diversification, in Africa, nonfarm economic activities are very much indispensable for improving the livelihood of rural poor HHs. Besides, it can serve as source of input supply for agricultural production and employment opportunity for those who did not have arable land and do not further want to rely on agriculture. Despite its vitality, in Africa OFEs participation is low; and according to Haggblade et al. (2007) as cited in Merima and Peerlings (2012), 37% of the rural HHs' income is really extracted from non-farm activities where surprisingly not more than 20% of the labor force is being participated. Coming to Ethiopia, Merima and Peerlings (2012) had purported that, for the past eight years not more than 25% of the rural HHs had engaged in NEFs which is minimal compared with 42% of the SSA average. Consequently, in Ethiopia, its contribution for employment creation is 1.14%.

Likewise, in Nigeria, a study by Adewunmi et al (2011) revealed that participation on OFEs more particularly wage employments of skilled and unskilled has had resulted in a reduction of rural poverty respectively by11.02% and 10.68%; in Nigeria participants lessen poverty than non participants (Alaba and Kayode, 2011) similarly in China according to Du, Park and Wang (2005) cited in Haggblade et al. (2010) remittances are playing a pivotal role in reducing the rural poverty rate by 1%, from 15.4% to 14.4%.

Participation, therefore, is the most important determinant of agricultural production where identifying the bottlenecks and opportunities Vis-a Vis their effect on agricultural production seems imperative. Off-Farm Participation (OFP) would further increase off-farm income that paves the way for investing in farm production like purchasing fertilizer, pesticides and HYV and will also replace oxen plough by mechanized farming; in enhancing the working capital of off-farm workers (Malek and Usami, 2010). As one means of income diversification and food security, Adebayo et al. (2012) posited that off-farm activity generates more income and instigates HHs to participate in income diversification activities where by a unit increase in off-farm income will raise the probability of participation by 0.0000091.

In Uganda, a finding by Kaija (2007) revealed that sex is a factor that determines HHs' participation in income diversification activities; hence, unlike males, females participate more in off-farm activities like brewing local alcohol, operating kiosks and crafting mats.

Contrary to this, in Ethiopia, Abebe (2008) put forward that since male-headed HHs are more accessible for everything and are probable to engage in off-farm activities unlike females. Despite this, Abebe (2008)'s finding of farm size's negative influence for male HHs' OFP corroborates with the findings of Alaba and Kayode (2011); in such a way that large farm size and farm experience could increase production whereby male-headed HHs become improbable to participate.

Contrary to these findings, a finding by Merima and Peerlings (2012) and Alaba and Kayode (2011) reveal that female HHs do participate more indicating that other alternatives are being closed for them. According to Haggblade et al. (2010) and Abebe (2008) child rearing duty hampers women in their participation. Abebe (2008) posited that the presence of children (< 5 years) and dependents (>65 years) impede females' and instigate males' participation to fulfill food requirement at home that could discourage his participation sustainability.

Age affects off-farm diversification where by old aged HHs are unable to diversify and participate in off-farm activities rather to rely on farm incomes. The implication indicates that younger HHs can migrate and engage in self-employment and earn income; and as age increases, the probability of OFP will decrease and will more concentrate on farm activities (Merima and Peerlings, 2012; Alaba and Kayode, 2011; Babatunde and Qaim, 2009; Abebe, 2008 and Kaija, 2007). Contrary to these findings, in their finding in Oromia region, Ethiopia, Berg and Girma (2006) asserted that with the already accumulated skills and experiences, old aged HH heads are probable to incline towards manufacturing sectors. Similarly, according to Zahonogo (2011) though it goes to a certain age limit, the older the HH age becomes the more likely to participate.

According to Alaba and Kayode (2011) HHs with no formal education tend to engage in OFEs. Similarly, in Ethiopia, Abebe (2008) found that education is insignificant in determining the probability of participation since the well known non-farm income source is food-for-work that did not require educational background. Similarly, in Oromia, Ethiopia, Berg and Girma (2006) purport that formal education is not a prerequisite to participate in NFEs; since activities like food, drink and trade activities can easily be done by a layman.

Contrary to this in Ethiopia, Merima and Peerlings (2012) and in Burkina Faso by Zahonogo (2011) found that HHs with educated heads are more probable to participate in NFEs. Similarly, a finding in Uganda by Kaija (2007) revealed that HHs with educated females were found to be participants in off-farm income sources than those without.

According to Alaba and Kayode (2011) HHs with large family size tend to engage in OFEs; to meet the rapidly growing food requirement (Abebe, 2008). Merima and Peerlings (2012) also purport that, since it is possible to divert one member of the family from one activity to another, HHs with large family size are more likely to participate. More surprisingly HHs with enough number of children aged between 6-15 years of age are likely to participate in OFEs by using child labor in agricultural activities. Besides, in Burkina Faso Zahonogo (2011) found that HHs with large number of working people tend to diversify farm practices and crop diversification and OFP will decrease.

Cultivated land size is one determinant of OFP where farmers who do have large farm size are more probable to increase their reservation wage and they are less likely to participate. Hence, farmers do participate in off-farm activities as solution for shortage of arable land (Asenso-Okyere and Samson, 2012; Abebe, 2008). Large farm size coupled with farm experience could increase the production potential of HHs and become less probable to participate in off-farm activities (Alaba and Kayode, 2011; Abebe, 2008). According to Babatunde and Qaim (2009), the poor and small scale farmers are more probable to participate in off-farm activities due largely to the push factor; while those with large land size do participate due to pull factor.

As far as urban-rural linkage, access to and cost of transportation and credit are concerned, according to Haggblade et al. (2010) and Merima and Peerlings (2012) posited that OFP is being influenced by high transportation cost, paucity of input, credit and relevant market access. More to the point, Merima and Peerlings (2012) and Babatunde and Qaim (2009) assert that the far the distance of HHs' residence to the nearest market and all weather roads the less will be their participation. From the competition points of view, Berg and Girma (2006) also posited that, with improved infrastructure and market access rural HHs will face stiff competition from the better equipped urban people and the demand of their products will

decline; but can better engage in less competitive activities like food and drink. Moreover, according to Abebe (2008), non-farm trainings and credit provision (a 10% credit provision increases the probability of participation by 0.085) are positive determinants of participation.

Livestock may not pave the way for OFP since it could result with higher farm productivity due to the supply of manure as fertilizer (Kaija, 2007); but the presence of draft animals like donkey, horse, mule and camel encourages to participate in trade (Abebe, 2008; Berg and Girma, 2006). According to Merima and Peerlings (2012) and Abebe (2008), in Ethiopia, farmers tend to participated in OFEs to supplement the sluggish agricultural income caused by erratic and seasonal rain fall; and due to abundant labor force during the time of crop failure (Abebe, 2008) aimed to satisfy consumption needs, to purchase farm land and oxen. A finding in Burkina Faso by Zahonogo (2011) revealed that when rain fall is insufficient HHs tend to participate in NFEs so as to offset the challenge; and the reverse holds true.

2.4. Factors Affecting Agricultural Marketing and thereby Production

Indeed, agricultural transformation in general and smallholders' in particular are issues that deserve much attention by policy makers and governments of different countries, economists and agricultural economists (Barrett, 2007). In Africa, Berhanu and Jaleta (2012) posited that agricultural transformation is not yet been realized since it is influenced more by the sluggish and static market oriented production and the resultant poor market participation. Downsizing the constraints, subsistence production, market access and the overall production determinants and yield quantity are sought to be the worth mentioning bottlenecks.

It is beyond doubt that, agricultural marketing is an important part of agricultural production where it will be intensified if there is ample agricultural production and vice versa. As a result of this complementary relationship, in Guatemala, Tanzania and Vietnam a finding by Rios et al. (2008) asserted that improving one of them undoubtedly will improve the other and thereby living conditions of the poor will be improved. According to Onoja et al. (2012) and Jagwe et al. (2010) if there is a need to ensure agricultural development led economic growth and increasing rural income, the poor majority need to be integrated with market and making them accessible for market is a must.

According to Diao and Nin Pratt (2007) agricultural production need to be supported by well structured infrastructural development as well as by a market structure that stood to serve smallholder farmers by minimizing transportation and transaction costs and increasing price of products. Farmers' production motive can highly be determined by favorable market access in such a way that farmers who are nearer to the market and all-weather roads are more probable to produce marketable products unlike their counter parts who produce for consumption alone (Onoja et al., 2012).

According to Abdoulaye and Sanders (2006) and Tabo et al. (2005), farmers in developing countries are seriously challenging by the price fall of agricultural products immediately after harvest. Price fall coupled with the intention of merchants to purchase agricultural products at harvest time and then store to sell later aggravated the improbability for farmers' profitableness. These problems can be solved through the provision of storage and inventory credit. The implication is that, if farmers are provided with credit at harvest time so as to cover all the expenses, they will store their products and undoubtedly get higher prices; and would enable to adopt different agricultural technologies. Using the supposed mechanisms, findings by Tabo et al. (2006) in Burkina Faso, Mali and Niger reveal that, production and farmers' income has increased from 44 to 120% and 52 to 134% respectively.

Being predominantly rural, according to Barrett (2007), the population of Eastern and Southern Africa can worth be mentioned as semi-subsistence producers for home consumption and their motivation in producing marketable products is been taken as tepid. In the same line of reference, some HHs may produce and sell during the harvesting time and a few months later they become net buyers. Similarly, in Western Kenya, Stephens and Barrett (2006) have reported that, 30% of their total respondents do sell their products soon after harvest, a few months later, 62% of them were found to be net buyers of products they sold.

According to Stephens and Barrett (2011; 2009) farmers' eagerness to sell out their products immediately after harvest makes them improbable to store and sell in a better price. Probably, the reason, according to Stephens and Barrett (2009) is due to shortage of storage or ware house facilities, the risk aversion nature of farmers with the probability of price loss and liquidity constraints. Due to these factors farmers are following the *"sell-low, buy-high"*

approach. Moreover, Stephens and Barrett (2011) purport that, storage can be taken as precautionary type of saving whereby farmers would use in time of emergency and sell when price increases. Albeit this, liquidity constraint forced farmers to follow *"sell-low, buy-high"* approach. According to Barrett (2007) though it seems irrational while farmers sold their products soon after harvest, they are rational and know as they will purchase later; they do it due to liquidity constraint to fulfill needs and cover credits incurred at harvesting time.

Agricultural EWs are paramount importance for the instigation of farmers to be market oriented through the accentuation of agricultural inputs and skill improvement. Similarly, so do it for market participation by promoting collective marketing, linking farmers with buyers, accessing market information, promoting cooperative work and controlling the middlemen not to cheat farmers (Berhanu and Jaleta, 2012); formal or informal market information, infrastructure conducive location and transaction costs (Jagwe et al., 2010); distance to the nearest market, transportation cost, farmers confinement to produce non-perishable products are the critical issues for better market participation (Omiti et al., 2009).

In Ethiopia, according to Bezabih (2009) cooperatives can play an indispensable role by providing marketing options and information, enhancing bargaining power, importing and distributing agricultural inputs with fair price and exporting domestic products. Cooperatives, in Ethiopia, according to Bernard et al. (2008) are serving more for their members than for nonmembers; where they got higher prices for their products ranging from 7.2% and 8.9% and their product sold is doubled than non-members. In Kenya, a finding by Omiti et al. (2009) revealed that, rather than formal, the informal market information is predominantly in place in providing accurate and timely information like friends and neighbors. The rationale, therefore, is farmers could not read magazines and sell their products accordingly; as a result they prefer the actual and on time market information.

According to Omiti et al. (2009) market-oriented production brings changes in the production process, utilization of new inputs and mechanized farming. By employing these inputs, in Ghana, according to Asuming-Brempong et al. (2013), smallholder farmers tend to be market oriented in producing like tomato or pineapple and become self-sufficient and food secured throughout the year. In Georgia, Kan et al (2006) also proffered that, large farm size, land

quality, irrigation and livestock assets let farmers to participate in market. Barrett (2007) posited that HHs with small land size are found to be gross purchasers. Furthermore, private asset paves the way for credit access and to invest in some other areas. In addition to this, Stephens and Barrett (2006) purport those HHs who do have access for credit are more likely to participate and transact in market; purchase inputs and be productive (Barrett, 2007).

Coming to market orientation, it is simply the consciousness of HHs to produce for market and allocating their time, fixed asset and capital accordingly (Berhanu and Jaleta, 2012). It can be determined by HH size, labor supply, presence of pack animals, extension services, rain fall and altitude (Berhanu and Jaleta, 2012); on time information flow, bargaining power (Jagwe et al., 2010) and by factors of production (Omiti et al., 2009; Rios et al., 2008 and Barrett, 2007).

CHAPTER THREE: RESEARCH METHODLOGY

3.1. Site Selection and Description of the Study Area

3.1.1. Site Selection

As far as study area selection was concerned, researcher's experience in knowing the problem under study and his overall affiliation to the study area has played a pivotal role. Moreover, the researcher's rationale in selecting Raya-Azebo and Raya-Alamata districts as focus of study was, compared with the rest districts of Southern zone, these two are more of promising and lucrative districts with plenty resource reservations basically fertile land resource, ground water, flat plain land supported by runoff rain water from the surrounding hilly parts. Despite these endowments, since production is decreasing, these districts are facing recurrent drought and food insecurity. Hence, finding out the responsible factors for this paradox and unmatchable result was found to be imperative.

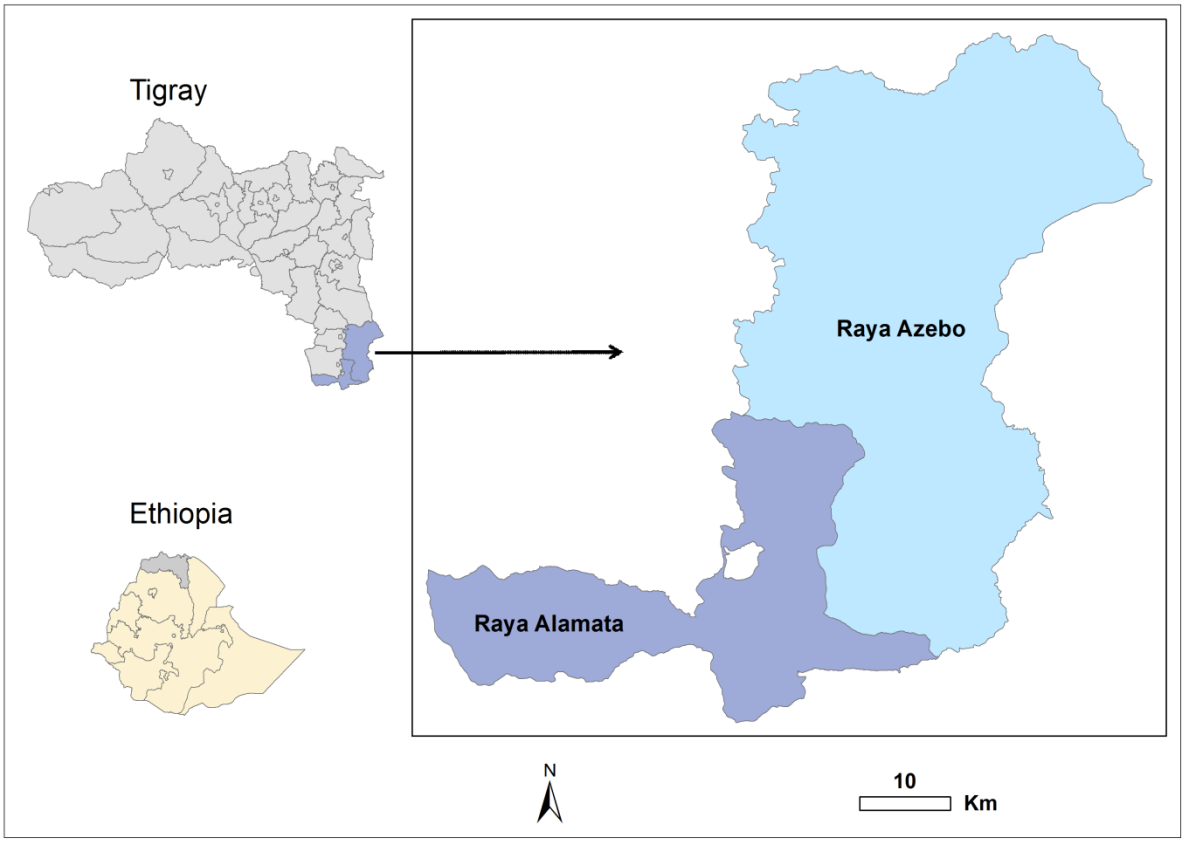
3.1.2. Description of the Study Area

Tigray regional state is Ethiopian northernmost tip located at $12^{o}15$ -$4^{o}57$ longitude and $36^{o}27$-$39^{o}59$ latitude. Tigray is one among the smallest regions of the country in terms of area surface (80,000 square miles) and number of population (4,316,988) where 844,040 (19.5%) and 3,472,948 (80.5%) live in urban and rural areas respectively (CSA,2007); of which 49.2% and 50.2% are males and females respectively. In the region there are 6 administrative zones including the state capital, Mekelle, comprising 47 districts and 673 sub-districts. Southern zone is one among the 6 administrative zones encompassing eight districts (including Raya-Azebo and Raya-Alamata) with a total population of 1,006,504 where 125,787 and 880,717 lives in urban and rural areas respectively.

Geographically, Raya-Azebo is located between 12^{o} 18'15'' and 12^{o} 38'15'' and it is about 666 and 112Km away from Addis Ababa and Mekelle respectively. It is bordered with Afar region in the east, Hintalo Wajirat district in the northwest, Endamekhoni district in the west and with Raya-Alamata district in the south. The district encompasses 16 sub-districts with a total population of 135,870 where 16,056 and 119,814 are urban and rural dwellers respectively (CSA, 2007). Besides, Raya-Alamata is located in between 12°15' latitude and

39°35' longitude; and it is about 600 and 178 Km away from Addis Ababa and Mekelle respectively. It is bordered with Afar region in the east, Ofla district in the north, Amhara region in the south and west and Raya-Azebo district in the north east. The district has 13 sub-districts with a total population of 85,403 where 4,563 and 80,840 are urban and rural dwellers respectively (CSA, 2007).

Figure 3.1: Location of the Study Districts.



Source: MU GIS Lab, 2014

Commonly, the two districts are more homogenous geographically, economically, socially and culturally. Topographically, according to Haile (2009) the valley is divided in to low land (altitude less than 1500 m.a.s.l) and high land (altitude above 1500 m.a.s.l). On the basis of its moisture index criteria, according to REST (1997) cited in Haile (2009), the Raya-Valley could be categorized as arid and semi-arid types. The average annual temperature is 29.7 degree centigrade with a maximum and minimum of 14.6 and 22.2 respectively.

Economically, the society is predominantly relied on mixed farming where cereal and livestock production are equally important. The rain fall nature is more of bi-modal with an average annual rain fall of 663 mm (Raya-Alamata) and 450-600 mm (Raya-Azebo); whereby the society uses two cropping season with in a year (the shortest for teff and longest for sorghum). Despite this erratic nature, according to Raya-Alamata district BoARD (2009) cited in Luchia (2010), the region is known in producing cereals, pulse, vegetables, horticultural crop and oil seeds. In addition to these all productions, in Raya-Azebo district, according to Haileselassie (2005) stimulants like coffee and chat are being grown. Concerning livestock production, the districts are the first from the zone where their share is proportional; according to Raya-Alamata district BoARD (2009) cited in Luchia (2010), there are 106,461 livestock with the largest share of cattle (74,853) followed by small ruminants (24,971).

3.2. Research Strategy and Design

3.2.1. Research Strategy

Mixed methods approach that base on pragmatic knowledge claims particularly consequence-oriented, problem-centered and pluralistic grounds were employed. The quantitative approach was used for really identifying the factors that determine crop production and thereby farm income. Besides, it was also be pertinent for indentifying determinants of smallholders' off-farm participation and their effect on agricultural production. Qualitative approach was used for qualitatively addressing and stating issues related with the details of crop production, off-farm participation and its effect on agricultural production and agricultural marketing using semi-structured questionnaires. Employing a single approach has its own strength and drawbacks; according to Creswell (2003) mixed approach is better in drawing positive sides and minimizing the drawbacks of any single approach. Moreover, the study was a developmental case study and a descriptive survey study as a result of this it needs to employ both qualitative and quantitative approaches. Hence, to keep validity and reliability of the study mixed approach was employed.

3.2.2. Research Design

To collect data the researcher used survey research design. This is because the survey design is preferable to conduct research employing large number of people questioning about their attitudes and opinions towards the specific issue, events or phenomena (Marczyk & Dematteo, 2005). It also enables the researchers to effectively administer and manage the tasks when the data collection takes place. Hence, the research questions and objectives have been addressed by cross-sectional survey data since the study has been done at one point of time and place.

3.3. Data Type and Sources

3.3.1. Data Type

To come up with a clear conclusion about the aforementioned objectives, the researcher used both quantitative and qualitative data types. While employing quantitative data types, the researcher's rationale were basically to achieve the first two specific objectives; whereas qualitative data types were used while stating and narrating about three of the objectives. Hence, objectives addressed by quantitative means were also addressed qualitatively, a condition that accentuates the pertinence of employing qualitative and quantitative data types; that in turn is imperative for making the study more accurate and reliable. Quantitative data types were analyzed using two different models specified below.

3.3.1.1. Econometric Model Selection and Specification

Econometric models were specified and used to identify the determinants of farm income and off-farm participation; on the basis of dependent variables' nature.

Econometric Model for Determinants of Farm Income and Variable Description

To identify the determinants of farm income, Ordinary Least Square (OLS) regression model was employed. The rationale was due to the continuous nature of the dependent variable, farm income. Furthermore, according to Gujarati (2006), with the assumption of classical linear model, OLS estimators are with unbiased linear estimators with minimum variance and hence they are BLUE (Best Linear Unbiased Estimators). Besides, different researchers like

Babatunde & Qaim (2009) and Olujenyo (2008) has had used OLS model in addressing similar issues. Since this study is similar with different prior researches, it has employed this model. Hence, its specification is given below.

$Y = \beta_0 + \beta i\ Xi + U_i$

Where: Y = the dependent variable (farm income)

Xi = a vector of explanatory variables

βi =a vector of estimated coefficient of the explanatory variables (parameters)

u_i = disturbance term that is assumed to satisfy all OLS assumptions (Gujarati, 2006).

The economic model specification of the variables is:

$$Farminc = \beta_0 + \beta_1 gender + \beta_2\ age + \beta_3\ educ + \beta_4 familysz + \beta_5 landsz + \beta_6 slope + \beta_7 plotdist + \beta_8 pest + \beta_9 fertuse + \beta_{10} hyv + \beta_{11} rowspa + \beta_{12} croprota + \beta_{13} intercrop + \beta_{14} irriguse + \beta_{15} extension + \beta_{16} credit + \beta_{17} associ + \beta_{18} TLU + ui$$

Where: Farminc=Continuous dependent variable indicating farm income

gender = indicates gender of farm households

age = stands for age of farm respondents

educ = indicates the educational or literacy level

familysz = stands for farm respondents' family size

landsz = indicates farm land size

slope = stands for plot slope type that household did possess

plotdist = stands for plot distance from the homestead

pest = stands for pests and curing mechanisms

fertuse = stands for smallholders' fertilizer use

hyv = indicates use of high yielding varieties

rowspa= stands for row spacing mechanism being used by farm households

croprota = stands for the use of crop rotation system

intercrop= stands for the use of intercropping practices

irriguse = stands for irrigation use

extension = stands for contact of extension workers

credit= stands for credit access

associ =stands for farmers membership to an association

TLU= stands for the number of Tropical Livestock Unit that farm households possess

3.3.1.2. Description of Variables used in OLS Model

Variables type, unit of measures and expected signs were described below.

Gender of HH Head: It is a dummy variable 1 if gender of the HH head is male and 0 otherwise. Male-headed HHs are physically strong and capable than female headed HHs and then the former would have better opportunities for enhancing their farm income (Malek & Usami, 2010; Abay & Assefa, 2004); as a result positive sign was expected.

Age of the HH Head: It is a continuous variable measured in number of years that also indicates farm experience and proper time allocation for farm activities until a certain age limit and thereafter their farm income would decrease (Adebiyi & Okunlola, 2013; Shumet, 2011; Anyanwu, 2009 and Abay & Assefa, 2004). Hence, negative coefficient was expected from the final regression result.

Education: It is a continuous variable measured in number of years of schooling; where the educated farmers are believed to acquire, analyze and evaluate information on different agricultural inputs, market opportunities that potentially could increase farm income than illiterate farmers (Uwagboe et al., 2012). Positive coefficient was expected from the regression result.

Family Size: This is a continuous variable measured in numbers. Large and productive family size could increase crop production through proper labor division, on time weeding and harvest. Besides, small and efficient family size could increase crop production by devoting all their time for farm activities as well as by employing agricultural inputs (Amaza et al., 2006). Its expected effect on farm income was not determined in priori.

Land/farm size: It is a continuous variable measured in hectare. Those with larger farm size could produce a lot that could potentially increase farm income (Mpawenimana, 2005). Hence, positive sign was proposed.

Plot Slope: It is a dummy variable which represents plot slope types in the study area; flat, medium and steep. Those who owned flat plot slope are fortunate to produce sufficient production that could increase farm income (Shumet, 2011); positive sign was expected.

Plot Distance: It is a continuous variable measured in minutes walking; as plot is far away from the homestead, the less probable will be on time plot preparation, weed, harvest and input utilization and then less will be farm income (Minale et al., 2012). Hence, negative sign was expected.

Pests: This is a continuous variable that measured in terms of Birr invested to purchase pesticides and herbicides. As per the view of Eshetu et al. (2005) pesticides, insecticides and herbicides can harm crops and the resultant farm income will also be compromised. As a result, negative sign was hypothesized for the final regression result.

Fertilizer use: This is a categorical variable representing 1 if the farmer uses fertilizer and 0 otherwise. As per the conclusion of Samuel (2006), farmers those who use chemical fertilizer were expected to have lesser crop yield and thereby farm income. Hence, negative coefficient was expected from the regression result.

HYV: It is a categorical variable representing 1 if the farmer uses HYV and 0 otherwise. Farmers who adopt are probable to produce higher that increases farm income and further adoption of different agricultural inputs (Eshetu et al., 2005); as a result it was expected to affect farm income positively.

Row Spacing: This is a categorical variable 1 if the farmer sows through in row and 0 otherwise. Row spacing cannot use all the land reserved for cultivation and a lot of space will be in place and crop production will be less that finally lessens farm income; and hence negative coefficient was expected.

Crop rotation: It is a categorical variable representing 1 if the HH uses crop rotation and 0 otherwise. Using crop rotation is believed to increase soil fertility, increase crop production and thereby farm income (Chomba, 2004). Positive coefficient was proposed.

Intercropping: It is a categorical variable representing 1 if the HH uses intercropping and 0 otherwise. Intercropping system is believed to save space and increase production and there by farm income (Chomba, 2004). Hence, positive was the sign proposed.

Irrigation: This is a dummy variable representing 1 if the HH has irrigable cultivated land and 0 otherwise. HHs who do have irrigable land and use irrigation were expected to have a much better farm income than non-users (Datar and Del Carpio, 2009). Therefore, positive coefficient was expected.

Extension Workers' Contact: It is a categorical variable representing 1 if HHs' were visited by EWs and 0 otherwise. Farmers' visited by EWs are believed to be exposed for different, new, updated inputs and information used to increase and double agricultural production that finally could increase farm income (Wondimagegn et al., 2011). Therefore, positive was the sign being expected from the final regression analysis.

Access to Credit: It is a categorical variable; 1 represents if the HH has had credit access and 0 otherwise. Credit access reduces liquidity problems that HHs could face while intending to purchase agricultural inputs; and hence paves the way for timely application of inputs thereby increase the overall farm income (Mpawenimana, 2005). Hence, positive sign was proposed.

Association: This is a categorical variable; 1 represents if a HH was member of a certain farmers' association or cooperatives and 0 otherwise. Membership to an association let farmers to access inputs easily with an affordable price that is pertinent to increase agricultural production and thereby farm income (Uwagboe et al., 2012 and Tewodaj et al., 2009). Hence, positive sign was proposed.

TLU: This is a continuous variable measured in numbers; where those with a flock of livestock were believed to have higher crop production that would potentially increase the resultant farm income (Rios et al., 2008 and Kaija, 2007). Hence, positive sign was expected.

Econometric Model Employed to address Smallholders' Off-farm Participation

The second model employed while examining farm HHs' participation in off-farm activities was basically the probit model. The reason behind employing probit model was due to its normal distribution assumption of error terms as well as farmers' unobserved or latent behavior that could be determined by using probit model. In probit model, HHs are assumed to make decisions so as to maximize utility (Uaiene et al., 2009).

Besides, different researchers like Uaiene et al. (2009) and Abebe (2008) has had used this model in addressing issues related with adoption and participation decisions respectively. Though it was also been worth to use logit model, its assumption is based on logistic cumulative distribution functions; hence, probit model is found to be appropriate for this research (Uaiene et al., 2009). Therefore, in this model there is a latent or unobservable variable that takes all the values in ($-\infty$, $+\infty$).

As a result the probit model can be expressed by the following general formula.

$Pr\ (Y=1/X_i) = \Phi\ (\beta_1\ X_1 + \varepsilon_{i1})$……..(1)

The latent variable Y_i^* is not observable and is represented by its proxy Y_i taking a value One (1) for participants and Zero (0) for non-participants.

$$Y_i = \begin{cases} 1, & Y^*_i > 0 \\ 0, & Y^*_i \leq 0 \end{cases}$$

$Y^*_i = X'_i\ \beta + \varepsilon_i$ ……..(2)

Where $\varepsilon \mid x$ is a normally distributed error term.

Thus, for the household *i*, probability of participation is given by:

$P(1) = \Phi\ (\beta X_i)$…… (3)

Where:

P (1) is the probability of participation

Φ is the cumulative distribution function of the standard normal distribution.

β is the parameters that are estimated by maximum likelihood

x' is a vector of exogenous variables which explains off-farm participation. Therefore:

$OFP = \Phi(\beta_1 gender + \beta_2 age + \beta_3 educ + \beta_4 familysz + \beta_5 dependent + \beta_6 landsz + \beta_7 mrktdis + \beta_8 location + \beta_9 TLU + \beta_{10} packanim + \beta_{11} creditamou + \beta_{12} nftgs$

Where: OFP= is a dependent variable, off-farm participation

gender = stands for gender of HH heads

age = indicates age of farm respondents

educ = stands for literacy level of farm HHs

familysz= indicates farm respondents' family size

dependent = indicates number of dependents within a certain house

landsz= stands for farm land size

mrktdis= stands for distance to the nearest market

location= stands for food deficit and relatively better area for off-farm participation

TLU= indicates Tropical Livestock Unit that sample HHs possess.

packanim= indicates number of draft animals that HHs possess.

creditamou= stands for the amount of credit taken.

nftgs= stands for non-farm trainings

3.3.1.3. Description of Variables used in Probit Model

Variables type, unit of measures and expected signs were described below.

Gender of HH head: It is a dummy variable 1 if gender of the HH head is male and 0 otherwise. Male-headed HHs would have better opportunity to participate in off-farm activities compared with the overburdened and discriminated female-headed HHs (Abebe, 2008). Hence, male HHs were expected to be better off-farm participants.

Age of HH head: It is a continuous variable measured in numbers; as age increases the probability of HHs to participate in off-farm activities were expected to decrease; where younger farmers were expected to participate unlike elder farmers (Merima and Peerlings, 2012; Alaba and Kayode, 2011; Babatunde and Qaim, 2009; Abebe, 2008 and Kaija, 2007). The sign being expected from the final result was negative.

Education: This is a dummy variable; 1 if a HH can read and write and 0 otherwise. According to Alaba and Kayode (2011) literate HH heads are more probable to participate in off-farm activities unlike illiterate ones. Hence, literate HHs were expected to participate better than their counter parts.

Family size: It is a continuous variable measured in numbers and whenever HHs have larger number of child aged in between 6-15, may tend to participate in off-farm activities (Merima and Peerlings, 2012) and conversely HHs with larger family size probably may diversify their farm activities and could not tend to participate (Zahonogo, 2011). Hence, its sign was not determined priori.

Number of dependents: It is a continuous variable measured in numbers; where HHs with large number of dependents were less probable (Zahonogo, 2011) and can even be high probable to participate (Merima and Peerlings, 2012). Due to this case, the sign was not determined priori.

Size of cultivated land: This is a continuous variable measured in hectare and the expectation was negative sign since those with larger farm lands participate less frequently due to the productive potential of their large farm size that could restrain off-farm participation rather diversifying farm activities (Alaba and Kayode, 2011; Abebe, 2008).

Distance to the nearest market: This is a continuous variable measured in kilo meters; and the longer the distance of farmers' residence to the nearest market, the improbable will be their participation (Babatunde and Qaim, 2009). Hence, negative sign was expected.

Location: It is a dummy variable which represents four of the sample sub-districts where their respective location was been considered as food deficient and relatively food sufficient (Abebe, 2008). Food deficient sub-districts were expected to have better probability of participation.

Tropical Livestock Unit: This is a continuous variable measured in number; where those who possess a flock of TLU were expected to participate much better than those who possess less (Shumet, 2011). TLU was expected to serve as a source of a startup capital and thereby raise the probability of participation. The expected sign, therefore, was positive.

Pack animals: It is a continuous variable measured in numbers where those who possess pack animals are believed to participate in off-farm activities like in cereal crop trading, charcoal trading and the like (Abebe, 2008; Berg and Girma, 2006). Due to this, positive sign was expected from the final regression result.

Credit amount: This is a continuous variable measured in birr where those who borrow large amount of birr were expected to participate in different off-farm activities (Abebe, 2008). Hence, positive was the coefficient expected from the final result.

Non-farm trainings: This is a dummy variable representing 1 if any member of a certain family has taken any training in off-farm skills and 0 otherwise. Trainings in off-farm activities like in masonry, carpentry, construction works and the like would motivate HHs to participate in off-farm activities (Abebe, 2008). Hence, positive was the coefficient expected from the last result.

3.3.2. Data Sources

Data was collected from both primary and secondary sources. To address the specific objectives, primary data (horse's mouth) has been collected from HH heads, DAs, district and sub-districts' crop production personnel. Secondary data, to supplement primary data, was collected from published and unpublished documents including journals (annual, quarterly and monthly publications), reports and manuals from Agricultural Marketing and Promotion Agency, Agriculture bureaus (in region and districts). Besides, reports from CSA, and academic journal articles were used.

3.4. Target Population and Sampling

3.4.1. Target Population

The target populations under study were all the residents of Raya-Azebo and Raya-Alamata districts with 16 and 13 sub-districts respectively; with a total population of 221, 273. Of the total sub-districts, by employing lottery method, the researcher has selected 4 sub-districts namely Bala-Ulaga, Kukufito, Lemeat and Tao with a total population of 9,342. This is due to the homogenous nature of the society where there is similar plot system and economic bases; as a result one sub-district can represent the other. Employing lottery method, therefore, could not be liable for selection bias and bring no difference among sub-districts.

3.4.2. Sampling Design

To get households, actually unit of analysis, the researcher has used both Probability and Non-probability sampling designs. Among the Probability sampling designs simple random sampling was employed while selecting the study sub-districts and eleven villages where final sample respondents were withdrawn proportionally. Non-probability sampling designs

particularly convenience, purposive sampling designs were used while selecting the study zone and districts, interviewees and focus group discussants (FGDs) respectively.

3.4.3. Sample Size Determination

There were different possible ways of sample size determination with different approaches in determining error terms and precision levels. While calculating the published tables as a guide for sample size determination, Israel (1992) had used a formula developed by Yamane (1967) with the precision level of ± 3, ±5, ±7 and ±10. Therefore, due to this and the commensurately known use of precision levels starting from ±1 to ±10 (if the target population is homogenous) the researcher used Yamanes' (1967) formula with a precision level of ±6.

$$n = \frac{N}{1+N\,(e)^2}$$

Where

N= designates total number of households in four sub-districts

n = the sample size whom the researcher used

e = designates maximum variability or margin of error 6% (0.06).

Thus, N= 9342 e= 0.06

Therefore, $n = \frac{9342}{1+9342\,(0.06)^2} = \frac{9342}{1+9342\,(0.0036)} = \frac{9342}{34.6312} = \mathbf{269.756751 \approx 270}$

Following this, sample size for each sub-district was calculated proportionally using number of HHs in each sub-district.

Table 3.1: Targeted sub-districts, their total population size and the Sample Size taken

No	Name of sub-district	Population size (N)	Sample size (n)
1	Bala-Ulaga	2164	63
2	Kukufito	3784	109
3	Lemeat	1697	49
4	Tao	1697	49
	Total	**9342**	**270**

Source: CSA, 2007 and Own Computation, 2014

3.4.4. Sampling Procedures

In order to select sample households, multistage sampling procedure was followed. In the first stage, conveniently one study zone was selected. Secondly, based on their agricultural conduciveness, two study districts were selected purposively. Thirdly, four sub-districts were selected randomly; of which, in the fourth stage, eleven villages (nine from Bala-Ulaga, Kukufito and Lemeat (three from each) and two from Tao) were selected proportionally where sub-districts with larger number of villages were given more weight. Finally, villages' sample size was determined proportionally from the already defined sample size.

3.5. Data Collection Instruments and Field Work

3.5.1. Data Collection Instruments

Questionnaire: It was in fact the most important approach by which primary data has been collected. Structured and semi-structured questions were designed for the sake of collecting both qualitative and quantitative data.

Interview: The researcher has administered structured and unstructured questions for purposively selected informants mainly DAs and districts' crop production personnel; because of their closeness to the issue under study.

Focus Group Discussion (FGD): Four FGDs, one from each sub-district (particularly in Marsa-Danisa, Kulqual Kebele, Kutiche and Maekel-adi villages) was held focusing on the challenges of agricultural production and their propositions to solve the problem.

3.5.2. Data Collection Procedures

For the purpose of data reliability, the researcher himself has personally administered all data collections excluding the questionnaire. As a result, five trained enumerators guided by a supervisor, actually the researcher himself, has administered the questionnaire. One enumerator has filled five questionnaires per day mainly in occasions like in soil and water conservation practices; food-for-work, public meetings and weekend. Twice interview has been held with DAs and districts' crop production personnel. Besides, four FGDs were conducted soon after questionnaire distribution involving 6 purposively selected numbers of

discussants including female-headed HHs, experienced farmers, off-farm participants and technology adopters.

3.6. Data Processing and Analysis

3.6.1. Data Processing

Soon after key informants' interview and FGD the researcher has summarized and coded the data manually. Besides, data collected through questionnaire has been edited manually at home and entered in to STATA soft ware version 11.

3.6.2. Data Analysis

Methods of data analysis used were descriptive statistics and econometric analysis tools. Descriptive statistics like mean, standard deviation, percentage and frequency were used to describe socio-economic and farm characteristics and factors affecting crop production, off-farm participation and its effect on agricultural production and market issues. OLS and Probit regression models were employed to examine determinants of crop production on farm income; and determinants of off-farm participation respectively using STATA version 11.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1. Demographic Characteristics of Sample Households

It is believed that demographic characteristics of sampled HHs were pertinent in providing insights and a hunch about the general features of a certain area under investigation. Hence, an attempt has been made to describe some important characteristics of sample respondents.

Table 4.1: Description of Demographic & Socio-Economic Variables (Categorical variables)

Variables	Labels	Freq	%	Crop yield difference	
				Mean	Std.Dev
Gender	Female	63	23.33	6.5	4.55
	Male	207	76.67	8.97	6.32
	Total	270	100	7.73	5.39
Religion	Muslim	151	55.93	8.36	5.58
	Orthodox	119	44.07	8.42	6.59
	Total	270	100	8.39	6.1
Marital Status	Others	32	11.85	5.94	4.21
	Married	238	88.15	8.72	6.17
	Total	270	100	8.61	7.84

Source: Own Field Survey Result, 2014 Freq= Frequency %= Percentage

As it can be seen in table above, 76.67% of the sample respondents were male headed HHs. In such instance, the study found a significant crop yield difference between male and female headed HHs where the former's yield overweighs with a mean difference of 2.82 quintal. Due to gender differences, female headed HHs are more prone to different internal and external tasks. Besides, with rare exceptions, their physical strength can also inhibit them not to do their farm activities energetically. Hence, their productive potential is low unlike their counter parts. The finding corroborates with the findings of Ekbom et al. (2012) in Kenya-where female headed HHs were inefficient in crop production; and Tewodaj et al. (2009) in Ethiopia as work division culture negatively affects crop production.

Table 4.1 above noted that, 44.07% of the sample respondents were Orthodox followers; where there is no significant crop yield difference compared with Muslim followers. Despite this, Muslims can do their farm activities every day unlike Orthodox followers where their thought forced them to celebrate some common Saint days that stagnates farm production. The finding is in agreement with BoFED (2011) and with the findings of Yezihalem (2007) in Northern Ethiopia where farmers abandoned their farm activities in fear of shocks and condemnation by the community. The same table further shows that, 88.15% of the respondents were married who were believed to invest their time on farm activities; since they have family responsibility that could encourage them to adopt agricultural inputs so as to increase crop production. Due to this, married sample respondents have produced a mean crop yield of 8.72 quintal much better than single, divorced and widowed. The finding is consistent with the findings of Adebiyi and Okunlola (2013) in Oyo state of Nigeria as married farmers do produce better than others.

Table 4.2: Description of Demographic & Socio-Economic Variables (Continuous Variables)

Explanatory Variables	Obs.-	Mean	Std .Dev	Min	Max
Age	270	44.66	10.47	23	72
Education	270	0.99	1.90	0	12
Family size	270	6.29	1.91	1	12
Number of Dependents	270	3.18	1.48	0	9
Land Size	270	1.49	0.67	0	4.75
Plot Distance	270	37.04	20.65	0	90
Irrigated Land Size	270	0.14	0.31	0	2.5
Oxen number	270	1.75	1.04	0	6

Source: Own Field Survey Result, 2014 Std.Dev=Standard Deviation,

As it can be seen above, the mean age and farm land size were 44.66 years and 1.49 hectares respectively (see the details in table 4.3 below). The mean educational back ground of sample HHs was 0.99 where by respondents did attend formal education at least for a year. As a result of this, sample respondents can worth be taken as illiterate who were far remote for agricultural information; who could give a deaf ear for interventions being made like taking

and using chemical fertilizer, HYV and agronomic advices. This year of schooling could not let farmers to engage in scientific agricultural practices by which yield can be increased.

As shown in table 4.2 above, average family size of sample respondents was 6.29 which in fact was greater than the national and regional average 5.24 and 5.05 respectively (CSA, 2009). Of the total mean family size, 3.17 were dependents who were relying on 3.12 working people. The mean plot distance from the homestead was 37.04 minutes. Besides, sample HHs have had a total of 0.14 ha irrigated land size. Furthermore, as the main source of draft power and factor of crop production, on average, sample HHs possess 1.75 oxen.

4.2. Factors Affecting Crop Production

There are different and multifaceted factors that determine crop production in the study area. These include demographic, physical, technological, agronomic and institutional factors.

4.2.1. Insights from Demographic Factors: Age, Land Size, Family Size and Oxen

Demographic factors mainly age; land size, family size and oxen have a far-reaching impact on crop production. Hence, categorizing these variables in to different divisions and analyzing crop production was found to be imperative to see a clear relationship and effect on crop yield. Three age groups were created with sixteen years interval by deducting the minimum age from the maximum and dividing it to the needed age groups (3). In due course of time, farmers were arbitrarily classified as young, middle age and old aging, respectively, 23 to 39, 40 to 56 and 57 to 74. Besides, family size was also divided in to three groups arbitrarily. Moreover, as power of crop production, number of oxen was also divided in to four as those who own no, single, pair and above oxen. As a factor of crop production, plot distance was also divided in to three (less than 30 minutes, 31 to 60 and above 60 minutes) divisions of minutes walking as Minale et al. (2012) has also used similar measurement in rural parts of Tanzania and divisions are made arbitrarily.

Table 4.3: Age group, land and family size vis-à-vis crop yield

Age & Family Size		Mean Land Size				Yield difference			
		Obs	Owned	Rented	Total	Mean	Std.Dv	Min	Max
Age groups	23-39	85	0.65	0.66	1.31	8.08	6.00	0	40
	40-56	138	1.00	0.53	1.53	8.30	4.83	0	33
	57-74	47	1.33	0.32	1.65	9.20	8.75	1	59
	Total	270	0.99	0.5	1.49	8.53	6.53	0	59
Family size	Small	21	0.88	0.38	1.26	5.55	3.46	1.5	15
	Medium	122	0.86	0.48	1.34	8.80	7.19	0	59
	Large	127	1.05	0.65	1.7	8.46	4.97	0	33
	Total	270	0.93	0.5	1.43	7.6	5.21	0	59

Source: Own Field Survey Result, 2014

As indicated in table 4.3 above, the modal age group interval was 40 to 56 years; where the mean age was basically 44.66. Hence, they are in their productive age group, an age that is believed to make people dynamic and flexible in input adoption; to exert their overall potential on agricultural and non-agricultural activities so as to increase crop production.

As it can be seen vividly above, the mean crop yield increases as age increases. For instance, the mean crop yield of farmers aged between 23 and 39 was 8.08 quintal unlike 9.2 quintal of those aged between 57 and 74. Despite the claim and assumption that older farmers are unable to do their farm activities energetically, in a nut shell, they are found to be productive unlike middle aged and younger farmers. In fact, middle aged farmers may participate in different off-farm activities that could reduce the time available for farm practices. Likewise, beyond lack of experience, younger farmers are improbable to be stable and motivated to do their farm activities. They really wonder here and there in search of some lucrative off-farm activities. Typically, inter and intra migrations were their features and hence they do engage in farm activities consciously to buy time.

Contrary to these age groups, old aged farmers really have an accumulated farm experience like plot preparation, clearly identifying what and when to sow crops. Besides, they are too stable and mostly could not think some other off-farm activities and migration. Due to this,

they are more probable to invest their time on farm activities; hence, they had ensured a relatively higher crop yield. The finding corroborates with the findings of Ekbom et al. (2012) in the highlands' of Kenya and Chiputwa et al., (2011) in Shamva district of Zimbabwe. Unlike this, it completely contradicts with the findings of Uwagboe et al. (2012) in Edo state of Nigeria; Shumet (2011) in Ethiopia where middle aged farmers tend to adopt agricultural inputs than younger and older farmers and are more productive.

Table 4.3 above, portray as the mean land acreage of sample HHs was 1.49 ha (5.98tsimad[1]); which was much larger than the national and regional average, respectively 1.18 and 1.08 hectare (CSA, 2007). Of this land size 0.99 and 0.5 hectares were owned and rented respectively. Although the rented land size was lesser, still, owned land size was larger than the national and regional average (CSA, 2007). The mean total land size of sample HHs was positioned on modal age group interval of 40 to 56 years. Although their rented land size was less and higher than their successors and predecessors, respectively, they have had a great share from the last regional land redistribution held twenty three years back.

The succeeding age groups, therefore, are more liable to meager land size transfer from their fathers' and mothers' lottery, a single dead bodies and if possible, expanding to the frontier. In Tigray region, Ethiopia, for instance, 4,005 ha was given for 15,198 youngsters through inheritance; and 27,924 ha was divided among 23.6 thousand youngsters in the frontiers (BoFED, 2011). It is possible, therefore, to deduce that when we come across higher age groups, it is fortunate to get higher owned and total land holding size. This large land holding size is found to be imperative for producing a relatively higher crop yield. The finding is consistent with the findings of Adebiyi and Okunlola (2013) in Oyo state of Nigeria; Endrias et al. (2013) in SNNPR, Ethiopia and Falco et al. (2010) in Ethiopia.

As it can be seen in table 4.3 above, HHs with small family size do produce 5.55 quintal unlike those with medium and large family sizes, who produce 8.8 and 8.46 quintal respectively. Hence, it is possible to surmise that, compared with small, those with medium and large family size members were better productive. They can do farm activities on time and seriously. The finding is consistent with the findings of Shumet (2011) in Tigray region

[1] One tsimad is equivalent with 0.25 ha or one ha is equivalent with 4 tsimad.

Ethiopia; Askal (2010) in Tigray, Amhara, Oromia and SNNPR regions of Ethiopia; Amaza et al. (2006) in Borno state of Nigeria. Despite this, it strongly contradicts with the finding of Coelli, Rahman and Thirtle (2002) in Bangladesh cited in Askal (2010) whereby HHs with small family size were found to be effective in resource allocation and fertilizer adoption and had ensured better production unlike those with large and medium family size members.

Table 4.4: Number of oxen owned, plot distance and yield difference

Variable	Label	Freq.	%	Yield difference			
				Mean	Std.Dev	Min	Max
Oxen Owned	0	38	14.07	3.46	2.53	0	10
	1	48	17.78	7.11	4.64	2.5	28
	2	147	54.44	8.83	5.86	1.5	59
	3 and above	37	13.71	13.38	6.62	5	40
	Total	270	100	8.2	4.91	0	59
Plot Distance	0 to 30	159	58.89	9.06	7.12	0	59
	31 to 60	82	30.37	7.96	3.75	1	22
	Above 60	29	10.74	5.91	3.65	0	13
	Total	270	100	7.64	4.48	0	13

Source: Own Field Survey Result, 2014

Being the only draft power and key asset of crop production, more than 54% of the sample HHs possesses a pair of oxen. Whether they own a plot or not, yet in the study area, farm HHs are intended to have at least a pair of oxen so as to plough by renting and sharecropping system. Keeping other things constant, the mean crop yield of farmers who own no, single, a pair and above oxen respectively was 3.4, 7.1, 8.8 and 13.3 quintal. Hence, crop production in the study area was really determined by the number of oxen possessed.

The nearer the plots distance from the homestead, the serious and on time are follow up, input adoption, weeding and harvest. Hence, those whose plot is nearer were found to be better productive unlike the faraway plot owners. It is consistent with the findings of Minale et al.(2012) in rural Tanzania; as crop yield was found to decrease with an increase in plot distance.

4.2.2. Physical Environment Nexus Crop Production

It is beyond doubt that the physical environment of a certain area is very crucial in determining the potential as well as actual production pattern of the region. Physical environment and its effect on crop production is described in table 4.5 below.

Table 4.5: Descriptive Statistics of physical environment of the region

Variables	Labels	Freq.	%	Mean Crop yield
Soil Quality	Infertile	42	15.56	6.22
	Fertile	228	84.44	8.78
	Total	270	100.00	7.5
Plot Slope	Flat	218	80.74	8.74
	Medium	26	9.63	8.48
	Steep	26	9.63	5.34
	Total	270	100.00	7.52
Rainfall[2]	Insufficient	269	99.63	
	Sufficient	1	0.37	
	Total	270	100.00	
Insect/pesticide use	No	60	22.22	6.94
	Yes	210	77.78	8.80
	Total	270	100.00	7.87

Source: Own Field Survey Result, 2014

As it can be seen above, 84.44% of the respondents do have a fertile arable land that could produce a lot in normal circumstances. The mean yield difference among those with fertile and infertile plots respectively was 8.78 and 6.22 quintal. It, therefore, is possible to conclude as the region has a fertile land endowment where those who own fertile land were found to be productive. The result is similar with the findings of Shumet (2011) in Tigray region, Ethiopia; and Umar et al. (2011) in Southern, Central and Eastern provinces of Zambia where fertile land possession is pertinent for increasing crop production and productivity.

[2] Mean crop yield was not calculated for rainfall divisions since no difference has been seen in rainfall sufficiency.

As far as plot slope was concerned, 80.74% of sample respondents have a flat land acreage that could retain flood from the surrounding hilly parts of the region. Compared with those who own flat land acreage, steep land acreage owners did produce almost 3/5 of the formers' product. Hence, flat land owners were more advantageous in crop production.

Table 4.5 above shows that, 77.78% of the sample respondents had faced parasitic problems that really cause a serious damage on crops. More particularly, striga is the most disastrous and repeatedly occurring parasite that rapidly expands using the fertile ground of erratic nature of rain fall and high temperature. To curb the infestation, these sample HHs have used insecticides and pesticides costing, on average, birr 67.36 (see its summary in Appendix I); and the mean crop production of pesticide users was much better than their counter parts. Furthermore, using pesticide can serve as a proxy factor of labor burden minimization whereby after using it, the labor force will do some other farm activities that could increase crop production. The finding is in line with the findings of Uwagboe et al. (2012) in Edo State of Nigeria; Olujide and Adeogun (2006) in Ondo state of Nigeria. But it is inconsistent with the findings of Eshetu et al. (2005) as they purport farmers' preference of disease tolerant crops in fear of chemicals' damaging effect on crops.

Had there been a rain in the study area, there would have been ample production. As indicated in the table above, 99.63% of the respondents did not get rainfall that enables them to produce and satisfy their annual consumption needs. In line with this, FGDs' and districts' crop production personnel's view surmised that, the regions' rainfall condition is becoming untimely; late entry and early exit; and at harvest time that washes the cereal on field.

This irregularity, non-drought resistant crops and lack of irrigation, as a proxy of rainfall, have resulted with poor crop production to the extent of food shortage and starvation. The finding is similar with the empirical findings of Dim and Ezenekwe (2013) in Nigeria; Woldeamlak (2009) in Amhara region, Ethiopia. However, the finding contradicts with the findings of Saifu (2004) in Ethiopia where insignificant correlation between crop production and rainfall seasonality had been exemplified; and further rainfall variability could not be a factor of crop production failure.

Table 4.6: Whether households do produce enough products or not and solutions taken

Variables	Labels	Freq.	%
Enough product produced	No	247	91.48
	Yes	23	8.52
	Total	270	100
Solution to fulfill food needs	Purchasing soon after harvest	9	3.64
	Food-for-Work & other off-farms	85	34.42
	Food for work & selling animals	153	61.94
	Total	247	100

Source: Own Field Survey Result, 2014

Table 4.6 above vividly shows that, only 8.52% of the sample respondents did produce crops that can possibly satisfy their annual HH consumption needs. The rest, actually the majority, sample HHs have faced food shortage, on average, for 6.33 months; almost half a year (see its summary in Appendix I). As it can be seen above, food for work and selling animals were solutions taken by 61.94% of the sample respondents. From this one can deduce that 61.94% of the sample respondents were those whom the government does believe to include them under the Productive Safety Net Program (PSNP); and at the same time these were those who do have their own animals that can be sold out and guarantee to purchase food crops.

In fact, this much months of food shortage was not due to shortage of rain fall a lone rather due to different and inter-related reasons. One among others, once included in the program, HHs do pay due attention for program tasks by delaying farm activities like sowing and weeding that ultimately diminishes overall production and productivity. The reason behind, according to FGDs, was over burdened and unaffordable penalty that forced them to prefer delaying farm activities and to start even after six o'clock local time. Consequently, farmers would be forced to sell their animals including the main draft power, oxen, and will keep their hands up begging oxen that adversely affects farmers' production potential. The impact of such things on crop production, therefore, was really negative and resulted in a down ward production growth.

4.2.3. Agricultural Technologies, Agronomic Practices Nexus Crop Production

It is beyond doubt that agricultural technologies and agronomic practices are determinants of crop production where soil and land can best be managed through these factors and there by production would increase.

4.2.3.1. Agricultural Technologies and Crop Production Nexus

Agricultural technologies play a paramount importance in increasing the productive potential of the land in maintaining and restoring soil fertility. In this study, chemical fertilizer and irrigation practices were examined to see their implication on crop production.

Table 4.7: Description of fertilizer took, use and price affordability

Variable	Labels	Freq.	%	Mean Yield
Fertilizer took	No	55	20.37	7.73
	Yes	215	79.63	8.56
	Total	270	100	8.15
Fully Fertilizer use	No	210	97.67	8.39
	Yes	5	2.33	15.9
	Total	215	100	12.15
Price affordability	No	214	99.53	
	Yes	1	0.47	
	Total	215	100	

Source: Own Field Survey Result, 2014

As evidenced in table 4.7 above, 79.63% of the sample respondents have taken 24.13 kg of chemical fertilizer which is believed to be an important asset of crop production increment (see its summary in Appendix I). Whatever the reason might be, however, taking this much chemical fertilizer does not mean that farm respondents did use of it fully or partially. As a result of this, out of 79.63% sample respondents, only 2.33% have sown fully in their farm land. While analyzing crop yield difference, those who have taken fertilizer and who have sown fully have a better crop yield record unlike their respective counter parts. The finding is consistent with BoFED (2011) of Tigray regional state where not using agricultural inputs

fully was raised as a challenge of crop production increment. The issue arouses strong questions: For what purpose they use it? Where did they throw? (Answers were given in table 4.8 below). Quite surprisingly, for not fully used fertilizer, on average farm respondents did invest birr 612.07 (see its summary in Appendix I) where price variation between the two districts and among equidistant sub-districts was evident. Due to this, price un-affordability have had exemplified by 99.53% of those who have taken fertilizer; where it increases from week to week if farmers fail to take as per the proposed time set. Hence, inference can be drawn as farmers have taken fertilizer that they could not sow fully in their farm land with its price variation and rapid increment.

Table 4.8: Sources to purchase chemical fertilizer; why and why not they took and use

Variable	Labels	Freq.	%
Source of income	Productive Safety Net Program	15	6.98
	Selling Animals & Crops	105	48.84
	Credit, selling animals & safety net	19	8.83
	Safety net & selling animals	76	35.35
	Total	215	100
Why farmers take fertilizer	To increase soil fertility	5	2.33
	Fear of denial of credit access	6	2.79
	Fear of exclusion from safety net program	118	54.88
	Not to be excluded from credit & safety net	54	25.12
	Not to be imprisoned (Forcefully)	32	14.88
	Total	215	100
Why not take fertilizer	Unaffordable/ High selling price	4	7.27
	No periodic payment arrangement	3	5.45
	Risky due to Erratic Rain fall	42	76.36
	Use of manure and compost	5	9.1
	High price, erratic rain fall & use of manure	1	1.82
	Total	55	100

Source: Own Field Survey Result, 2014

To get rid of the price headache, day-night nagging, anxiety and its rapid increment, 48.84 % sample respondents did sold out their animals and meager products to cover the required price. For un-used fertilizer, if farmers did sell their animals and products, their final destination will be begging food aid and migration to fill the food longing mouths at home.

As noted in table 4.8 above, 54.88% of sample respondents have taken fertilizer in fear of exclusion from PSNP. These days PSNP is becoming the blood stream and guarantee of food security since crops produced could not satisfy annual HH consumption needs. As a solution, farmers want to participate in the program as per the criteria dictated by taking the ordered chemical fertilizer that unfortunately add no significant value on crop production increment due to absence of rainfall and irrigation water.

According to FGDs, they took fertilizer in fear of exclusion from PSNP, credit access and forcefully. Finally, they kept at home; some people use it as for decorating their house; and still others did sell it illegally, if founded they will be imprisoned up to five years. Besides, EWs had responded as their role was convincing farmers to take agricultural inputs; but checking each and every farmer whether they use it or not was their most cumbersome task. Hence, they could not show farmers how to use fertilizers and thereby increase crop production as needed. Furthermore, crop production personnel did respond, as if farmers were not interested to hear any lobby about fertilizer and its significance for crop production. Hence, trying to convince them basically seems a strong cold war while farmers throw defending words. These circumstances could not let professionals to follow them up whether they use or not. From this, one can deduce that although EWs and crop production personnel do convince and tried to show how to use chemical fertilizer, farmers were reluctant to use due to erratic rainfall and unfortunately have taken mainly in fear of exclusion from PSNP.

The same table further indicated that, as have been supported by 76.36% respondents, the main reason for not taking and using chemical fertilizer was erratic rain fall and the resultant moisture stress; that corroborates with their belief of having fertile arable land. Had there been abundant rain fall and irrigation water, fertilizer would have been more effective and productive. Similarly, the view of agricultural experts of the two districts surmised that, late entry and early exit rain fall fluctuation coupled with high evapo-transpiration make the people hopeless to employ fertilizer since its result is really negligible and discouraging.

Perhaps, chemical fertilizer can best be effective in some other parts of Tigray region; all in all, however, in the study districts it has a paucity of encouraging results across different agro-climatic conditions. The finding is in line with BoFED (2011) of Tigray regional state.

The same table further indicated that, manure and compost, used by 9.1% of chemical fertilizer non-users, was the second inhibiting factor for not using chemical fertilizer. It, therefore, is possible to infer that, farmers were in a position to use animal dung as manure rejecting the old fashioned use of dung as fuel. Despite this, yet, farmers are seen while collecting crop residues for guaranteeing their future animal feed which is becoming more of a cut and carry system due to the introduction of the new regional policy what we call it zero grazing. Hence, farmers' probability of preparing and making compost and mulching for future cropping season is being compromised and not yet been seen.

Table 4.9: Description of Irrigation Use and Irrigation Water Sources

Variable	Labels	Freq.	%	Mean Crop Yield
Irrigation Use	No	203	75.19	8.09
	Yes	67	24.81	9.29
	Total	270	100	8.69
Irrigation Water Source	Check Dams	17	25.37	
	Runoff/River Diversion	39	58.21	
	Communal Wells	11	16.42	
	Total	67	100	

Source: Own Field Survey Result, 2014

As it can vividly be seen in table above, 24.82% of the sample HHs were irrigation users with an average irrigated land size of 0.14 ha. Having this land size, irrigation users have produced, on average, 9.29 quintal and hence were found to be better producers unlike their counter parts. As far as their water sources were concerned, more than 58% of irrigation users had used river diversion mechanism basically the run off-water from the surrounding hilly parts of the two districts. From this narration, it is possible to show an insight as if both owned and rented arable lands of irrigation users were more nearer to the river inflow and in the shadow of hilly lands. In these areas finding a rented and share-cropped land was too

difficult and expensive due to the possibility of producing four times a year using different inputs. Hence, whether they believe or not, the environment can in force them to use the flowing resource that unfortunately was scarcest to their counter parts.

Apart from its invaluable contribution for crop production increment, water use issues were in fact the most terribly addressed ones. As per the view of FGDs and districts' crop protection personnel, unfortunately, competition among irrigation users was stiff that tried to exclude free riders and in turn free riders had tried to feed their crops at night, in fact a water where they did not spend much effort and money. The finding corroborates with the finding of Lipton (2007) in Africa and Asia; as if such activities are corrupt practices.

4.2.3.2. Agronomic Practices Nexus Crop Production

Agronomic practices, in nature, are diverse cultivation practices where all are pertinent for increasing crop production in such a way that soil and land can best be managed and preserved. In this study, however, only use of HYV, row spacing, crop rotation and inter cropping were considered to examine their nexus with crop production.

Table 4.10: Use of HYV and Row Spacing Practices

Variables	Labels	Freq.	%	Mean Crop Yield
HYV Use	No	177	65.56	7.88
	Yes	93	34.44	9.42
	Total	270	100	8.65
Results before and after using HYV	Increase	42	45.16	10.71
	Decrease	35	37.64	8.9
	Equal	16	17.20	7.19
	Total	93	100	8.93
Use Row Spacing	No	267	98.89	8.34
	Yes	3	1.11	12.67
	Total	270	100	10.51

Source: Own Field Survey Result, 2014

As displayed in table 4.10 above, only 34.44% of the total plots of the sample HHs were covered by HYV. Due to awareness problem, farmers hesitate about the productive potential of these seeds and fear about crop failure and the resultant food deficiency. FGDs believe that indigenous seed is basically unproblematic and then preferable for better production. Contrary to this, HYV were blamed for increasing quality of products instead of quantity due to the in hospitability of the environment. As per their view, farmers were not in a position to increase products' quality rather quantity that could satisfy their consumption needs and extend their production horizons.

Contrary to their view, the survey result mainly the mean crop yield calculation revealed that, HYV users produced 9.42 quintal unlike 7.88 quintal production record of non-users. Besides, as an indication of positive result, the mean crop yield after and before employing HYV respectively was 5.38 and 4.9 quintal (see the summaries in Appendix I). Beyond this difference, 45.16% of the total users were found to be witnesses for crop yield increment after employing HYV with a total mean yield of 10.71 quintal.

To reconcile these different findings, indeed, FGDs claim about employing HYV and the consequent product quantity decrement due to awareness problem and the in hospitability of the physical environment. Their view corroborates with the findings of Benin et al. (2003) in Tigray and Amhara regions, Ethiopia; where HYV is serving as complement of indigenous seed. Despite FGDs view, in a nutshell, HYVs were found to be imperative for crop yield increment and thereby alleviate food shortage problems compared with indigenous seeds. This finding agrees with the findings of Solomon et al. (2011) in Tanzania and Eshetu et al. (2005) in Eastern Hararghe, Ethiopia as HYV is vital for poverty reduction and food security.

In opposition to the recent labor intensive agronomic practice, more than 98% of the total plots of the sample HHs were sown using the usual and traditional system. Its labor intensiveness is normally the basic factor that inhibits farmers not to use row spacing. In its very nature, row spacing requires one additional labor force from the usual one to make drop seeds following the farmer and oxen. In this case, as FGDs, farm respondents did note row spacing method like plowing with camel as if one drag camels and one follows them. Hence, one labor force that was following animals and doing some other farm activities was

seriously required which becomes unacceptable in their mind. Besides, EWs come clean that row spacing is really the most productive agronomic practice that farmers ought to practice. Despite labor claim, the mean production summaries before and after sowing in rows were 4 and 4.33 quintals respectively that manifest a 0.33quintal increment (see the summaries in Appendix I). The finding is consistent with the findings of Endrias et al. (2013) in Wolaita and Gamo Gofa zones of SNNP region, Ethiopia as if row spacing is pertinent for enhancing production and productivity.

Table 4.11: Description of Crop-rotation and Inter-Cropping Practices

Variables	Labels	Freq.	%
Use of Crop-rotation practices	No	4	1.48
	Yes	266	98.52
	Total	270	100
Crop rotation steps	Cereal-Cereals	204	76.69
	Cereals-Pulses	62	23.31
	Total	266	100
Use of Inter-Cropping practices	No	267	98.89
	Yes	3	1.11
	Total	270	100
Inter-cropped crops	Teff with Sorghum	2	66.67
	Pepper with Sorghum	1	33.33
	Total	3	100

Source: Own Field Survey Result, 2014

Being the most nearer and easily be done means of soil fertility maintenance, 98.52% of the sample HHs use crop rotation; where 76.69 % of them did rotate cereals after cereals like sorghum after teff which really was unscientific. Rotating legumes after cereals and vice versa improves soil fertility and break weed and pest life that could pave the way for increasing crop production. Unlike this logical application, in the study area, all the cereals rotated require almost the same soil nutrient and have more or less similar water intake capacity where by crop rotation practice become ineffective.

Perhaps, farmers did it intentionally since pulses could not be grown and be productive like cereals in their specific village or unknowingly due to lack of awareness about the importance of nitrogen fixation plants for crop rotation. What it seems justifiable, 23.31% of the sample HHs have used appropriate crop rotation: Cereals-Pulses. Normally, these users were from Marsa-Danisa and Qalina (from Raya-Azebo district) and Kutiche villages (from Raya-Alamata district) due to their pulse productive geographic location nearer to the highlands of Korem and Merewa respectively. The finding is similar with the findings of Minale et al. (2012) in Tanzania, Chiputwa et al. (2011) in Shamva district of Zimbabwe and Chomba (2004) in Zone 1 and Zone 2 of Zambia.

As far as inter-cropping was concerned, only 1.11% of the total sample HHs has used inter-cropping practices mainly mixing teff with sorghum followed by pepper with sorghum. These users were from Lemeat sub-district probably due to its small land size compared with others. The finding is in line with the findings of Tadele (2011) in Adamitulu, Jido Kombolcha and Meskan Districts Central Rift Valley as intercropping is used by those with small land size.

4.2.4. Institutional Factors Vis-à-vis Crop Production

Institutional factors are crucial for crop production increment and food sufficiency by solving liquidity problem, making accessible agricultural inputs, by providing advisory services and the like. Of the institutional factors, in this study, access to credit, EWs' contact and farmers' association or cooperative were considered to see their implication on crop production.

4.2.4.1. Access to Credit and Crop Production

Credit either from formal or informal lending institutions was considered as a pivotal factor of crop production increment.

Table 4.12: Description of Credit access and related issues

Variables	Labels	Freq.	%	Mean Crop Yield
Credit access	No	170	62.96	7.84
	Yes	100	37.04	9.33
	Total	270	100	8.59
Credit took	No	192	71.11	8.04
	Yes	78	28.89	9.24
	Total	270	100	8.64
Credit source	Relatives & neighbors	21	26.92	
	Cooperatives	2	2.56	
	Dedebit Micro Finance	42	53.85	
	Traders	13	16.67	
	Total	78	100	
Why credit?[3]	For Agricultural inputs	6	2.45	
	To start new business	225	91.84	
	To Purchase food crops	6	2.45	
	To Purchase oxen	8	3.26	
	Total	245	100	

Source: Own Field Survey Result, 2014

Table 4.12 above reveals that, only 37.04 % of the sample HHs have had credit access. Of these, 28.89% have taken a credit of, on average, birr 1381.85 (see its summary in Appendix I) both from formal and informal lending institutions. Irrespective of credit access and amount taken, the mean crop yield of those who have had credit access and taken, respectively, was 9.33 and 9.24 quintal that was better than their respective counterparts. From this, therefore, it is possible to infer that HHs who have had credit access and who have taken were advantageous for ease access of agricultural inputs and solves liquidity problem; hence, better be in crop production. The finding evokes similar results with the empirical findings of Adebiyi and Okunlola (2013) in Oyo state of Nigeria; Anyanwu (2011) in Rivers

[3] The remaining 25 sample households do not want to take credit.

state of Nigeria; Shumet (2011) in Tigray region, Ethiopia and Chiputwa et al. (2011) in Shamva district of Zimbabwe.

Dedebit Micro Finance was the common formal lending institution for 53.85% of Orthodox sample HHs; whereas Muslim sample HHs have been borrowing from relatives and neighbors. The reason why Muslims do entwined to informal lending institutions alone is basically the rules of their Holly Qur'an that did not allow paying an interest rate for formal institutions. The same table further indicated that, majority of the sample HHs (83.33%) were keen to take credit for the sake of starting a new business. Though, to start new business, Orthodox followers can borrow from Dedebit Micro Finance, the chance is not yet been seen for Muslim followers.

Table 4.13: Description of months of keenness and sources for credit repayment

Variables	Labels	Freq.	%
Keenness to pay back credit	Soon after harvest	43	15.93
	June-August	227	84.07
	Total	270	100
Sources for credit repayment	Income from PSNP	15	19.23
	Selling crops & animals	40	51.28
	PSNP, selling animals & crops	23	29.48
	Total	78	100

Source: Own Field Survey Result, 2014

Regardless of credit access and taken, 84.07% sample HHs have reported that, their real interest to repay back their credit was in fact in months between June and August. Their argument was rational where crops' price is always increasing in between these months that make them profitable and ready to pay their credit unlike in subsequent months soon after harvesting. Contrary to this, if money lenders are in hurry to take back the money they lend and if farmers hesitate about their probability of storing their crops till June, farmers would be forced to sell their products soon after harvest which actually is unprofitable.

As it can be seen in table 4.13 above, 51.28% of the sample HHs had paid pack their credit by selling their animals and crops. As have been explained in table 4.12 above, majority of the sample HHs had intended to take credit so as to start new business that was expected to be profitable or if not could subsidize the credit repayment. Thus, inference can be made as farmers were not effective while allocating the credit taken as a result they do pay it back by selling their animals and crops that further affects crop production and HH food sufficiency.

4.2.4.2. Extension Workers' (EWs) Contact and Crop Production

Extension contacts are believed to play a pivotal role in accelerating the production potential of a farmer and the land itself by providing different pertinent advisory services.

Table 4.14: Description of EAs' Contact, contact summary and yield difference

Variables	Labels	Freq	%	Yield difference		Monthly contact		Yearly Contact	
				Mean	Std.Dv	Mean	Std.Dv	Mean	Std.Dv
EW Contact	No contact	47	17.4	8.81	8.29	0.8	0.5	9.6	6
	Contacted	223	82.6	8.30	5.46				
	Total	270	100	8.56	6.88				
EWs'contact	Not enough	79	35.43	8.2	3.96				
	Enough	144	64.57	8.36	6.15				
	Total	223	100	8.28	5.06				

Source: Own Field Survey Result, 2014

As it can vividly be seen above, 82.6% of the sample HHs were visited by EWs. It is believed that, these days, EWs are providing agronomic oriented advisory services like proper land preparation, application of chemical fertilizer and HYV, soil and water conservation practices, on how to manage post harvest practices and the like. As per this expectation, hence, these HHs had a chance of bequeathing these all indispensable advices that could potentially increase crop production. They have had 0.8 and 9.6 mean contact days per a month and a year respectively. Quite surprisingly, having the above mentioned contact days, 64.57% of visited sample HHs did believe as contact frequency was enough. As a regional policy, giving twenty days free labor service is one of the strategies designed to

implement soil and water conservation practices. In such scenario, EWs are expected to avail themselves in an area where conservation is being done thereby give their professional guidance and advice. Hence, the mean yearly extension contact (9.6 days) vis-à-vis 20 days of free labor service paves the way to conclude as if extension contact was negligible or zero. Sample HHs did say as if there was enough extension contact while EWs tried to convince them so as to take chemical fertilizer and HYV.

The mean yield of contacted and non-contacted HHs was 8.3 and 8.81 quintal respectively. Hence, inference can be made that, the role played by EWs in accelerating crop production was unspeakably low. As already have mentioned in table 4.8 above, EWs' limited feeling of accountability and commitment is due to a discouraging monthly salary and top-down financing system; where they simply become responsible for their bosses. The finding agrees with the findings of Tewodaj et al. (2009) in Tigray, Amhara, Oromia, SNNP and Gambella regions, Ethiopia; and Ozor et al. (2007) in Katsina, Bauchi, Kogi, Ondo, Enugu and Rivers states of Nigeria; Adesina and Baidu-Forson (1995) in Burkina Faso and Guinea.

4.2.4.3. Farmers' Association or Cooperatives and Crop Production

Farmers' association and cooperatives are believed to provide agricultural inputs on time with an affordable price; could also provide credit for their members, facilitate market access and linkage where crop production would be increased.

Table 4.15: Description of farmers' cooperative membership Vis-a-Vis yield difference

Variables	Labels	Freq	%	Crop Yield	
				Mean	Std.Dv
Presence of Farmers' cooperative	No	11	4.07	12.73	11.75
	Yes	259	95.93	8.21	5.64
	Total	270	100	10.47	8.7
Membership to an association	Non-member	117	45.17	8.18	4.37
	Member	142	54.83	8.23	6.51
	Total	259	100	8.21	5.44

Source: Own Field Survey Result, 2014

As it can be seen above, more than 95% of the sample HHs did confirm the presence of farmers' cooperative where by members (54.83%) were found to be advantageous and relatively better in mean crop production. This better production has exemplified the pivotal role of cooperatives since they, for members, do provide agricultural inputs and materials with an affordable price as well as short term credit. Furthermore, cooperative members do serve both as service providers and beneficiaries where their coordinated effort was imminent in influencing each other to employ agricultural inputs like chemical fertilizer and HYV. The finding corroborates with the findings of Uwagboe et al. (2012) in Edo state of Nigeria; Tewodaj et al. (2009) and Bezabih (2009) in Ethiopia.

4.2.5. Econometric Estimation Results of Farm Income

In this section, determinants of farm income were analyzed that was imperative to further understand the potentials and constraints of farm income increment. The researcher used the same household, technological, agronomic, physical and institutional characteristics that have been discussed above qualitatively, since it is most likely that factors determining crop production would also determine farm income. As a result of this, OLS regression analysis technique was employed to analyze the relationship between farm income and independent variables. The approach being taken is similar with the approaches of De Janvry and Sadoulet (2001) in rural Mexico cited in Babatunde and Qaim (2009) and Babatunde and Qaim (2009) in Kwara State of Nigeria. The model assumes a linear relationship between the dependent and independent variables that basically need to fulfill different assumptions.

Before rushing to econometric estimation[4] and result display, different econometric assumptions were tested. Variance Inflation Factor (VIF) was employed to test the presence of multicollinearity among independent variables. Secondly, the inclusion and exclusion of irrelevant and relevant variables respectively were tested by link and OV (Omitted Variable) tests. Thirdly, hetroscedasticity problem was tested by using Breusch-Pagen test (hettest), unfortunately unequal variance was detected; as a remedy, therefore, robust standard error calculation was used. All relevant tests for OLS regression model can be seen in Appendix II.

[4] *The econometric software Stata version 11 was used to estimate empirical models*

Table 4.16: OLS Regression Estimation of Farm income

Variables	Coef.	Std. Err.	t	P>|t|
Gender	1006.75	1529.43	0.66	0.511
Age	-116.02	65.45	-1.77	0.077*
Educ	73.16	330.96	0.22	0.825
Familysz	706.22	348.63	2.03	0.044**
TLU	6570.88	175.51	37.44	0.000***
Landsz	5001.95	1118.20	4.47	0.000***
Irriguse	751.58	1476.14	0.51	0.611
Plotdist	-133.52	56.65	-2.36	0.019**
Dummyslope1(flat)	3588.58	2102.93	1.71	0.089*
Dummyslope2(medium)	1550.64	2836.80	0.55	0.585
Pest	-3.48	15.07	-0.23	0.818
Fertuse	1458.63	539.68	2.70	0.007***
Hyv	753.06	1351.92	0.56	0.578
Croprota	-519.82	5261.72	-0.10	0.921
Intercrop	-2643.56	4237.79	-0.62	0.533
Rowspa	25652.53	5798.10	4.42	0.000***
Credit	2494.61	1289.17	1.94	0.054*
Extension	751.58	1476.14	0.51	0.611
Associ	2877.81	1167.20	2.47	0.014**
_cons	-1796.78	6934.6	-0.26	0.796
Number of Obs = 270	Prob > F = 0.0000	Adj R-squared = 0.8931		
F (19, 250) = 119.29	R-squared = 0.9007	Root MSE = 9544.6		

Source: Own Estimation Result, 2014 *, **&*** significant at 10, 5 & 1 % respectively

As it can vividly be seen above, farm income was significantly influenced by age, family size, land size, plot distance, plot slope, fertilizer use, row spacing, access to credit, membership to a certain association and TLU. Except age and dummyslope1, the rest statistically significant variables have positive relationship with farm income.

Age and Farm Income

As have been seen above, as age increases by one year, farm income would decrease by birr 116.02. Although descriptive statistics results reveal crop yield increment as age increase, old aged farmers are more probable to minimize their livestock number due to their inability to feed them by cut and carry system as well as taking them to far remote grazing areas. In this case their livestock income would diminish that have an overall negative effect on farm income. The econometric estimation result basically feet with the prior negative hypothesis and hence, it is not rejected at 10% significance level. The finding is consistent with the findings of Babatunde and Qaim (2009) in Kwara State of Nigeria where farm income decreases with an increase in age.

Family Size and Farm Income

Family size has a positive effect on farm income which is statistically significant at 5% level of significance. Probably, some people might be surprised with this positive relationship; but farm income, in this case, was measured not in per capita income terms rather with a mixed contribution of crop and livestock incomes. Hence, a unit increase in family member increases total farm income by birr 706.22. The prior undetermined sign, here, is found to be positive. The finding is in line with the findings of Babatunde and Qaim (2009) in Kwara State of Nigeria where family size had a positive contribution for farm income increment.

Farm Land Size and Farm Income

Arable land size has a strong positive relationship with farm income; and it is statistically significant at 1% significance level. As land size increase by one hectare, farm income would increase by birr 5001.95. It is due to higher crop production and besides, if farm HHs did own large arable land size, it will serve for animal feed in such a way those weeds in their farm land could serve for that matter through cut and carry system. Even though it may have a negative impact on preparing compost for future cropping season, farmers with large farm size would also collect huge crop residues for their animals. Hence, these all opportunities would lead to higher farm income. Interestingly, the prior hypothesized coefficient was positive and the hypothesis is not rejected at 1% level. The finding is consistent with the

finding of Anyanwu (2011; 2009) in Rivers state of Nigeria in which increment in farm income was found to be the result of arable land size increment.

Plot Distance and Farm Income

Plot distance from the homestead is negatively related with farm income and it is statistically significant at 5% significance level. Accordingly, as plot distance increases by one minute, farm income would decrease by birr 133.52. The far remote the plot from the homestead, the lesser would be the follow up, on time tillage, weed, harvesting and input utilization. Due to this, crop yield that ought to be harvested would decrease and finally farm income would also decrease. The prior hypothesized coefficient was negative and the hypothesis is not rejected at 5% level. The finding is in line with the findings of Minale et al. (2012) in rural parts of Tanzania where input adoption and farm income decreases as plot distance increases.

Fertilizer use and Farm Income

In determining farm income, fertilizer use was found to be statistically significant at 1% significance level. In this scenario, fertilizer users were much better to get birr 1458.63 than non users. This entails that, keeping other things constant, if sample HHs did use the already taken fertilizer in their farm land, their farm income would increase by birr 1458.63. The null hypothesis proposed, therefore, is rejected at 1% significance level.

Row Spacing and Farm Income

As a determinant factor, row spacing has a strong and positive relationship with farm income which is statistically significant at 1% significance level. The result indicates that, keeping other things constant, row spacing practitioners were much better to get birr 25652.53 than those who sow through the usual and traditional way. Quite interestingly, the prior proposed negative hypothesis is strongly rejected at 1% significance level. Despite its high labor requirement and cumbersome nature, its overall result was found to be really encouraging where the drawbacks can be solved with hired labor. The finding is consistent with the finding of Endrias et al. (2013) in Ethiopia as row spacing practice is pertinent for crop production and farm income increment.

Access to Credit and Farm Income

It is worth to note that, access to credit is one best option whereby smallholders could be instigated in diversifying their economic base; and it is statistically significant at 10% level. The econometric result reveal that, keeping other things constant, HHs who have credit access were much better to get birr 2494.61 than HHs with no access. From this it is possible to deduce that, if credit is ready and accessible for farmers, their overall farm income would increase by birr 2494.61. The estimated result confirms the prior positive hypothesis and not rejected at 10% significance level. The finding agrees with the findings of Adebiyi and Okunlola (2013) in Oyo state of Nigeria; Anyanwu (2011) in Rivers state of Nigeria; Shumet (2011) in Tigray region, Ethiopia and Chiputwa et al. (2011) in Shamva district of Zimbabwe; where the importance of credit access in enhancing farmers' livelihood and farm income was highlighted.

Association and Farm Income

Membership to an association or cooperatives was found to be statistically significant at 5% significance level. As per the result shown, keeping other things constant, cooperative member HHs were much better to get birr 2877.81 unlike non-members. This result accentuates the acceptance of the null hypothesis at 5% significance level.

Dummy Plot Slopes and Farm Income

Plot slope dummies have been created with a reference group of steep plot slope. Consequently, flat and medium plot slope owners have had better farm income; though not statistically significant for medium owners. Keeping other things constant, farm income of flat plot slope owners was much better by birr 3588.58 than steep plot slope owners which was statistically significant at 10% level. The prior proposed hypothesis is not rejected at 10% significant level.

4.3. Effect of Off-farm Participation on Agricultural Production

One of the most important facets of off-farm activities is providing employment opportunities and additional income for rural HHs more particularly during the slack time. Besides, it is well recognized that OFP has a multifaceted effect on agricultural production by paving the way for ease access of inputs and on the other hand it negatively shares the time to be allocated for farm activities. By and large, it is one of the best means of risk minimization. OFP and its effect on agricultural production have been reckoned as follows.

4.3.1. Off-farm Participation across Age Groups and Gender

Once three age groups have been created and their probability and rate of OFP was examined in the following table. Besides, gender oriented participation; yield difference between participant and non-participant has also been seen.

Table 4.17: OFP across age groups, gender and yield difference

OFP	Age Groups				Gender & OFP		Yield Difference	
	23-39	40-56	57-73	Total	Female	Male	Mean	Std.Dev
Non-participant	22	26	30	78	26	52	9.24	7.73
%	8.15	9.63	11.11	28.89	9.63	19.26		
Participant	63	112	17	192	37	155	8.05	5.18
%	23.33	41.48	6.3	71.11	13.7	57.41		
Total	85	138	47	270	63	207	8.65	6.46
%	31.48	51.11	17.41	100	23.33	76.67		

Source: Own Field Survey Result, 2014

As it can be seen in table 4.17 above, 28.89% of the sample HHs were non-participants whom the researcher believed as if they totally allocate their time for farm activities and thereby increase crop production. Farm activities' time allocation is one among the most important determinants of agricultural production that in fact differs across different age groups. In such instances the frequency of participation was found to be high among middle aged farmers aged in between 40 to 56; followed by the succeeding age groups. Hence,

young and middle aged farmers were more probable to participate unlike old-aged farmers. The finding is consistent with the findings of Merima and Peerlings, (2012) in Tigray, Amhara, Oromia and SNNP regions of Ethiopia; Alaba and Kayode (2011) in South West Zone of Nigeria; Babatunde and Qaim (2009) in Kwara State of Nigeria; Abebe (2008) in Ethiopia and Kaija (2007) in rural parts of Uganda. Despite this, the finding strongly contradicts with the findings of Zahonogo (2011) in Sudanese, Sahelian, North and South-Guinean zones of Burkina Faso; Berg and Girma (2006) in Oromia region, Ethiopia where old- aged farmers would tend to participate like in manufacturing areas.

The mean crop yield of participants and non-participants was not basically equal where the latter's yield overweighs the former one. Hence, non-participants were found to be better crop producers unlike their counter parts. This finding really been corroborated with age factor as old aged farmers were not probable to participate and they become relatively effective in crop production; and here non-participants become better producers where old-aged farmers were also found to be non-participants.

Table 4.17 above reveals that, of the total 63 female headed HHs, 37 (58.73%) were found to be participants while 155 (74.88%) male headed HHs, of the total 207 were participants. Hence, there is quite significant difference of participation where female-headed HHs are more probable to be sandwiched with child rearing practices and challenged by districts' labor division culture. The finding is in line with the findings of Haggblade et al. (2010) in North Africa, Latin America and West Asia; Abebe (2008) in Ethiopia. It strongly disagrees with the findings of Merima and Peerlings (2012) in Tigray, Amhara, Oromia and SNNP regions of Ethiopia; Alaba and Kayode (2011) in South West Zone of Nigeria; and Kaija (2007) in rural parts of Uganda where female-headed HHs were better off-farm participants.

4.3.2. Education, Land Size and Distance to the Market Vis-à-vis Participation

Educational status of respondents was arbitrarily classified as illiterate and literate, those who have had zero and above years of schooling respectively. Similarly land size and distance to the market were also classified in to four and three divisions respectively.

Table 4.18 Description of education, land size and distance Vis-à-vis participation

Variables	Labels	Freq.	%	OFP			
				No	%	Yes	%
Education	Illiterate	174	64.44	57	21.11	117	43.33
	Literate	96	35.56	21	7.78	75	27.78
	Total	270	100	78	28.89	192	71.11
Land Size in hectare	0 to 0.75	52	19.26	23	8.52	29	10.74
	1 to 1.75	145	53.70	26	9.63	119	44.07
	2 to 2.75	66	24.44	26	9.63	40	14.81
	3 to 4.75	7	2.59	3	1.11	4	1.48
	Total	270	100	78	28.89	192	71.11
Distance to the market	Below 15 km	135	50	30	11.11	105	38.89
	16 to 30 km	72	26.66	39	14.44	33	12.22
	31 to 45 km	63	23.34	9	3.33	54	20.01
	Total	270	100	78	28.88	192	71.12

Source: Own Field Survey Result, 2014

Educationally, as it can be seen above, more than 64% of the respondents were illiterate who could not read and write. It is believed that educational level of HH heads is crucial for economic and income diversification and thereby increase their wealth and living conditions. Unlike this believe, as shown above, of the total 71.11% participants, 43.33% were mainly from the illiterate group. Hence, it is worth to deduce as education is not mandatory and seriously required to participate in off-farm activities. This is due to the fact that majority of the sample HHs have engaged in Food- for-work, as their typical and best off-farm activity. Food- for-work, therefore, did not require education and for that pointing finger signature is enough basically to take the salary either in cash or in food. In addition to Food- for-work, off-farm activities like selling local beer, trading grains and animals did not require education necessarily; and hence, everybody can easily do it. The finding is consistent with the findings of Abebe (2008) in Ethiopia; Berg and Girma (2006) in Oromia region of Ethiopia.

Concerning land size, large numbers of off-farm participants were in fact those who have 1 to 1.75 hectare; and frequency of participation was found to decrease as plot size increases. Therefore, it is possible to infer that, OFP was in response to farm land constraints. The finding is in line with the findings of Asenso-Okyere and Samson (2012) in Africa at large; Alaba and Kayode (2011) in South West Zone of Nigeria; Babatunde and Qaim (2009) in Kwara State of Nigeria and Abebe (2008) in Ethiopia.

Keeping other things constant, it is believed that, OFP decreases if the village is far away from the market. As it can be seen in table 4.18 above, of the total 23.34% sample HHs whose residence was 45 km away from the district market, 20.01% were participants unlike those resided in between 16 to 30km. Hence, for OFP, distance cannot be a determinant factor. This is due to the fact that their typical off-farm type was Food-for-work which is too nearer to their homestead; within their villages and its vicinity. The finding corroborates with the findings of Abebe (2008) in Ethiopia. It contradicts with the findings of Babatunde and Qaim (2009) in Kwara State of Nigeria where distance matters for participation.

4.3.3. Family Size, Dependents, Working People, Remittance and Participation

To see the implication of these variables on participation, the researcher has categorized variables in to different divisions arbitrarily. Accordingly, family size was classified as small (one to three), medium (four to six) and large (seven to nine) family sizes; while number of dependents was divided in to four categories (those with zero, one to three, four to six and seven to nine dependents); likewise, working people was also categorized in to three (one to three, four to six and seven to nine) and finally remittance was divided in to two as the haves and the have-nots (zero and above birr 500). Their respective description was presented in table 4.19 below.

Table 4.19 Family size, number of dependents, working people, remittance and participation

Variables	Labels	Freq	%	OFP				Mean Yield	
				No	%	Yes	%	Mean	Std.Dev
Family Size	1 to 3	21	7.78	12	4.45	9	3.33		
	4 to 6	122	45.19	37	13.71	85	31.48		
	Above 7	127	47.03	29	10.74	98	36.29		
	Total	270	100	78	28.9	192	71.1		
Dependents	0	10	3.70	6	2.22	4	1.48	11.8	17.39
	1 to 3	144	53.33	37	13.70	107	39.63	8.43	5.88
	4 to 6	111	41.11	33	12.22	78	28.89	8.18	4.14
	7 to 9	5	1.85	2	0.74	3	1.11	5.1	4.25
	Total	270	100	78	28.88	204	71.11	8.38	7.92
Active force	1 to 3	180	66.67	58	21.48	122	45.19	8	4.91
	4 to 6	86	31.85	19	7.04	67	24.81	9.13	7.76
	7 to 9	4	1.48	1	0.37	3	1.11	9.63	9.59
	Total	270	100	78	28.89	192	71.11	8.92	7.42
Remittance	0	263	97.41	77	28.52	186	68.89	8.39	6.08
	>500	7	2.59	1	0.37	6	2.22	8.43	4.43
	Total	270	100	78	28.89	192	71.11	8.41	5.26

Source: Own Field Survey Result, 2014

The above table envisioned that, of the total 71.11% participants, 36.29% were basically with large family size. From this inference can be made that, HHs with large family size were more probable to participate in such a way that labor division would prevail more; and besides, enough labor force at home would let family members to participate. The finding corroborates with the findings of Babatunde and Qaim (2009) in Kwara State of Nigeria; where HHs with large family size were found to be participants.

Besides, as it can be seen above, the more the number of dependents in a certain house, the less likely the HH would participate in off-farm activities. Those who do have 1 to 3 numbers of dependents were participated (39.63%) better than those with 7 to 9 dependents. Hence,

majority of the family members of farm respondents' were dependents where their contribution for crop production and farm activities was minimal. Rationally, dependents do require care and follow up thereby HHs' probability of participation would be compromised. Besides, although they could participate and get off-farm income, with no doubt, all the incomes will be consumed at home and the probability of investing on agricultural tasks will be less. As a result of these things, their further motivation of participation will be dwindled. Hence, dependency ratio was one hindrance of participation and crop production that decreases production rate and increases consumption need of farm HHs. The finding is consistent with the finding of Shumet (2011) in Tigray region, Ethiopia where number of dependents were obstacles of productivity and efficiency of farm HHs.

Number of active labor force within a certain house is one of the most important instigating factors of participation. Although 66.67% of the total sample HHs have had 1 to 3 active work forces and its participation seems the highest, HHs who have had 4 to 6 and 7 to 9 active labor forces were found to be the highest participants; where their yield record has also been increased. The finding is consistent with the findings of Zahonogo (2011) in Sudanese, Sahelian, North and South-Guinean zones of Burkina Faso that adhere higher number of working people and their higher participation.

Although remittance is believed to determine the probability of participation and production has also been increased, the mean annual remittance income, birr 107.6 (see its summary in Appendix I), was negligible and could not let farmers to participate, purchase agricultural inputs and oxen. Besides, as it can vividly be seen above, 97.41% of the sample HHs had no remittance or any other transfer; and only 7 sample HHs have had annual remittance ranging from birr 500 to 12800. When we see frequency of participation, although almost all remitted were participants, 68.89% of non-remitted HHs were also participants. Indeed, the role of remittance in rising farm HHs' probability of participation and investing back on agricultural activities and agricultural production can best be taken as effective. Had there been startup capital requiring off-farm activities, these non-remitted respondents would have not been participated. Hence, it is justifiable to infer as participant HHs do participate in non-capital requiring activities actually Food-for-Work.

4.3.4. Types of Off-farm activities, Motivating Factors and Place of Work

Types of off-farm activities done and factors that motivated farmers to participate and place of work were discussed in table 4.20 below.

Table 4.20: Off-farm activities, motivating factors and place of work

Variables	Labels	Freq.	%
Activities being done	Trading goat and sheep	24	12.5
	Trading cereal crops	20	10.42
	Trading egg, coffee, honey and shopping	3	1.56
	Cart	6	3.13
	Hair dressing and selling local beer	3	1.56
	Daily work	12	6.25
	Food for work	124	64.58
	Total	192	100
Location of employment	Within village	9	4.69
	Within sub-district	150	78.13
	Within district	16	8.33
	Neighboring region (Afar)	17	8.85
	Total	192	100
Motivating factors	Proximity to urban area	36	18.75
	Availability of off-farm opportunities	3	1.56
	Education level	5	2.61
	Excess labor at home	4	2.08
	Small land size possessed	20	10.42
	Access to off-farm activities	124	64.58
	Total	192	100

Source: Own Field Survey Result, 2014

As it can be seen in table 4.20 above, 64.58% of the total participants had been engaged in Food-for-work activities under the umbrella of PSNP. These people were paid employees where one person was expected to do five days per month and will be awarded birr 19 in cash

and 3kg (0.03 quintal) in food per day. Next to Food-for-work, trading sheep, goat and cereal crop took up the share. As far as place of work was concerned, 78.13% of the participants have been participated with in their respective sub-districts basically Food-for-work, transacting goat and sheep by buying and selling on market day time, on weekly and monthly basis. Since Food-for-work, was easily accessible across different sub-districts, they were not forced to go out of their residence. The finding agrees with the findings of Abebe (2008) and Berg and Girma (2006) in Ethiopia. Besides, table 4.20 reveal that, 64.58% of the total participants were instigated to participate due to the advent of PSNP and access for it; followed by their residences' proximity to urban area that exposed them to new and updated information, market identification mainly for petty trading activities like trading egg, coffee, honey, selling local beer and using cart.

4.3.5. Institutional Factors and Off-farm Participation

Institutional factors like credit access and non-farm trainings can worth be taken as factors that determine participation probability of smallholder farmers that could have a direct and indirect effect on agricultural production. Beside to institutional factors, TLU[5] was taken as one factor of participation; where it was arbitrarily classified in to four categories.

[5] *See Appendix 4 for Conversion Factors Used to estimate TLU.*

Table 4.21: Description of non-farm training, credit taken and TLU

Variables	Labels	Freq.	%	OFP			
				No	%	Yes	%
Non-farm training	Not trained	241	89.26	70	25.93	171	63.33
	Trained	29	10.74	8	2.96	21	7.78
	Total	270	100	78	28.89	192	71.11
Credit took	No	192	71.11	70	25.93	122	45.18
	Yes	78	28.89	8	2.96	70	25.93
	Total	270	100	78	28.89	192	71.11
TLU	0 to 5	136	50.37	32	11.85	104	38.52
	5.01 to 10	104	38.52	41	15.19	63	23.33
	10.01 to 15	22	8.15	4	1.48	18	6.67
	Above 15.01	8	2.97	1	0.37	7	2.6
	Total	270	100	78	28.89	192	71.11

Source: Own Field Survey Result, 2014

It is believed that providing non-farm training is imperative for instigating farmers to participate and thereby diversifying their economic and income base. Of the total HHs, only 10.74% were trained which in fact was negligible and still in its infancy. Of the total trainees, 7.78% of them were participants that manifest the positive contribution of non-farm trainings in motivating farmers to participate. The finding corroborates with the finding of Abebe (2008) in Ethiopia as non-farm trainings instigate farmers' probability of participation.

As it can be seen above, sample HHs who have taken credit were more probable to participate. Unlike their counter parts, of the total 28.89% HHs who have taken credit, 25.93% were found to be participants. Access and presence of credit serve as a startup capital for off-farm participation and thereby easily access agricultural inputs, diversify their income and economic bases. The finding is in line with the finding of Abebe (2008) and it strongly contradicts with the findings of Babatunde and Qaim (2009) in Kwara State of Nigeria where liquidity requirement to start off-farm activities could not be solved by taking credit.

As it can be seen in table 4.21 above, sample HHs who possessed a flock of TLU in between zero and five were better off-farm participants unlike others. As sources of direct cash, livestock could serve as a guarantee of starting off-farm activities; but the time share could totally be given for rearing animals, source of draft power, animal traction and manure that finally could increase farm production and productivity; hence, participation would be compromised. The finding is in line with the findings of Kaija (2007) in rural parts of Uganda. With respect to TLU, the presence of pack animals is the most deriving factor of participation where discrepancy is seen among those who own and not. It is a consistent finding with the findings of Abebe (2008) and Berg and Girma, (2006) in Ethiopia and contradicts with the findings of Rios et al. (2008) in Guatemala as pack animals serve for transporting manure and increase production thereby participation would be compromised.

For non-participants, the following were some of the inhibiting factors of participation.

Table 4.22 Off-farm inhibiting factors and yield difference

Variables	Labels	Freq.	%	Mean Yield
Inhibiting	Needed on farm	4	5.13	20.63
factors	Retired	9	11.54	6.89
	Shortage of startup capital	21	26.92	7.83
	No opportunity, far away & capital shortage	44	56.41	9.35
	Total	78	100	

Source: Own Field Survey Result, 2014

Table 4.22 above vividly reveal that, more than 56% of non-participants were seriously inhibited by absence and the resultant farness of off-farm opportunities coupled with shortage of startup capital. Had there been off-farm opportunities, they would not have been exploited the opportunities due largely to shortage of capital. From this one can infer that, farm respondents were highly intended to do activities that really requires startup capital like trading camel-the then costly animal being transacted and trading crops across different regions. Such activities can be done on the expense of farm activities that could result with poor crop production. Besides, as have been reported, opportunities' farness highlights that,

farm respondents were intended to do both farm and off-farm activities side by side without compromising their farm activities, their family's love, affection and social ties.

The same table further indicated that, 5.13% of the respondents had alleged as if they preferred to do on their own farm land rather than engaging in non-profitable off-farm activities. Such clear identification about the profitableness of off-farm activities was found to be imperative for agricultural production in such a way that farmers would not waste their time in unprofitable tasks and hence engage in their farm activities. As a result of this, their mean crop yield (20.63 quintal) was much better than all their counter parts: including participants (see their mean yield in table 4.17 above), those who were retired, inhibited by shortage of startup capital and by opportunities remoteness. Hence, their preference, clear identification and comparison between farm and off-farm activities let them to allocate all the time for their farm activities that have resulted in much better crop yield unlike others.

4.3.6. Econometric Analysis Results of Probit Model

In this binary regression analysis, factors determining OFP[6] have been analyzed with respect to their sign and magnitude of determination. In cross sectional data set, expecting and facing multicollinearity and hetroscedasticity problems is very much common. To check and address multicollinearity problem, correlation matrix was generated that could let to drop some of the variables that really show a serious multicollinearity problem. Besides, as a proxy and solution for Brush Pagan test of detecting heteroscedasticity problem, robust standard error calculation of probit model was used. Probit model specification tests and Marginal effect after probit were shown in Appendix III.

[6] *Land Size, TLU, Distance to the nearest market and Amount of Credit taken were in logarithm form.*

Table 4.23: Probit Estimates of OFP and Marginal Effect

Variables	Coef.	Std. Err.	z	P>|z|	Marginal Effect (dy/dx)
-Cons	0.8212	0.7970	1.03	0.303	
Gender	0.6388	0.2277	2.76	0.006***	0.2062
Age	-0.1662	0.0698	-2.38	0.017**	-0.0490
Educ	0.8783	0.3241	2.71	0.007***	0.2314
Familysz	0.1890	0.0857	2.21	0.027**	0.0557
Dependent	-0.0367	0.995	-0.37	0.712	-0.0108
Landsz	-0.0907	0.436	-0.21	0.835	-0.0267
TLU	-0.3873	0.1860	-2.08	0.037**	-0.1142
Packanim	0.2882	0.1587	1.82	0.069*	0.0850
Mrktdis	-0.1908	0.1783	-1.07	0.285	-0.0563
Dummyloc1Bala-Ulaga	0.7247	0.3938	1.84	0.066*	0.1802
Dummyloc2Kukufito	-0.7795	0.2875	-2.71	0.007***	-0.2399
Dummyloc3Lemt	- 0.1174	0.3788	-0.31	0.757	-0.0356
Nftgs	0.0302	0.3784	0.08	0.936	0.0082
Creditamou	0.0984	0.0303	3.25	0.001***	0.0290
Log likelihood = -124.63846	Number of obs = 270			LR chi2(14) = 75.35	
	Prob > chi2 = 0.0000			Pseudo R2 = 0.2321	

Source: Own Estimation Result, 2014 *, **&*** significant at 10, 5 & 1 % respectively

As it can be seen above, OFP has been influenced by gender, age, education, family size, TLU, presence of pack animals, dummy location1(Bala-Ulaga) and 2 (Kukufito) and amount of credit taken. From these all, age, TLU and dummy location2 carries a negative coefficient.

Household Gender and Off-farm Participation

Implication of gender on OFP is positive and statistically significant at 1% level. Male headed HHs, citrus paribus, have 20.62% higher probability of participation than female headed HHs. In fact, in the study districts, letting females to be a HH head is not yet well developed and recognized. Consequently, female headed HHs mostly are those who are

widowed and divorced. In such instances, beside the cultural factors, their probability of participation becomes negligible. In line with this, the prior proposed hypothesis is not rejected at 1% significance level. The finding corroborates with the findings of Babatunde and Qaim (2009) in Kwara State of Nigeria and Abebe(2008) in Ethiopia where by female-headed HHs are less probable to participate and influenced by cultural influences.

Household Age and Off-farm Participation

Effect of age on OFP is negative and statistically significant at 5% level that lets to accept the prior proposed hypothesis. By its very nature, OFP does require physical strength and fitness whereby younger farmers are better than older ones. The magnitude of negative sign infer that, as age increases by a year farm HHs' probability of participation would decrease by 4.9%. As the farmer grows older, he/she will concentrate on farm activities; and most likely they receive money from subsidies like remittance. The finding is consistent with the findings of Babatunde and Qaim (2009) in Kwara State of Nigeria and Abebe (2008) and Kaija (2007) in rural parts of Uganda in such a way that probability of participation decreases as age increases. This finding contradicts with the finding of Zahonogo (2011) in Sudanese, Sahelian, North-Guinean and South-Guinean zones of Burkina Faso and Berg and Girma (2006) in Ethiopia; where the older the HH head gets, the more he/she tend to participate.

Household head Education and Off-farm Participation

The probit estimation result reveals that, the effect of educational level of farm respondents (illiterate and literate) is positive and statistically significant at 1% level. In fact, majority of farm HHs do participate in Food-for-Work that did not require any formal education. Despite this, the implication here is that, the more the farmers become literate the higher will be their probability of searching off-farm work in non-agricultural sectors. The magnitude of positive sign in tails those literate HHs, keeping other things constant, have 23.14% higher probability of participation unlike their counter parts. The finding confirms the findings of Zhu and Luo (2006) cited in Babatunde and Qaim (2009) in such a way that the more literate the HH is, the more probable to search and participate in profitable off-farm activities.

Family Size and Off-farm Participation

Family size is positively related with OFP; and significant at 5% level. Larger HHs can really do and manage both farm and off-farm activities side by side without compromising each of the activities. A unit increase in family size would raise the probability of participation by 5.57%. The finding is consistent with the findings of Merima and Peerlings (2012) in Ethiopia; Alaba and Kayode (2011) in South West zone of Nigeria and Babatunde and Qaim (2009) in Kwara State of Nigeria as if HHs with large family size would participate better than those with small family size; but the finding contradicts with the findings of Zahonogo (2011) in Sudanese, Sahelian, North and South-Guinean zones of Burkina Faso where HHs with small family size were found to be better participants unlike large family size.

Pack Animals and Off-farm Participation

Presence of pack animals has positive relationship with participation and statistically significant at 10% level. The finding reveals that a unit increase in draft animals would raise the probability of participation by 8.5%. Farm HHs who possess pack animals are more probable to participate in activities like trading cereals, cart, transporting sand and stone for construction purpose, charcoal production, fire wood selling and the like. This finding is similar with the findings of Abebe (2008) and Berg and Girma (2006) in Ethiopia as if HHs who possesses pack animals would participate much better than those who did not possess. Despite this agreement, the finding strongly contradicts with the finding of Rios et al. (2008) whereby pack animals would serve to transport manure from home to farm land and thereby increase crop production that finally decreases the probability of participation.

TLU and Off-farm Participation

The effect of TLU on participation is negative and statistically significant at 5% level. As livestock increases by one, the probability of participation would decrease by 11.42%. Indeed, larger TLU can serve as source of startup capital for off-farm participation but the time share could totally be given for rearing animals, source of draft power and manure that finally could increase farm production and productivity; hence, participation would be compromised. The finding is consistent with the findings of Kaija (2007) in rural parts of

Uganda who found the negative coefficient of TLU on participation since it could increase reservation wage.

Amount of Credit taken and Off-farm Participation

Credit has a positive effect on participation; and statistically significant at 1% level. As credit increases by birr one, the probability of participation would increase by 2.9%. Hence, access and taking credit influences participation, indicating that the more farmers have access to source of finance, the more likely to participate in off-farm activities and further adopt different agricultural inputs and then increase crop production. The finding agrees with the findings of Adebiyi and Okunlola (2013) in Oyo state of Nigeria and Abebe (2008) in Ethiopia; as if taking credit is imperative for solving liquidity problem and thereby increases the probability of participation. On the other hand, the finding contradicts with the findings of Babatunde and Qaim (2009) in Kwara State of Nigeria where liquidity problems, when OFP is needed, could not be solved by accessing and taking credit.

Location Effect and Off-farm Participation

Location can serve as a proxy of rain fall availability, productive potential of districts, sub-districts and villages. It is worth to note the discrepancy of participation among sub-districts. Consequently, sub-district dummies have been created; *Tao* was taken as a reference group due to its middle crop production position. Relative to *Tao*, the probability of participation is higher in *Balla-Ulaga* sub-district by 18.02%; a sub-district basically with higher crop yield and farm income; and it is statistically significant at 10% significance level. Compared with *Tao*, the probability of participation is much lesser in *Kukufito* sub-district by 23.99% that in fact is relatively food-deficit and credit rationed sub-district due to rules of their holly Qur'an; and it is statistically significant at 1% level. Farmers who live in areas with relatively better crop production and farm income, therefore, tend to participate unlike areas with food deficient. Due to this, the finding completely disagrees with the findings of Zahonogo (2011) in Sudanese, Sahelian, North and South-Guinean zones of Burkina Faso and Abebe (2008) who found as participation is higher and lower in food-deficit and surplus regions respectively.

4.4. Factors Affecting Agricultural Marketing and thereby Production

Agricultural marketing is one of the most important factors that seriously determine agricultural production and the reverse holds true where increasing production will increase agricultural marketing. Some of the basic factors that affect agricultural marketing were analyzed in the following sub-sections.

4.4.1. Distance and Transportation Cost nexus Agricultural Marketing

It is worth to note that distance to the district and village markets and the resultant transportation cost can best determine agricultural marketing. These issues were analyzed in table 4.24 below.

Table 4.24: Village distance from market centers and transportation costs

Variables	Obs	Mean	Std.Dev	Min	Max
Village distance from the district market	270	22.06	15.4	2	45
Village distance from Asphalt road	270	14.31	17.69	0	45
Village distance from the Gravel road	270	2.66	2.71	0	7
Transport cost per person to district market	270	19.08	8.7	5	30
Transport cost per quintal to district market	270	10.11	4.17	3	15
Village Distance to the nearest village market	270	8.88	4.24	0.94	13
Transport cost per person to village market	270	10.69	6.9	0	25
Transport cost per quintal to village market	270	6.63	3.77	3	15
Travel to reach the district market (hr.)	270	4.36	1.93	1	7
Travel to reach the village market (hr.)	270	1.52	0.66	0.25	2

Source: Own Field Survey Result, 2014

Distance factors of agricultural marketing, as vividly been seen above, on average a village was far away from the district market, asphalt and gravel roads by 22.06, 17.69 and 2.71 km respectively. This figure clearly perpetuates that, farm respondents were unable to access market information easily; they were not been instigated for market oriented production system (produce for home consumption alone) and unable to participate in districts' market

day by crossing 22 km; that can worth be mentioned as one bottleneck of agricultural transformation in general and smallholder farmers in particular.

Average transportation cost per person to the district and village markets was birr 19.08 and 10.69 respectively. In fact, as per the country's current transportation frame, it can be taken as high and costly; but due to the districts' and sub-districts' infrastructural condition the cost cannot be exaggerated. Irrespective of these explanations, since respondents were smallholder farmers, they were unable to afford the required transportation costs. The cost becomes worse while including, on average, birr 10.11 and 6.63 transportation costs of cereals per quintal to the district and village markets respectively. To this end, if one farmer sells out his/her one quintal product and returned back to his/her home, he/she was expected to pay birr 48.27 and 28.01 to and from the district and village markets respectively. Due to these reasons, therefore, farmers become de-motivated to engage in market and market related issues as well as in producing marketable products. Moreover, with such transportation costs, farm respondents' transaction power become less and less; as a result they could sell their products below the normal price set out. Hence, agricultural production, in the study districts, has been seriously determined with these all circumstances.

Although farmers can overcome the above costs by transporting their products using pack animals and on foot; on average, they had been traveling 4.36 and 1.52 hours to the district and village market centers respectively; that would increase even twice while using pack animals. This farness, therefore, inhibit farmers not to sell their products at the right and required time and finally could not easily access agricultural inputs. These all findings are consistent with the findings of Omitti et al. (2009) in rural and peri-urban areas of Kenya where farmers' probability of productiveness and market orientation was inhibited by these factors.

4.4.2. Need Versus Actual Product Selling Season

Product selling period is one important facet of agricultural marketing that make farmers either profitable or losers. Farmers' selling period need analysis, actual selling period and reasons for selling mainly in unprofitable months were analyzed in table 4.25 below.

Table 4.25: Need versus actual product selling season and reasons for that

Variables	Labels	Freq	%	Mean Food shortage months
Months of product sell	October to January	231	85.56	8.12
	February to May	28	10.37	6.96
	June to September	11	4.07	3.91
	Total	270	100	6.33
Why not in between June & September[7]	Lack of credit inventory	116	44.79	
	Fear of price decrease	16	6.18	
	For cloth, marriage, root crops	18	6.95	
	For credit, cloth, marriage	109	42.08	
	Total	259	100	
Net buyers in last season	No	4	1.48	
	Yes	266	98.52	
	Total	270	100	

Source: Own Field Survey Result, 2014

As it can be seen above, more than 85% of the sample HHs have sold their products soon after harvest. In the then time, price of products was unspeakably low with the assumption that majority of smallholder farmers would take their products to the market. The profitability of smallholder farmers then be compromised and their overall condition will be less attractive. Consequently, farmers who sold their products soon after harvest have been facing a mean of 8.12 months of food shortage unlike those who sold in between June and September. Hence, selling products soon after harvest is found to be a driving factor for farmers' future food deficiency.

Although farmers want to sell in the last season of a year, 44.79% of the sample HHs were forced to sell soon after harvest due largely to lack of inventory credit which is pertinent for compensating all the costs incurred at harvesting time. The implication is that, if farmers are provided with credit at harvest time so as to cover all the expenses, they will store their products and undoubtedly get higher prices; and would enable to adopt different agricultural

[7] 11 (Eleven) Sample respondents do sell their products in profitable months.

technologies. The finding is consistent with the findings of Barrett (2007) in Eastern and Southern Africa; Abdoulaye and Sanders (2006) in Fakara plateau of Niger and Tabo et al. (2006) in Burkina Faso, Mali and Niger where farmers had faced food shortage and starvation due to their tendency of selling their products soon after harvesting.

Still in the same table, as a soon harvest selling factor, 42.08% of the sample HHs had raised the issue of credit, cloth and marriage. Farmers do take credit both from formal and informal institutions to be paid back mainly within the harvesting season. Regardless of the ground reality, creditors like Dedebit Micro Finance did not tolerate farmers till June with the assumption that farmers could finish and could not store their products till then. Moreover, marriage usually held on January, still, is one of the prestige, privilege and escort-ion manifestations that forced farmers to sell their products soon after harvest as a cost sharing mechanism for feast owners. Marriage, in the study districts, is one of the most needle-biting aspects where one could not determine its far-reaching impact on the economic and livelihood status of farm HHs. To surmise, therefore, farm HHs do sell their products soon after harvest both rationally, due to lack of inventory credit and for basic needs; and irrationally, for marriage, the most extravagant culture of the two districts.

As a result of the above mentioned factors, in the last season of a year, more than 98% of the sample respondents were found to be net buyers of consumable products. On the basis of these respondents, they were sellers with less price and buyers with high price that they could not afford easily. Likewise, as already have mentioned above, feast owners do it by over exploiting the products produced to be subsidized by the cost sharing means for purchasing HH consumption needs in the last season of a year. The finding is consistent with the findings of Stephens and Barrett (2011; 2009) in Kenya; Barrett (2007) in Eastern and Southern Africa; Stephens and Barrett (2006) in Western Kenya whereby farmers had followed a sell low-buy high principle that exploits the potential reservations of farmers' ability to purchase and produce.

4.4.3. Institutional Factors, Means of Transportation and Agricultural Marketing

Despite the above discussed credit issues, institutional factors like extension services and presence of cooperatives or farmers' associations are crucial for the overall marketing environment and facilitation. Besides, means of transportation while taking products to the market is also vital for the sake of benefiting from the rapidly changing product price.

Table 4.26: Means of transportation used and institutional factors

Variables	Labels	Freq.	%	Mean Yield[8]
Transportation used	On foot	26	9.63	4.26
	Pack animals	226	83.70	8.55
	Vehicles	18	6.67	12.39
	Total	270	100	8.4
Price information source[9]	Neighbors	221	86.33	8.29
	Extension Workers	29	11.33	9.43
	By calling wholesalers	3	1.17	10.67
	Cooperatives/associations	3	1.17	7.67
	Total	256	100	
Role of cooperative[10]	Linking with buyers	5	1.93	
	Information dissemination	3	1.16	
	Not to be cheated	5	1.93	
	Supplying inputs	53	20.46	
	Nothing	193	74.52	
	Total	259	100	

Source: Own Field Survey Result, 2014

As it can be seen in table 4.26 above, while taking their products to the market, more than 83% of the sample respondents had used pack animals across the already mentioned distance. The second means of product transportation used was in fact the usual burdened women and

[8] Mean Yield calculated for those who got price information cannot be summed in total since 14 farmers did not got information

[9] 14 (5.19%) sample respondents had no prior price information.

[10] 11(4.07%) sample respondents do claim as if there were no farmers' cooperative.

daughters carrying on their back yard. While taking products to the market, 94.81% of the respondents had prior price and overall market information obtained mainly from neighbors. Since they could not read and write and difficulty of accessing radio and television, reading market information leaflets, listening radio and watching television could not be their price information sources. As it can be seen above, mean crop yield varies across different transportation users; where pack animal users were better and lesser than those who transport on foot and via vehicles respectively. Therefore, one can deduce that those who have better production record were in a position to use vehicles with prior price and market information by contacting wholesalers and EWs. The finding is consistent with the findings of Omitti et al. (2009) in rural and peri-urban areas of Kenya where neighbors and friends were sources of market information and where pack animals were their main means of transportation.

As an instigating factor of agricultural marketing and production, presence of farmers' cooperative had been supported by more than 95% of the sample respondents. Despite their presence, while analyzing their importance, more than 74.52% of the sample HHs had reflected as if they do nothing. Their reflection was basically in relation to chemical fertilizer and HYV where price increases through time and the cooperative was asking them to pay; hence, respondents did consider as if the cooperative was crediting them. Any which way, 25.48% of the sample HHs had witnessed as if cooperatives were pertinent for supplying agricultural inputs like HYV and fertilizer, shopping; linking farmers with buyers, market information and make farmers aware not to be cheated by middlemen. The finding is in line with the findings of Bezabih (2009) and Bernard et al. (2008) in Ethiopia at large that exemplifies the importance of cooperatives in supplying agricultural inputs, credit and facilitating market information and its strong effort in making members profitable.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1. CONCLUSION

Although it needs different and multifaceted interventions, the age-old advocacy for agriculture in development is not in any way misleading. Stemming from this logical ground, this study have been done with the intention of identifying determinants of agricultural production; with due emphasis on determinants of crop production, effect of off-farm participation on agricultural production and finally agricultural marketing determinants nexus production.

Crop production, in the study area, has been determined by respondents' and plot level characteristics, technological, agronomic and institutional factors. Of the demographic factors, gender and marital status were found to be the determinants in which male headed and married HHs were found to be better crop producers unlike their counter parts. Although farm respondents were in their productive age group, 44.66 years, their educational level could not let them to adopt different agricultural inputs and practices; and unfortunately crop production has been increased as age increase. Regardless of land size, gender and age of sample HHs, mean crop yield increment has been seen when we goes from those who own no, single, a pair and above oxen.

The study districts have a fertile land endowment with flat plain. Despite these endowments, crop production is being determined by the erratic and untimely nature of rainfall basically featured with late entry and early exit that paves the way for the spread and expansion of striga parasite. These make people unable to fulfill consumption needs where participating in food-for-work and selling ruminants were found to be the solutions being taken.

Technologically, 79.63% of sample HHs have taken chemical fertilizer on average 24.13 kg with an average cost of birr 612.07. Taking chemical fertilizer by itself could not be a guarantee for use of it; and hence, only 2.33% of the sample HHs did use it fully basically with the pre-text of increasing soil fertility and thereby crop production. The rest did not take and use fully due to erratic rain fall whereby the chemical fertilizer would damage crops. Due to price un-affordability, that actually increases from week to week, 48.84% the sample

respondents have taken by selling their animals and crops which have a negative impact on crop production. They have taken it in fear of exclusion from the safety net program. Although some people use river diversion, mainly the runoff water from the hilly parts as irrigation water source, water use issues were the most terribly addressed ones. Although FGDs have blamed HYV for increasing quality of products instead of quantity due to in hospitability of the environment, the survey result reveals as HYV are inputs for increasing crop production. Use of row spacing was found to be effective in crop production increment despite its labor intensive nature. In fact, agronomic practices like crop rotation were used mainly rotating cereals after cereals which were unscientific; inter-cropping was also rarely practiced in areas where land size is relatively small.

Indeed, financial capital is the scarcest factor for farm HHs in the study districts, where they need to diversify their income horizons like participating in off-farm activities. For those who have credit access, Dedebit Micro Finance was providing credit for non-Muslim people for a limited time duration period mostly in months soon after harvesting unlike the farmers' June to September need. EWs contact was in fact found to be insignificant for crop production since they did not show farmers how to use inputs and would double their products as needed and since they simply convince them to take chemical fertilizer. Member ship to an association was imperative for increasing crop production by providing inputs for members and members would influence each other to employ different agricultural inputs.

The OLS regression analysis result reveals that, farm income was significantly influenced by age, family size, land size, plot distance, plot slope, fertilizer use, row spacing, access to credit, membership to a certain association and TLU. Except age and dummy steep slope, the rest have a statistically significant positive relationship with farm income.

One of the most important facets of off-farm activities is providing employment opportunities and additional income for rural HHs more particularly during the slack time. Besides, off-farm participation has a multifaceted effect on agricultural production in such a way that it paves the way for ease access of inputs and on the other hand it negatively shares the time to be allocated for farm activities. By and large, it is one of the best means of risk minimization. Even though some people do participate in off-farm activities due to small

arable land size, majorly a demand driven participation has been investigated. Comparing crop yield difference between participant and non-participant farm HHs, the latter's did overweigh. This is due to proper time allocation for their farm activities by comparing and clearly pinpointing the profitability of these two activities.

The Probit regression analysis result reveals that, off-farm participation is determined by gender, age, education, family size, TLU, presence of pack animals, location dummies and amount of credit taken. From these all, age, TLU and location dummies carried a negative coefficient indicating their negative implication on farm HHs' probability of participation and the resultant effect on agricultural production.

Agricultural marketing is one of the most important factors that seriously determine agricultural production where the reverse also hold true. Sample districts have an average distance of 22.06 km from the district market where agricultural marketing and producing marketable products were compromised. Majority of the sample HHs do sell their products in subsequent months soon after harvest due largely to lack of inventory credit followed by paying the credited burden and marriage practices. Hence, farmers were following a "*sell low-buy high"* principle where majority of the sample respondents were found to be net buyers of consumable products in the last season of a year. Besides, while selling their products, they got prior price and market information from their neighbors.

In a nut shell, agricultural production in the study districts has been determined by household characteristics, physical environment, agricultural technologies, institutional factors; off-farm participation and agricultural marketing issues. Solving these all challenges would undoubtedly increase crop production and resultant livelihood of the rural people.

5.2. RECOMMENDATIONS

To a large extent, the problem of food insecurity in Ethiopia has been addressed by annual emergency food aid from abroad. One of the most important avenues of alleviating food insecurity and reducing hands begging food aid is in fact increasing yield per unit area by employing different inputs. As a result, a lot has been done largely on identifying the issues that will suffice for policy recommendations. Hence, the following are born out of the study.

- As a proxy of rain fall and a way out to employ agricultural inputs, irrigation practices more particularly drip and pipe irrigation need to be introduced. Using irrigation striga pests would be minimized and best practice from Ghana need to be shared.
- Contractual agreement between the government and farmers at large is seriously required, at least for one cropping year, in order to show them how HYVs and employing some other inputs would be imperative for increasing crop production; and thereby they would use HYVs and the required inputs; best experience from Madagascar need to be shared.
- While chemical fertilizers are generally beneficial, their application need to be based on better soil information; water presence (irrigation) and with volunteer motivation.
- EWs need to be instigated through a mixed financing system (both the government and farmers) so as to make them motivated and committed in showing farmers how to double their crop yield; and expand their horizons (responsibilities) to the extent of checking fertilizer use and continuous follow up. This would be an input for positive and friendly relationship among EWs and farmers.
- Providing appropriate short term non-farm trainings like in construction works, weaving, carpentry, masonry, ease ways of market access and the like are sought to be pertinent for diversifying economic bases that would have a positive impact on agricultural production; imperative for farmers' transformation in particular and agricultural and industrial transformation of the country in general.
- The sell low-buy high principle of agricultural marketing need to be alleviated by providing inventory credit as well as extending the payback time limitation of lending institutions. Therefore, given complementarities between off-farm, crop production, agricultural marketing and farm income that all face similar constraints, one policy instrument can solve the whole problems; like credit access.

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APPENDICES

Appendix I : Summary Statistics of Selected Continuous Variables

Explanatory Variables	Obs	Mean	Std.Dev	Min	Max
Birr invested for Pesticides	270	67.36	44.97	0	270
Months of Food Shortage	270	6.33	2.56	0	12
Fertilizer Taken in kilogram	270	24.13	15.60	0	100
Fertilizer Price in Birr	270	612.07	667.02	0	8900
Amount of Credit Taken in Birr	270	1381.85	2884.19	0	10000
Amount of Remittance in Birr	270	107.64	917.37	0	12800
Yield before employing HYV	93	4.9	2.93	2	20
Yield after employing HYV	93	5.38	4.06	1	25
Yield before using Row Spacing	3	4	2.64	2	7
Yield after using Row Spacing	3	4.33	1.15	3	5

Source: Own Survey Result, 2014 Std.Dev=Standard Deviation, Min,Max=Minimum, Maximum

Appendix II : OLS Model Specification & Hetroskedasticity Tests

Appendix 2.1: Model Specification Tests

```
. linktest

      Source |       SS       df       MS              Number of obs =     270
-------------+------------------------------           F(  2,   267) = 1210.44
       Model |  2.0649e+11     2   1.0324e+11          Prob > F      =  0.0000
    Residual |  2.2774e+10    267  85294351.8          R-squared     =  0.9007
-------------+------------------------------           Adj R-squared =  0.8999
       Total |  2.2926e+11   269   852271650           Root MSE      =  9235.5

------------------------------------------------------------------------------
     Farminc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        _hat |   1.006147   .0527868    19.06   0.000     .9022158    1.110078
      _hatsq |  -4.74e-08   3.75e-07    -0.13   0.900    -7.87e-07    6.92e-07
       _cons |  -147.9738   1613.147    -0.09   0.927    -3324.081    3028.133
------------------------------------------------------------------------------

. ovtest

Ramsey RESET test using powers of the fitted values of Farminc

       Ho:  model has no omitted variables

                 F(3, 247) =      1.62

                  Prob > F =      0.1863
```

Appendix 2.2: Tests for Multicollnearity

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
   dummyslope2 |     2.08    0.481792
   dummyslope1 |     2.04    0.490651
     landsz    |     1.67    0.599694
          TLU  |     1.46    0.685588
          age  |     1.39    0.721885
         pest  |     1.36    0.737570
      familysz |     1.30    0.766822
        associ |     1.29    0.774085
       fertuse |     1.26    0.795961
        credit |     1.23    0.814259
     extension |     1.23    0.815167
           hyv |     1.22    0.817569
      irriguse |     1.20    0.829955
      croprota |     1.20    0.834997
          educ |     1.17    0.853933
    intercrop  |     1.16    0.864665
        gender |     1.15    0.866103
       plotdist|     1.10    0.906578
        rowspa |   1.09    0.913435
-------------+----------------------
      Mean VIF |     1.35
```

Appendix 2.3: Hetroskedasticity Test: OLS Robust Standard Error Calculation

```
. reg Farminc gender age educ  familysz landsz plotdist dummyslope1 dummyslope2 pest fertuse hyv
croprota intercrop rowspa credit extension associ TLU irriguse,robust

Linear regression                                       Number of obs =     270
                                                        F( 19,   250) =  130.28
                                                        Prob > F      =  0.0000
                                                        R-squared     =  0.9007
                                                        Root MSE      =  9544.6
------------------------------------------------------------------------------
             |               Robust
     Farminc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |   1006.745   1147.317     0.88   0.381    -1252.895    3266.384
         age |  -116.0216   60.95604    -1.90   0.058    -236.0744    4.031218
        educ |   73.15604   484.7391     0.15   0.880    -881.5368    1027.849
    familysz |   706.2238   437.1571     1.62   0.107    -154.7565    1567.204
      landsz |   5001.954   1297.704     3.85   0.000     2446.129    7557.779
    plotdist |  -133.5215   59.30338    -2.25   0.025    -250.3194   -16.72358
   dummyslp1 |    3588.58   1650.175     2.17   0.031     338.5628    6838.597
   dummyslp2 |   1550.635   2216.379     0.70   0.485    -2814.519    5915.789
        pest |  -3.476714   13.42513    -0.26   0.796    -29.91748    22.96405
     fertuse |   1458.626   383.3055     3.81   0.000     703.7062    2213.545
         hyv |   753.0559   1456.449     0.52   0.606    -2115.418     3621.53
    croprota |  -519.8182   4213.801    -0.12   0.902    -8818.892    7779.256
   intercrop |  -2643.555   2842.963    -0.93   0.353    -8242.765    2955.656
      rowspa |   25652.53   25015.28     1.03   0.306    -23615.02    74920.07
      credit |   2494.609    1397.31     1.79   0.075    -257.3918    5246.609
   extension |   703.7661   1591.838     0.44   0.659    -2431.357    3838.889
      associ |    2877.81   1070.667     2.69   0.008     769.1327    4986.488
         TLU |   6570.877   192.3281    34.16   0.000     6192.088    6949.667
    Irriguse |    751.578   1594.216     0.47   0.638    -2388.228    3891.384
       _cons |  -1796.775   5553.725    -0.32   0.747    -12734.83    9141.277
------------------------------------------------------------------------------
```

Appendix III: Probit Regression Estimation and Tests

Appendix 3.1: Regression Result for Determinants of Off-farm Participation

```
.Probit OFP gender age dependent familysz loglandsz logmrktdis educ pacanim logcreditamou
dummysubdist2 dummysubdist3 logTLU nftgs

Iteration 0:   log likelihood = -162.31153

Iteration 1:   log likelihood = -125.86608

Iteration 2:   log likelihood = -124.64033

Iteration 3:   log likelihood = -124.63846

Iteration 4:   log likelihood = -124.63846

Probit regression                                 Number of obs   = 270

                                                  LR chi2(14)     = 75.35

                                                  Prob > chi2     = 0.0000

Log likelihood = -124.63846                       Pseudo R2       = 0.2321

------------------------------------------------------------------------------

        OFP |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]

-------------+----------------------------------------------------------------

      gender |   .6287586   .2276837     2.76   0.006     .1825067     1.07501

         age |  -.1662909   .0698267    -2.38   0.017    -.3031486   -.0294332

   dependent |    -.03666   .0994536    -0.37   0.712    -.2315854    .1582655

    familysz |   .1889959   .0857075     2.21   0.027     .0210123    .3569796

   loglandsz |  -.0906561   .4360157    -0.21   0.835    -.9452312     .763919

  logmrktdis |  -.1907532   .1782712    -1.07   0.285    -.5401583    .1586519

        educ |   .8782559   .3241249     2.71   0.007     .2429828     1.513529

    packanim |   .2882477   .1587264     1.82   0.069    -.0228504    .5993457

logcreditamou|   .0984162    .030279     3.25   0.001     .0390704     .157762

dummysubdi~1 |   .7247283   .3937509     1.84   0.066    -.0470092    1.496466

dummysubdi~2 |  -.7794789   .2875329    -2.71   0.007    -1.343033   -.2159246

dummysubdi~3 |  -.1173958   .3787585    -0.31   0.757    -.8597488    .6249571

      logTLU |  -.3873343   .1860013    -2.08   0.037    -.75189      -.0227785

       nftgs |  .030183   .3783604     0.08   0.936      -.7113897    .7717557

       _cons |   .8212054   .7970376     1.03   0.303    -.7409597     2.38337

------------------------------------------------------------------------------
```

Appendix 3.2: Model Specification Tests

```
. linktest

Iteration 0:   log likelihood = -162.31153

Iteration 1:   log likelihood = -125.83519

Iteration 2:   log likelihood = -124.57578

Iteration 3:   log likelihood = -124.56361

Iteration 4:   log likelihood = -124.56361

Probit regression                                 Number of obs   = 270

                                                  LR chi2(2)      = 75.50

                                                  Prob > chi2     = 0.0000

Log likelihood = -124.56361                       Pseudo R2       = 0.2326

------------------------------------------------------------------------------

        OFP2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]

-------------+----------------------------------------------------------------

        _hat |   .9321999   .2174048     4.29   0.000     .5060943    1.358305

      _hatsq |   .0602939   .1561303     0.39   0.699     -.245716    .3663037

       _cons |  -.0100896   .1108495    -0.09   0.927     -.2273506    .2071714

------------------------------------------------------------------------------
```

Appendix 3.3: Hetroskedasticity Test: Probit Robust Standard Error Calculation

```
.Probit OFP gender age dependent familysz loglandsz logmrktdis educ pacanim logcreditamou
dummysubdist2 dummysubdist3 logTLU nftgs,robust

Iteration 0:   log pseudolikelihood = -162.31153

Iteration 1:   log pseudolikelihood = -125.86608

Iteration 2:   log pseudolikelihood = -124.64033

Iteration 3:   log pseudolikelihood = -124.63846

Iteration 4:   log pseudolikelihood = -124.63846

Probit regression                                 Number of obs   = 270

                                                  Wald chi2(14)   = 66.55

                                                  Prob > chi2     = 0.0000

Log pseudolikelihood = -124.63846                 Pseudo R2       = 0.2321

------------------------------------------------------------------------------

             |               Robust

        OFP2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]

-------------+----------------------------------------------------------------

      gender |   .6287586   .2219986     2.83   0.005     .1936493    1.063868

         age |  -.1662909   .0736124    -2.26   0.024    -.3105685   -.0220133

   dependent |    -.03666   .1232035    -0.30   0.766    -.2781343    .2048144

    familysz |   .1889959   .0964562     1.96   0.050    -.0000547    .3780466

   loglandsz |  -.0906561     .42496    -0.21   0.831    -.9235624    .7422502

  logmrktdis |  -.1907532   .1875095    -1.02   0.309     -.558265    .1767586

        educ |   .8782559   .3272289     2.68   0.007      .236899    1.519613

     pacanim |   .2882477   .1582541     1.82   0.069    -.0219247      .59842

logcreditamou|   .0984162   .0290957     3.38   0.001     .0413896    .1554428

dummysubdi~1 |   .7247283   .3426625     2.11   0.034     .0531222    1.396334

dummysubdi~2 |  -.7794789    .259941    -3.00   0.003    -1.288954   -.2700038

dummysubdi~3 |  -.1173958   .3578074    -0.33   0.743    -.8186855    .5838938

      logTLU |  -.3873343   .1987415    -1.95   0.051    -.7768605     .002192

       nftgs |  .030183   .3493245     0.09   0.931      -.6544805    .7148464

       _cons |   .8212054   .8846054     0.93   0.353    -.9125894       2.555

------------------------------------------------------------------------------
```

Appendix 3.4: Marginal Effects after Probit Estimation of off-farm participation

mfx

Marginal effects after probit

y = Pr(OFP) (predict)

= .77521238

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
gender*|	.206155	.08004	2.58	0.010	.049275	.363035	.766667
age |	-.0490416	.02053	-2.39	0.017	-.089282	-.008802	44.663
dependent|	-.0108116	.02935	-0.37	0.713	-.068345	.046722	3.17778
familysz |	.0557376	.02523	2.21	0.027	.006291	.105184	6.28889
loglandsz|	-.0267358	.12848	-0.21	0.835	-.278559	.225087	.877726
logmrktdi|	-.0562559	.05289	-1.06	0.287	-.15992	.047408	2.13095
educ*|	.2313564	.07413	3.12	0.002	.086071	.376642	.355556
pacanim |	.0850084	.04639	1.83	0.067	-.005916	.175933	.588889
logcredam|	.0290244	.0086	3.37	0.001	.012165	.045883	2.58002
dumm~st1*|	.180243	.08039	2.24	0.025	.02268	.337806	.233333
dumm~st2*|	-.2399021	.08954	-2.68	0.007	-.415395	-.064409	.403704
dumm~st3*|	-.0356087	.11776	-0.30	0.762	-.266405	.195188	.181481
logTLU |	-.1142304	.05494	-2.08	0.038	-.221912	-.006549	1.67647
nftgs*|	.0081518	.1011	0.08	0.936	-.190007	.20631	.107407

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix IV: Conversion Factors Used to Estimate Tropical Livestock Unit

Livestock Type	Conversion Factor
Oxen	1.00
Cows	1.00
Bull	0.34
Heifer	0.75
Calves	0.25
Goats	0.13
Sheep	0.13
Camel	1.25
Donkey	0.70
Mule	1.10
Hen	0.013

Source: Stork, *et al.*, 1991 cited in Mikinay, H. (2008)

Appendix V

Mekelle University

College of Business and Economics

Department of Management

Post Graduate Program -Development Studies

Household Survey Questionnaire to be filled by Farm Household Heads

Introduction:

This questionnaire is prepared by Berihun Kassa, a Development Studies Post Graduate student in Mekelle University for partial fulfillment of Master of Arts Degree in the aforementioned program. The aim of this questionnaire is to collect data about *"Factors Affecting Agricultural Production: Evidence from Smallholder Farmers of Southern Tigray, Northern Ethiopia".* The information you provide is pertinent for successfully accomplishing the research. For this sake, I really confirm you that all the data will be used for academic purpose and will be analyzed anonymously. Hence, because of your provision, you will never be exposed to any harm. I am thanking and appreciating your kind cooperation in advance; and I need to say thank you!!!!!!!!

General Instruction: 1. Please encircle your answer for multiple choice questions.

2. To open-ended questions, please write your response on the space provided.

Questionnaire ID:_____ **Enumerator's name** _____

Section I: Demographic Characteristics

1. District Name _____Sub-district Name _____Village Name _____
2. Sex: 1.Male 0. Female
3. Age_____ (years)
4. Marital Status_____
5. Religion_____
6. Educational Status: _____(Number of years of schooling)
7. Family Size_____ (Number)
8. Number of Dependents: 1. < 15 years old _____(Number) 2. >65years old_____(Number)
9. Remittance per year_____(Birr)

Section II: Factors Affecting Crop Production and Farm Income of Smallholder Farmers

10. How much is the arable land size being possessed by a farm household?

    1. Owned land _____(Tsimad)[11] 2. Rented land ____(Tsimad) 3. Total____(Tsimad)

11. Of the land you owned and rented, how many Tsimads are irrigated?

    1. Owned land _____ (Tsimad) 2. Rented land_____ (Tsimad) 3. Not at all

12. What is your source of water for irrigation?

    1. Check Dams 2. River Diversion 3. Communal Wells 4. Private Wells 5.Others____

13. Would you please state all irrigation related problems that you face?

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

14. Household's Plot Characteristics

No.	Item	Plot	Description
1.	Plot distance from homestead (walking minutes)	Plot 1 Plot 2 Plot 3 Plot 4	_____(minutes) _____(minutes) _____(minutes) _____(minutes)
2.	Slope of the plot Code: 1=Flat 2=Medium 3=Steep	Plot 1 Plot 2 Plot 3 Plot 4	Code:_____ Code:_____ Code:_____ Code:_____
3.	Plot soil quality/fertility Code: 1= Fertile 0=Infertile	Plot 1 Plot 2 Plot 3 Plot 4	Code:_____ Code:_____ Code:_____ Code:_____

15. Have you face insect problems? 1. Yes 0. No

16. If your answer for question number 15 is yes, how much did you spend to purchase pesticides, herbicides and insecticides? _____ (Birr)

17. Have you taken fertilizer in 2005E.C cropping year? 1. Yes 0. No

[11] One Tsimad=0.25 hectares

18. If your answer for question number 17 is yes, how many kilograms did you take for tsimad?

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

19. Have you used what you take fully in your farm land? 1. Yes 0. No

20. What motivated you to take and use chemical fertilizer?

1. To increase soil fertility and thereby increase production
2. To be included under and get credit access
3. Not to be excluded from the Productive Safety Net Program
4. To get access of irrigable land
5. If others, specify _____

21. How much was the cost of a chemical fertilizer in 2005 E.C. production year?

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

22. Was the price of a chemical fertilizer really affordable?

1. Yes 0. No

23. If your answer for question number 22 is no, what source did you use so as to cover it?

1. By substituting the transfer from the Productive Safety Net Program
2. By selling your own asset like sheep, goat and saved grains
3. Credit from relatives and neighbors
4. Income obtained from off-farm activities

24. If you did not use a chemical fertilizer, what factors inhibit you not to use it?

1. High selling price
2. Delay in fertilizer procurement
3. Scarcity of fertilizer supply
4. Poor credit arrangement
5. Poor periodic payment arrangement
6. Risky due to erratic rain
7. Using manure and compost
8. Others, specify _____

25. Have you ever used HYV in your own or rented land? 1. Yes 0. No

26. If your answer for question number 25 is yes, would you tell me the yield difference?

1. Average production before you use HYV _____(quintal/Tsimad)
2. Average production after you use HYV _____(quintal/Tsimad)

27. Have you ever used row planting method? 1. Yes 0. No

28. If your answer for question number 27 is yes, would you tell me the production difference?

1. Yield before you use row planting_____(quintal/Tsimad)
2. Yield after you use row planting_____(quintal/Tsimad)

29. Types of Crop grown by Smallholders and their Estimated Values

No	Types of Crop	Total Production (Quintals)	Total Production Estimated Value (Birr)	Gross Income from Sales (Birr)
1.	Sorghum			
2.	White Teff			
3.	Red & mixed Teff			
4.	Maize			
5.	Barely			
6.	Wheat			
7.	Chickpea			
8.	Pepper			
9.	Onion			
10.	Potato			
11.	Tomato			
12.	Others (specify)			
	Total			

30. Have you ever used crop rotation? 1. Yes 0. No

31. If your answer for question number 30 is yes, would you please specify the crops rotated?

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

32. Have you used inter-cropping in your owned and rented land? 1. Yes 0. No

33. If your answer for question number 32 is yes, which crops?

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

34. Did you get enough rain in the last production season (2005 E.C)? 1. Yes 0. No

35. Have you produced enough products for annual household consumption? 1. Yes 0. No

36. If you did not produce enough products, what solutions would you use to fulfill consumption needs?

1. Purchasing at harvesting time
2. Looking for food aid
3. Looking for remittances
4. Working in off-farm activities

37. If you did not produce enough products, for how many months did you face problems of fulfilling the food needs of the household? _____ (months)

38. Livestock Type and their Estimated Values

No.	Livestock Type	Number owned	Livestock Estimated Value (Birr)	Gross Income from sales (Birr)
1	Oxen			
2	Cows			
3	Bull			
4	Heifer			
5	Calves			
6	Goats			
7	Sheep			
8	Camel			
9	Donkey			
10	Mule			
11	Horse			
12	Poultry			
13	Honey bees			
	Total			

39. Do you have credit access for? 1. Yes 0. No

40. Have you taken a credit in 2005E.C cropping year? 1. Yes 0. No

41. How much money did you borrow? _____(Birr)

42. Why do you want to take credit?

1. To cover expenses incurred for weeding
2. To start new businesses
3. To purchase agricultural inputs
4. To buy animals to be fattened
5. Others, specify_____

43. If you take a credit, who was your credit source?

1. Relatives/neighbors
2. Cooperatives
3. Dedebit Micro Finance
4. Bank
5. Money lender
6. Traders
7. Others, specify___

44. When do you become very much keen to repay back your credit?

1. Soon after harvesting crops (in September, October and December)
2. At the weeding time when we work in others' land
3. When we sell our crops profitably (in June, July and August)

45. What really is your source to repay back the debt you incurred?

1. Profit gained from the new business
2. Remittances
3. Income from food for work/ safety net
4. Selling the pre-existed animals
5. Selling the produced products
6. Others, specify _____

46. Did you get an advice from extension agents in the last production season? 1. Yes 0. No

47. If your answer for question number 46 is yes, what was the average number of contact?

1. _____ (times a month) 2. _____ (times a year)

48. Do you think the number of contacts with the extension agents was enough? 1. Yes 0. No

49. If the answer for question number 48 is no, what are the reasons for insufficient contact?

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

Section III. The Effect of Smallholders' Off-farm Participation on Agricultural Production

50. Have you engaged in activities out of your farm land? 1. Yes 0. No

51. If your answer for question number 50 is yes, would you please specify the activities?

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

52. What reasons let you participate in off-farm employment? **(Multiple answers are possible)**

1. Proximity to urban area 4. Favorable demand for goods/ services
2. Availability of off-farm opportunities 5. Excess labor at home
3. Education level 6. Small land size
7. Other, specify _____

53. Could you tell me your place of work? **(Multiple answers are possible)**

1. This village 4. Neighboring district 7. Migration to foreign country
2. Other villages 5. Regional capital 8. Other, specify_____
3. This district 6. Other regions of the country

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

1. No opportunity 3. Jobs too far away 5. I am retired
2. Needed on farm 4. Off-farm work is less profitable 6. Other, specify_____

55. Does one of your family members get the chance of non-farm trainings?

1. Yes 0. No

Section IV. Factors Affecting Agricultural Marketing and agricultural production

56. Village distance from the district and regional market centers and transportation costs.

No.	Issues/Concerns	Description
1	Distance of your village from district market	_____kms
2	Distance of your village from Asphalt road	_____kms
3	Distance of your village from Gravel road	_____kms
4	Average transport cost per person to district market	_____ Birr
5	Average transport cost per quintal to district market	_____ Birr
6	Village Distance to the nearest village market	_____kms
7	Average transport cost per person to the nearest village market	_____ Birr
8	Average transport cost per quintal to the nearest village market	_____ Birr
9	Average travel to reach the district market	_____ hours
10	Average travel to reach the nearest village market	_____ hours

57. When did you really sell your products?
    1. In months between October and January
    2. In months between February and May
    3. In moths between June and September
58. If your answer for question number 57 is in months between October and January, what are the reasons that forced you not to sell in months between June and September?
    1. Warehouse problem 3. Since buyers come to our farm land
    2. Lack of credit inventory 4. Fear of price decrease 5. Others, specify_____
59. If you are a seller in months between October and January, will you be a net buyer in months between June and September? 1. Yes 0. No
60. What means of transportation did you use while taking your products to the market?
    1. On foot 2. Pack animals 3. Vehicles
61. Do you have prior price and overall information before you take your products to the market?
    1. Yes 0. No

62. If your answer for question number 61 is yes, who is/are your source of information?

1. Neighbors 3. Mobile call to wholesalers 5. Cooperatives
2. Extension workers 4. Radio transmission 6. Others _____

63. Are there farmers' cooperative in your village?

1. Yes 0. No

64. Are you a member to an association or agricultural cooperative?

1. Yes 0. No

65. If your answer for question number 63 is yes, what roles do they play for you?

1. Linking us with buyers
2. Increasing our bargaining power
3. Disseminating price information
4. Aware us not to be cheated by middle men
5. Facilitating warehouse services
6. Others, specify _____

THANK YOU VERY MUCH!

Appendix VI

QUESTIONS FOR INTERVIEW FOCUS GROUP DISCUSSION

QUESTIONS FOR INTERVIEW

1. What do you think are the basic and backbreaking factors that paralyze agricultural production despite different endowments of the region/district?
2. Do you think that paucity of agricultural technologies is one factor of poor production?
3. Do you think that the overall environment can enable smallholder farmers to produce sufficient production that could satisfy annual household consumption?
4. Would you please suggest the way outs to curb the challenges the society is facing?
5. Do you think that off-farm participation of smallholder farmers could worth be mentioned as one determinant of agricultural production? Would you please specify the dimensional or both positive and negative aspects of off-farm participation and agricultural production vis-à-vis the determinants of off-farm participation?
6. Since marketing and agricultural production are complements, how do you see the effect of agricultural production on agricultural marketing and vice versa?
7. Do you think that there is an enabling environment that could instigate agricultural marketing? Would you please elaborate it taking the issue of transportation and over all infrastructure, credit inventory, fair price, role of cooperatives or farmers' association and extension agents?

QUESTIONS FOR FOCUS GROUP DISCUSSION

1. What are the factors are hindering you in producing more that could be sufficient enough for your annual household consumption?
2. Is fertilizer vital to produce more within your limited land acreage?
3. How do you see the impact of off-farm participation on crop production?
4. How do you see marketing challenges that you are facing? Do cooperatives, farmers' association and development agents are serving you to be benefited from market?
5. What do you think are the possible solutions to solve production and marketing challenges?