ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

Analysis of Off-Farm Engagements and Implications for Economic Transformation: Empirical Evidence from Libo Kemekem Woreda

Workineh Asmare Kassie

Addis Ababa University
Addis Ababa, Ethiopia

October, 2013

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

Analysis of Off-Farm Engagements and Implications for Economic Transformation: Empirical Evidence from Libo Kemekem Woreda

Workineh Asmare Kassie

A Thesis Submitted to
The Department of Economics
Presented in Partial Fulfilment of the Requirements for the
Degree of Master's of Science
(Economics: Economic Policy Analysis)

Addis Ababa University
Addis Ababa, Ethiopia

October, 2013

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

This is to certify that the thesis work by Workineh Asmare entitled: *Analysis of Off–farm Engagements and Implications for Economic Transformation: Empirical Evidence from Libo Kemekem Woreda*; and submitted in fulfilment of the requirements for the Degree of Master's of Science (Economic Policy Analysis) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

_____	_____
Advisor	Signature
_____	_____
Examiner	Signature
_____	_____
Examiner	Signature

Abstract

Analysis of Off-farm Engagements and Implications for Economic Transformation: Empirical Evidence from Libo Kemkem Woreda

Workineh Asmare
Addis Ababa University, 2013

Off-farm engagements and earnings from such employment opportunities have become increasingly important in rural Ethiopia as the nation is striving to end poverty through a steadily growing rural income. There is an expressed policy effort to materialize a more stable and growing farm income. However, there is a paucity of policy attention to the off-farm economy notwithstanding its huge potential in diversifying rural income, reducing unemployment and transforming the rural economy. This study analyses off-farm engagements by farm households to drive important implications for policy as farm households' behavioural choice matters for the desired/undergoing economic transformation. Specifically, we estimate farm households' propensity to and the intensity of off-farm engagements using binary choice and censored regression models, respectively. We use a survey data of 200 farm households in Libo Kemkem Woreda, Amhara Region. Farm households' socio-political capital, risk behaviour, financial conditions, characteristics of their farm and local labour market conditions are found to be significant predictors of the choice to off-farm engagements. On the other hand, wage-related household characteristics and human capital variables appeared less important in explaining farm households' choice to diversify into the off-farm economy. Likewise, a significant relationship is found between the intensity of off-farm engagements (off-farm days and earnings) and the indicators of socio-political capital, farm characteristics, risk behaviour, financial conditions and labour market conditions. The results imply that off-farm engagements have become permanent pursuits to efficiently husband farm and off-farm income sources of farm households. Thus, the study calls forth a considerable policy attention to the off-farm economy and more robust institutional arrangements to enable farm households exercise informed choices for the desired/undergoing economic transformation in the rural economy to flourish and sustain.

Acknowledgement

A thesis is never produced as an independent and sole contribution of the writer. As a matter of fact, the academic advisor takes the largest stake right from the time of framing the research idea, during the actual course of producing the thesis, to the final content and shape that the thesis may assume. In this regard, I am truly fortunate to work with Dr. Assefa Admassi, for he has given me the freedom to nurture my views and practical guidance in accomplishing this piece of work. Thank You Dr. Assefa! More so, I really appreciate the incredible support 'my friends' humbly forwarded to me during those good and bad times. Normally, I prefer to use 'my friends' as you guys certainly know whom I am referring to. You will be in my heart!!

Table of Contents Page

List of Figures

List of Tables

List of Annexes

Acronyms

ADLI	Agricultural Development Led Industrialization
AHM	Agricultural Household Model
CLAD	Censored Least Absolute Deviation
CM	Conditional Moment
CSA	Central Statistic Agency
DA	Development Agents
EPA	Environmental Protection Authority
EPLAUO	Environmental Protection, Land Administration and Use Office
ERHS	Ethiopian Rural Household Survey
ETB	Ethiopian Birr
EUAES	European Union Adult Equivalence Scale
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
ILO	International Labour Organization
K-T	Kuhn Tucker
LIC	Low Income Countries
LM	Lagrange Multiplier
LPM	Linear Probability Model
LR	Likelihood Ratio
MDG	Millennium Development Goals
ML	Maximum Likelihood
MLE	Maximum Likelihood Estimator
MoFED	Ministry of Finance and Economic Development
MOLSA	Ministry of Labour and Social Affairs
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Square
PASDEP	Plan for Accelerated and sustainable Development to End Poverty
PM	Probit Model
PRSP	Poverty Reduction Strategy Paper
SCLS	Symmetrically Censored Least Square
TGE	Transitional Government of Ethiopia
TLU	Tropical Livestock Unit

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

Rapid agricultural growth has been sought as a prior economic development strategy in Low Income Countries (LIC) since it was deemed superior to either of the widely experimented industry-led import substitution development strategy and export-led growth strategies (Mellor, 1986; Adelman, 1984). The underlying argument that places farming at the centre of economic development is that growth in agricultural income helps address pervasive unemployment and poverty, on one hand, and provides substantial stimulus for new economic activities to flourish through its production and consumption linkages, on the other hand. And, this has got something to do with the ground fact that the rural sector plays a fundamental role in the economy both as the major activity and a pivotal element of the development strategies in LICs (Sadoulet, and De Janvry, 1995). In fact, consumption linkages are much stronger than production linkages and a combination of agricultural growth with non-agricultural growth is most beneficial to reduce rural poverty (Diao *et al.,* 2007). It is also documented that such linkages can run from non-farm to farm activities in terms of demand, supply, motivational and liquidity linkages (Woldehanna, 2000; Reardon, 1997).

In Ethiopia, the national economic development strategies pursued since 1991 to date includes Agricultural Development Led Industrialization (ADLI), Sustainable Development and Poverty Reduction Program (SDPRP) and the Poverty Reduction Strategy Paper (PRSP), Plan for Accelerated and Sustainable Development to End

Poverty (PASDEP) and the current Growth and Transformation Plan (GTP)[1]. These development strategies identified the rural economy as a central focus and encapsulate endeavours to deliver growth in rural income, reduced poverty and economic transformation (TGE, 1991; EPA, 2012). Poverty headcount ratio, which has been 56% in 1992, is currently decreased to 29.2% in 2011 after an enduring effort to meet the Millennium Development Goal (MDG) of halving extreme poverty and hunger by 2014/15. Among the indicated medium and long-term development programs put in place, the Growth and Transformation Plan envisages a 236.2% growth in per capita income ($378 in 2010 to $1271 in 2025) during which the size of the farm economy is projected to diminish to 29% from the then 42% (MoFED, GTP, 2010; 2012).

Even though further empirical evidence is required if there is a causal relationship, the reduction in poverty headcount coincides with the positive and strong growth experience since the very reform periods to date (MoFED, 2012)[2]. While recognizing the possibility that such an encouraging economic performance is realized through the formulation of prudent economic policies (implementation of development programs) and putting in place the relevant institutional arrangements for the sector of priority, one can also argue that agriculture led rapid growth record may not be good enough. Because, the ultimate goal is to pull the massive poor out of poverty trap and sustain a kind of economic growth with concomitant growth in employment opportunities for the explosive population (labour) – summarized as 'virtual quest for pro-poor and inclusive growth'.

[1] ADLI, PRSP, SDPRP (1991/2-2004/05); PASDEP (2005/06-2009/10); GTP (2010/11-2014/15)

[2] Reform period (1990s & early 2000s) average GDP growth is estimated to be 3.7%; growth of 6.7% during SDPRP (2002/03-2004/05); double digit growth of about 10.6 % during PASDEP.

The rural economy may have undergone and will involve a substantial transformation in terms of the structure of farms and farm households' microeconomic behaviour, mainly through 'labour markets' as a non-separable connection of production and consumption choices. Focusing on the off-farm employment opportunities in Ethiopia, a survey of rural farm households by the Ministry of Labour and Social Affairs (MoLSA) revealed that about 44% of the representative sample does engage both in agricultural wage employment and rural non-farm employment. Nevertheless, earnings from off-farm employment are found to contribute marginally to the total income of farm households in that only 10.2% of which is contributed as off-farm income (MoLSA, 1997).

Similarly, the summary results from the Ethiopian Rural Household Survey (ERHS) showed that 24.3% of the sample farm households do participate in off-farm activities. Accounting for about 83%, the widely reported off-farm employment opportunities (employers) are public work programs administered by either the government or Non Governmental Organizations (NGOs) as an 'employment-based safety net' for small farmers. Agricultural wage employment is the other equally important source of employment that accounts 24% while 81.9% of the representative sample reported that the main reason for participation is low and fluctuating farm income (ERHS, 1999).

Subsequent survey results from the ERHS has revealed a remarkably increasing rate of participation in the off-farm economy with 47.4% in the year 2004 and 51.2% in 2009. And, the source of off-farm employment opportunities has significantly shifted from public work programs (usually food-for-work, cash-for-work and employment generating schemes), which accounted for about 39% in 1999 and 2004 rounds of surveys, to the low skill non-farm activities, paid agricultural employment and ritual practices, in that it

accounts only 8.2% in 2009 (ERHS, 2004; 2009). This is in line with several empirical studies which indicated that off-farm activities indeed occupy an important place in rural economies throughout the developing world (Hazell and Haggblade, 1993).

The important implication of the forgoing evidence is thus rural farm households can reasonably diversify their income sources pursuing dual career (allocating household labour between farm and off-farm activities). Accounting for some proportion of the total income of participating households, earnings from off-farm engagements are important primarily for the economic well-being of households. Essentially, off-farm employment and income opportunities can fill the income-expense gap for households who choose farming as their lifestyle; increases households' cash flow to effectively carryout farm operations; serves as a buffer for farm income fluctuations and hence a prudent risk management offsetting unexpected variation in income (Mishra and Goodwin, 1997).

Thus, off-farm income opportunities can smooth household income that fluctuates with unpredictable farm income shocks for which farm households may reasonably consider their participation in off-farm employment as a permanent engagement than temporary for transitional pursuit. In Ethiopia, the expansion and dynamism of off-farm activities, on the one hand; and the concomitant opportunities of off-farm employment and income for the growing labour force, on the other hand, are integral elements of the undergoing rural economic transformation since the reform period, and possibly in the GTP period. Several rural development programs and farm policies, which are put in place to engender the economic transformation, can affect the rural labour market and thereby the microeconomic behaviour of farm households in allocating rural labour calling forth context specific empirical analysis of farm households' choice.

1.2 Problem Statement and Justification

Economic analysis of the nexus between rural farm and non-farm sectors, and hence the rural economy, has long occupied the centre of development research and policy in low income countries (LICs). In Ethiopia, despite the widely celebrated growth records during the latest decade, the failure of the farm economy to create and deliver sustainable livelihood apparently remained to be a real development and policy challenge. Youth unemployment, poverty and food insecurity are some of the distinguishing characteristic features of both rural areas and urban centres. This has recently redrawn the attention of the government and its development partners – including the non-governmental development community – to alternative non-farm income opportunities while promoting the productivity of farming and concomitant growth and stability of farm income.

Viewed from a more pragmatic developmental perspective of increased per capita rural income and reduced poverty, diversification of rural livelihood is quite crucial as it can possibly help reduce recurrent vulnerability of poor farm households to exogenous farm income shocks (Reardon, 1997; Mishra and Goodwin, 1997). In effect, the development of the non-farm sector and improvements in the working of the rural labour market, broadened opportunities of off-farm employment and income thereof, is increasingly recognized to play an important role in this regard and the gradual transformation of the rural economy. This has long necessitated a development approach – "twin-track development approach" – in which measures are considered to promote rural household income both via improved farm productivity and increased opportunities to off-farm income activities (Mulat *et al.*, 2006).

Several studies have also indicated that the development of the non-farm sector and markets in the rural economy, creating opportunities for off-farm employment and income, serves as an important leap-forward in the process of structural transformation besides diversification of rural income sources. In the process, relatively rich farm households will have more diversified income; and with an initial diversified incomes, such households will realize a greater increase in income and consumption – creating more demand (Block and Webb, 2001). With such a dynamic non-farm sector and dynamic interaction with the farm sector in terms of opportunities of employment and increased commodity demand, it is possible that the rural economy can experience a virtuous cycle of increased employment opportunities, farm productivity, rural income and commodity demand. As such, it can be argued that the consolidation and transformation of the farming sector may not be realized in a situation where there is no dynamic non-farm sector which provides off-farm employment (income) opportunities to the rural farm households (Reardon, 1997; Woldehanna, 2000).

In the scholarly literature, investment and pricing policies are indicated for the government to intervene in the rural economy on its attempt to ensure sound interaction and robust complementarities – than commotion – between farm and non-farm activities (Singh *et al.*, 1986). For instance, farm technology packages and farmer training on alternative farming systems can be put in place to realize enhanced farm productivity and farm income. What is equally important is public investment aimed at expanding the capacity of the non-farm rural economy to create more job opportunities and alternative income sources to farm households. However, it is also argued that diversification of rural income into off-farm income activities may emerge naturally from either of such conditions as: diminishing returns to labour and/or land; market failure; frictions that

involves entry into high return niche; ex-ante risk management and/or ex-post coping with unfavourable household income shocks (Barrett *et al.*, 2001). Either way, the microeconomic choices of farm households and the functioning of the rural market are important in the very economic process – to respond to natural or policy shocks.

Despite the possible, perhaps marked, difference in the performance and structure of the farm and non-farm activities of the rural economy across countries (states), the underlying economic choice remains to be a shared characteristic. It is thus self-evident that rural household income is an efficient combination of farm and off-farm incomes earned through an efficient combination of farm and off-farm work. By off-farm work, we are referring to paid hours of work in the non-farm sector, self-employment (entrepreneurial) and paid farm work in the rural economy (Robinson *et al.*, 1982).

Notwithstanding the huge potential of off-farm engagements in realizing a growing rural income, reduced poverty, improved economic well-being and robust transformation of an economy, experimented development policies historically aimed at increasing farm income and reducing its variability with limited policy efforts to inclusive off-farm opportunities. Hopkins *et al* (2002) argued that attention has historically focused on farm incomes while farming today is only one of the several economic endeavours of farm households. More so, household income is more indicative of economic well-being than income from farming. Diao *et al.* (2007) uncovered Ethiopia's exclusive focus on farming and insufficient attention to the non-farm economy, which they argued, is counterproductive. In the same vein, Woldehanna (2000) argued that the undergoing economic reform proved to exclusively focus on farming despite the expressed policy direction to promote the farm – non-farm nexus.

On the other hand, it is now established that the increasing proportion of farm families with off-farm employment and a growing share of off-farm income constituted a process of change in the rural economy. However, knowledge about how the farm households respond to such changes in exogenous policy and natural factors is limited generally in Ethiopia. The relative importance of farm, family, financial, and local economic characteristics to decisions by the farm households are crucial to understand the structural change and the undergoing process of economic transformation. Specifically, there is a dearth of systematic and rigorous study that dealt with farm households' allocation of labour (labour market) in Amhara regional state.

Thus, understanding how farm households efficiently allocate their [time] endowment, which is argued to be a missing link between policy making and implementation in this study, is vital for sound development policy in (rural) Ethiopia. Putting it differently, discovering the increasing importance of off-farm engagements and understanding the nature and distribution of factors that explain the choice of farm households' labour use is posited crucial prior to a specific policy making and its implementation. One may reasonably question that such a study has been part of the burgeoning literature in Economics. However, the importance of off-farm engagements, the microeconomic choice of farm households; and the nature and distribution of factors explaining such a decision process arguably vary across regions, time and households.

The research questions, on which the study is founded and attempts to address, are thus:

i) **Does the neo–classical theory of labour allocation predict the observed participation and intensity of off–farm engagements?**

ii) How does farm households' decision to engage in off-farm activities vary with household, farm, labour market conditions, financial and institutional factors?

iii) What explains the intensity of off-farm engagements as it is measured in terms of days of off–farm work and/or off-farm income?

iv) What does farm households' off-farm engagement imply for rural income and the desired/undergoing economic transformation?

1.3 Objective of the Study

The study seeks for empirical evidence on the propensity and extent of farm households' engagements in the off-farm economy and its implication to the economic transformation underway, desired otherwise. More so and based on the mounting empirical evidence supporting the significance of off-farm employment and income to the wellbeing of farm households, the nature and distribution of factors that determine households' choice to engage in off-farm activities are equally analysed. More precisely, the objectives of this particular study are twofold:

i) To understand and explain the labour supply behaviour of farm households to the off–farm economy.
ii) To examine the relationship between the propensities to engage and/or the extent of off–farm engagements and factors that influence its variance.

1.4 The Scope and Significance of the Study

This thesis analyzes land farm households' propensity to off-farm engagements and the level of such an engagement in the off-farm economy to inform rural development policy, making use of a cross-sectional data generated through household survey. The

field survey is administered at two randomly selected Kebeles in Libo Kemekem Woreda, Amhara Regional State. Thus, the study contributes greatly to the economic literature in this subject area, which is criticised for its concentration on documenting the extent of participation and the level of income generated from off-farm employment by providing results with a better methodological and analytical rigor.

The empirical evidence from this study is equally palatable at local, regional and national endeavours to effectively materialize the economic transformation plan as it encapsulates the more fundamental microeconomic choice regarding labour use – employment. For the results of the study clearly shows how farm households respond to economic incentives, its importance goes beyond documenting the propensity and extent of off-farm engagements to inform policy making as part of the ongoing/desired economic process. It can also inform policy analysts, farm investors, and lenders who are few among those interested in monitoring the economic well-being of farm households.

1.5 Organization of the Study

The remaining part of the thesis work is organized as in what follows. The second chapter presents a comprehensive but succinct review of the scholarly work in the literature related to the subject matter under study. The research methodology pursued is discussed in the third chapter in which a comprehensive presentation of the theoretical model, empirical specification, data and methods of data collection are covered. In the fourth chapter, data analysis, hypothesis testing and discussion of results are reported. Summary of findings, conclusion and policy suggestions constituted the closing chapter.

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

There is a wider-range of theoretical analysis on the microeconomic choice to engage, and the level of engagements thereof, in paid nonfarm work, self-employment and paid farm work – collectively conceptualized here as off-farm activities[3] – when we closely look at the burgeoning literature in agricultural economics and policy analysis. As an integral element of rural livelihood, off-farm engagements have remained to commonly characterize rural life across the world irrespective of the structure of the rural economy.

Several studies on agricultural transformation and farm households' choice showed that structural change in production agriculture would inevitably occur and have a substantial implication on resource use, population distribution and the continuity of small farms. Because such a structural change resemble to be more permanent that a temporary phenomenon, the report of positive and increasing days of off-farm activity is long considered as one of the crucial structural changes for economic transformation. Early in the "push - pull" hypothesis of Fuguitt (1959), this idea was clearly put in that the decision to and level of off-farm engagement is directly related to widening off-farm and declining farm opportunities and inversely related to opportunities in farming.

In this chapter, the reviewed literature is presented for two reasons: [1] to put the research questions in perspective which requires them be well-embedded on the existing knowledge and empirical evidence; [2] to help us frame our thought in developing the relevant theoretical model, research hypothesis and the empirical approach to consider.

[3] Ellis (2000) defined off-farm employment as 'wage or exchange labour on other farms, including payments in kind and cash' and non-farm employment as 'non-agricultural income sources that includes non-farm rural wage or salary employment, non-farm self-employment income and remittances. We conceptualized off-farm engagement/employment to include both sets of activities except remittances.

2.1 Theoretical Foundations

2.1.1 Economic Model of the Farm Household

Farm households are no different from other households in pursuing two careers and diversifying earnings. The economic history of nations made it clear that farm business as a source of income has played an increasingly smaller role in determining the well-being of farm households where economic well-being captures wealth and expenditures in addition to more conventional income measures (Hopkins *et al,* 2002). Farm households are thus faced with wide-ranging decisions about how to allocate their limited resources among the competing income earning engagements.

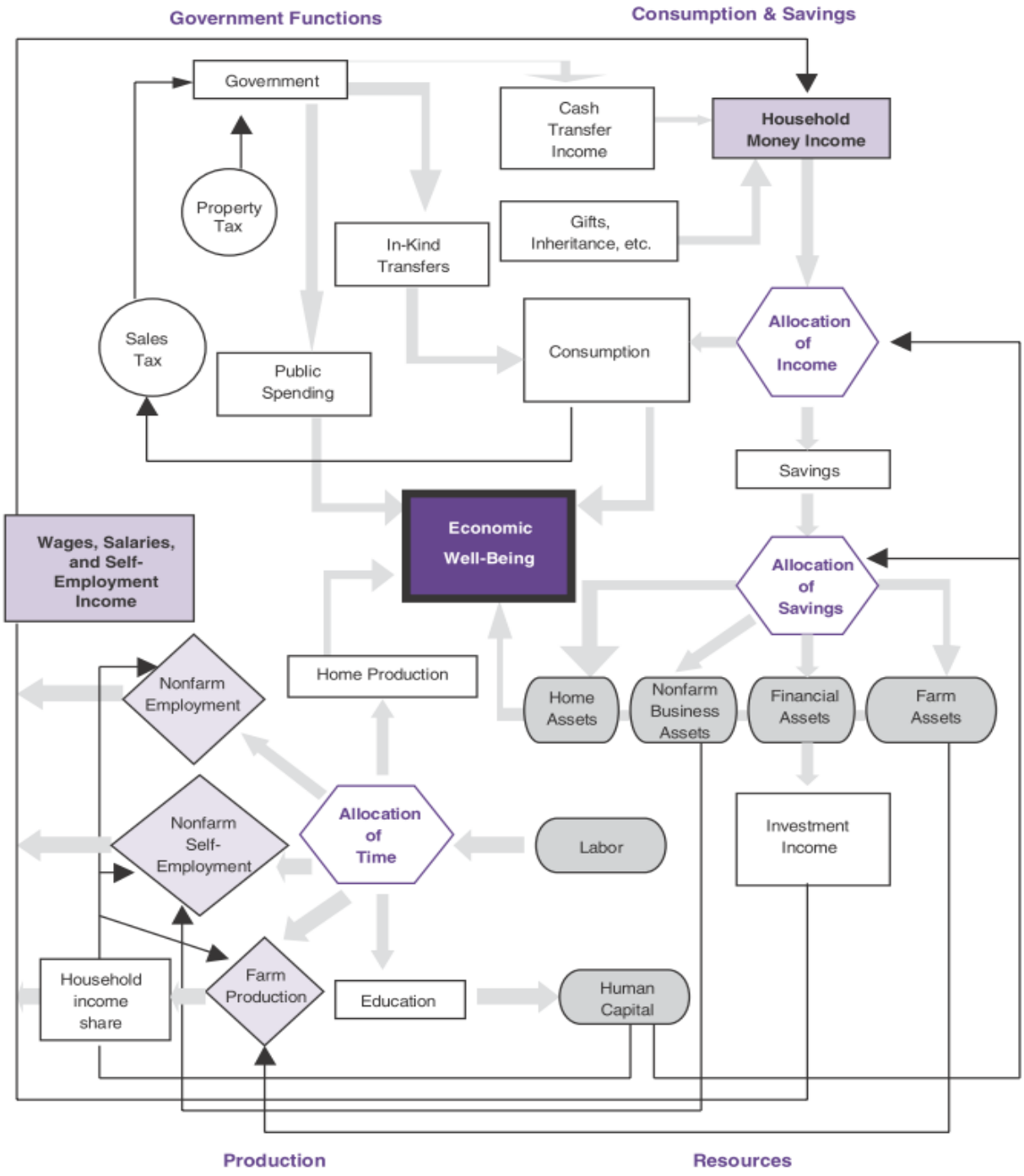
In the economic model of farm households below, it is apparent that the economic well-being of farm households depends not only on family characteristics but also its resources, production and employment; and the ability of income to meet consumption, savings and other household needs. Primarily, farm households allocate time (labour) to activities including farm operation, off-farm engagements, home production, leisure, education and so forth. It is worth noting that income and lifestyle benefits emerge from pursuing farm and off-farm activities jointly as becoming dual careerist can generate more income, help pursue entrepreneurial opportunities afterwards, and manage land and household resources (Ahearn and El-Osta, 1993). Evidence on the positive correlation between off-farm engagements and farm income variability is pervasive (Mishra, 1996).

However, off-farm work has traditionally been understood as a means of settling financial obligations including household debt and coping mechanism at times of farm income shocks. Yet, the off-farm jobs pay much higher wage than the productivity contribution on the household farm; decisions to off-farm work are part of the relatively

complex joint farm production and consumption decisions; off-farm work by farmers respond positively to their own wage rate but negatively to the wage rate of other members; imputed farm output has an expected negative effect (Huffman, 1977).

Figure 2.1: An Economic Model of the Farm Household

(Adopted from Thomas R. William, 1977*)*



Similarly, farm households allocate their savings among farm activities, household use and non-farm investments including the development of enterprises separated from the farm. In this regard, Mishra and Morehart (2001) argued that farm households have a higher saving rate compared to the non-farm household saving and off-farm investment behaviour. This saving and off-farm investment behaviour is found to vary with farm, operator and household characteristics. Yet, the economic well-being of farm households is derived not only from absolute levels of income and wealth available to the household but also from the income-consumption relationships as income allocated to savings can enhance future earnings, repay farm/household debt, help establish business enterprises and invest in financial alternatives.

Combining farm and off-farm work has grown easier as technology and mechanization freed labour from agricultural production and as off-farm compensation become more attractive. This has long been argued as fundamental in the transformation process of the rural economy and improving the economic well-being of farm households. Looking closely at the composition of household income and wealth in the economic model of farm households, the farm household hardly receive all of its income/wealth from a single source. Farm household income can originate from both farm and off-farm sources. The farm household appeared to run a multitude of decisions the knowledge of which is imperative to study the impact of economic policy as it informs the sensitivity of farm household income to the policy changes.

2.1.2 Models of Off-farm Work Choice by Farm Households

Although scholars seem to agree on the significance and importance of off-farm activities, there seems to be no consensus regarding the most important factors that drive

participation and the intensity of off-farm activities (Ellis, 2000). Several theoretical models offer different arguments for farm households' on-farm and off-farm diversification among which efficiency gains and risk reduction are considered most.

The neo-classical farm household model predicted that a farm household chooses to work either on the farm or off-farm depending on the marginal return from farm and off-farm engagements (Becker, 1965; Singh et al., 1986; Huffman, 1991). When the market wage rate is above the shadow or reservation wage, off-farm income substitutes for farm income whereas when marginal return to labor is greater than the market wage rate, farm income substitutes for off-farm income (Benjamin and Guymand, 1994). Low and unstable yields, a short growing season, lack of irrigation or drought, credit/capital market failure and land constraint may push farm households into off-farm activities.

At the centre, the well-received household utility maximization framework under the set of income, technology and time constraints provided the theoretical foundation for the analysis of off-farm engagement in the mounting empirical literature. However, the unit of analysis has not remained to be invariantly the farm operator [household head in the context of Ethiopia]. Even only in US, several studies (e.g. Gunter and McNamara, 1990; Robinson *et al.*, 1982; Simpson and Kapitany, 1983 among others) have considered farm operators as a unit of analysis to study the propensity and level of engagement in off-farm activities. Gould and Saupe (1989) and Olfert *et al* (1993), on the other hand, analysed the propensity and level of engagement in off-farm activities for spouses in the rural economy while others (e.g. Kimhi, 1994; Tokle and Huffman, 1991; Kerachsky, 1977) considered households' income and employment from off-farm engagements.

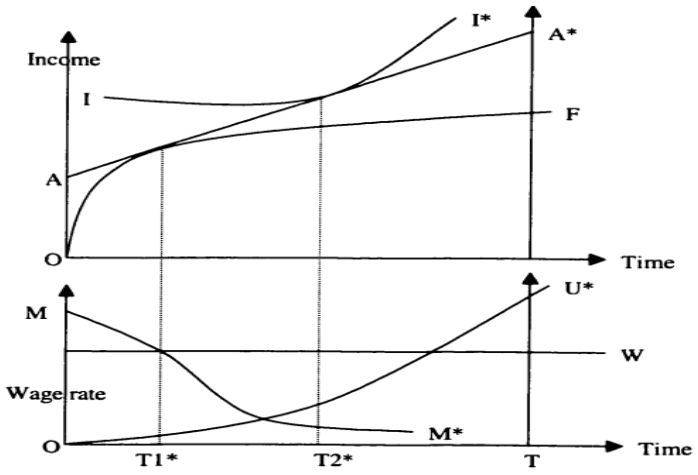
Despite the differences in the choice of the unit of analysis, it is commonly shared that most of the discrete choices in a farm household – decisions to engage in off-farm activities - are made individually or jointly based on the households' income needs, tests and preferences, returns to farm work, volunteer work, household work and childcare. The basic neo-classical theory of labour supply is often used as the starting point to explain the propensity and extent of engagements in off-farm activities in that household agents aim to maximize their household utility through an efficient allocation of their time endowment (labour) between income earning activities and home time.

In effect, the household decision entails us that households allocate their endowment among farm work, off-farm activities of different kind and leisure activities such that the value of marginal productivity from the respective engagements (enterprises) is equal [e.g. Nakajima, 1986; Sumner, 1982]. It can be illustrated as in what follows by considering a hypothetical household diversifying into farm and off-farm activities. The curve labelled as "OF" indicates the return from farming computed as the product of the farm production function for the household labour unit and output price index while the curve "AA^*" captures the return from off-farm activity at various levels of labour time.

The "II^*"curve indicates the labour-leisure indifference curve for the assumed farm household. Similarly, the total household endowment of time is depicted as the distance "OT" on the time axis while the curve labelled as "OU^*" represents the marginal valuation of household labour and the curve labelled as "MM^*" captures the marginal value product of household labour from farm work. And, "W" represents the compensation for households' off-farm engagements – off-farm wage.

Figure 2.2: The Subjective Equilibrium of Farm Households' Labour Use

(Adopted from Nakajima, 1986)



For an optimizing farm household, the basic model predicts that farm households allocate the total endowment of time 'OT' among farm hours of labour 'O-T1*'; labour hours of off-farm engagements 'T1*-T2*'; and hours of leisure time 'T2*-T'. Such equilibrium of the household labour use is attained such that the marginal returns from the three activities of the household are equated. In fact, this basic model is based on a set of simplifying assumptions for comprehension purposes even though it can be extended to model more complex situations without loss of generality (Sumner, 1982).

In one of the early scholarly works, Simpson and Kapitany (1983) offered an alternative explanation to the conventional utility maximizing framework which they labelled it as the Income Target Model of Off-farm work behaviour. The off-farm work decisions in a conventional utility-maximizing framework are consistent with the view that off-farm work is chosen when marginal returns to farming fall below potential off-farm returns. Contrarily, the objective of the farm household in the Income Target Model of Off-farm work behaviour is an income target than the unified utility maximization objective, reflecting the need to meet the financial obligations of farming.

However, as entering farmers may have current off-farm work skills, they may choose some off-farm work regardless of the financial obligations of farming. Similarly, as off-farm work skills depreciate and returns to farming appreciate over time, established farmers are less likely to engage in off-farm work. The empirical test demonstrates that these models produce divergent predictions about off-farm work decisions only under the assumption that higher financial obligations exceed higher returns to work on farms.

On the other edge of the efficiency vis-à-vis risk argument, many farm households combine farming with a variety of other pursuits since off-farm work has traditionally been viewed as an action necessary to save households from farm uncertainties (Ahearn and Lee 1991). Historically, off-farm engagements were also considered temporary and as a supplement to the major source of income – farming (Mishra, *et al.*, 2002). The income-risk argument to non-farm enterprise diversification stresses on the importance of risk associated with agricultural production as a key motivation to off-farm engagements.

Steven (1993) developed a model of the household labour allocation decision based on the risk and returns characteristics of each activity and tested using a state level cross section of the United States over the post-war period, and performs well in explaining variation in reliance on off-farm income. Similarly, McNamara and Weiss (2005) modelled the effect of price risk on household diversifications in an expected value variance approach maximizing the expected utility. Alike the predictions of farm household models, the testable implications revealed that the amount of off-farm labour increases with off-farm wages; off-farm work is more attractive for risk-averse individuals and in situations of increased risk associated with farming. More so, off-farm work increases with family labour and decline with farm size.

The other equally important strand of the literature argues for three sets of variables that determine choices into activities by farm households. First, the set of incentive "levels" facing the household, including relative prices of outputs from and inputs to activities under choice. Then, instability of incentives – the set of incentive "variation" facing the household – including relative risks (climatic, market, and other risks) of the activities. Last, the set of capacity variables (including human, social, financial, organizational, and physical capital assets) that enable the undertaking of activities (Reardon *et al.*, 2006).

In an earlier work, the same author asserted that off-farm income provides farm households with insurance against the risk of farming and thereby enables them to adopt new technologies. Off-farm activities help farm household to hire farm labor, purchase farm implements, livestock and other inputs such as fertilizer, pesticides and seeds. Off-farm income reduces the variance of household income, improves food security and smoothes consumption thereby keeping farmers healthy and productive. It serves as collateral and facilitates access to credit irrespective of space and time (Reardon, 1997).

Russell (2003) similarly developed a theoretical model in which a risk-averse farmer uses off-farm labour to smooth consumption, leading to greater use of fertilizer. Fertilizer demand is shown to increase with the depth of the off-farm labour market. Farmers use more fertilizer, the lower the unemployment rate and the higher the share of non-agricultural work in total off-farm labour. The empirical results suggested that off-farm labour markets and own-farm production may be complementary in risky production environments so that policies which promote off-farm labour market in low income areas may bolster farm productivity.

According to Ellis (2000), seasonality, risk strategies, coping strategies, as well as labour and credit market conditions are key factors that can be considered as causes for diversification to the off-farm activities. No matter what the motivation is, the existing literature extensively discovered the importance of off-farm engagements/income. And, it is generally learnt from the literature that the agricultural household model, emphasizing at the role of technologies, costs and marginal productivity of labour, serves as the standard theoretical framework to model the efficiency issues related to off-farm diversification decisions (Sumner, 1982).

The central argument is that the marginal return from extra hours of farm labour declines with the amount of time spent working on the farm. And, the household members will allocate time to off-farm work whenever household reservation wage exceeds the marginal return from farm work. However, off-farm activities are highly heterogeneous and have different magnitude on returns that ranges from highly lucrative to a very lower earning activity like poorly paid unskilled labour works. This is due to heterogeneity in personal, regional and national factors that affect household choices (Davis, 2003).

2.2 Empirical Literature

Based on a cross-country analysis, it has been found that crop and livestock production remain key activities in developing countries with 54-98% of participation rate for crop and 10-91% of participation rate for livestock (Winters *et al.*, 2009). However, the off-farm economy has increasingly become the central focus of attention in development policy over the last two decades due to its positive contribution to poverty reduction and food security (Reardon, 1998; Davis, 2003). Currently, participation in off-farm activities

is one of the livelihood strategies among poor rural households in many developing countries (Mduma and Wobst, 2005). Empirical studies have generally shown that off-farm sources contribute 40-50 percent to average household incomes across the developing world (World Bank, 2008a).

According to Haggblade et al., (2009), expansion of agriculture contributed for the growth of off-farm economy. In regions where agriculture has grown robustly, the rural non-farm economy has also typically enjoyed rapid growth. For instance, each dollar of additional value added in agriculture generates $0.30 to $0.50 additional rural non-farm income in Africa and Latin America, respectively. Recent globalization, urbanization and improved infrastructure have facilitated the development of the non-farm economy.

Decisions by farm households to engage in off-farm activities depend on two major factors: incentives offered and household capacity (Reardon *et al.*, 2001). Taking into consideration the wage differential between the two sectors and the riskiness of each type of employment, some poor rural households will make a positive choice to take advantage of opportunities in the rural off-farm economy. Other households choose to engage in the off-farm economy because of limited or no on-farm opportunities, for example, resulting from drought or small size of land holdings (Davis, 2003).

Accordingly, the propensity to engage in off-farm activities is primarily determined by the off-farm wage along with other factors. If the off-farm wage rate is slightly shifted upwards, the optimal time allocation changes and off-farm labour time of the household increases. However, the off-farm wage rate is a function of local labour market conditions, household characteristics and the returns on the household farm.

In line with this, Huffman (1980) argued that the quantity of labour supplied for off-farm work will depend partly on the off-farm wage which is in turn a function of human capital and is further constrained by household work and leisure. In reduced form equations, the reviewed literature resembles to the use of the instruments influencing the off-farm wage rate than the wage rates provided that it does exist. Accordingly, several studies employed a set of characteristics hypothesising different variables in estimating the off-farm engagement, many of which are discussed in the ensuing pages.

Mishra and Paudel (2008) evaluated the determinants of off-farm labour supply for farm operators in the Delta States (US). Results show that off-farm work, educational level, presence of teenager, and farm tenure to have positive and significant impact on off-farm labour supply by farm operators. On the other hand, farm size, household wealth, decoupled and couple farm program payments, and degree of farm diversification have a negative and significant impact on off-farm labour supply by farm operators.

Ekstrom *et al.*, (1986) examined the effect of selected individual, household, farm, area and financial characteristics on the off-farm engagement behaviour of farm households. The results from both discriminant and regression analysis established the importance of financial variables on off-farm work behaviour. Kimhi (2004) studied the relationship between the off-farm participation behaviour of farm operators and their spouses and the demographic composition of the household. He found that both the father and the mother tend to reduce their participation in off-farm work as the number of elderly children rises.

Robinson *et al.* (1982) studied the basic factors that influence farm operators' engagement in farm and off-farm work in Australia where they argued that farm labour is different from off-farm labour [kinked demand curve]. Employing the Tobit maximum

likelihood procedure to evaluate the impact of operators' life cycle, human capital, wealth; farm characteristics; and off-farm income on the off-farm labour supply, they conclude that operators' lifecycle, human capital, wealth and farm income are significant variables in determining the hours of engagement in the off-farm activities.

Similarly, Guang and Zheng (2005) examined the impact of local power on off-farm employment where migration is among the alternatives. They argued that migration is a second best option for households. Political power in the rural area is found to have a significant influence on the outcome of local off-farm employment. When the off-farm population (migrants and local off-farm workers) is further divided into wage labourers and entrepreneurs, it can be seen that local power worked differently in each case. Being from a cadre family had little impact on whether a wage worker stayed local or migrated, but entrepreneurs with political connections are more likely to stay in the local area.

According to Chang (2006), the decision of the farm operator to engage in off-farm work depends on the characteristics of the farm, the farm operator, and the circumstances in the local economy. The empirical results indicated that older farmers are more likely to work off the farm. However, the effect is nonlinear, with the likelihood of participation increasing with the operator's age up to about age 44, but declining thereafter. Although the operator's education has a positive effect on the probability of participation in off-farm work, the years of experience on the farm has a negative effect that increases at an increasing rate. The likelihood of working off the farm decreases with family and farm size and tenancy. Since the return to off-farm labour is less variable than farm income, the indication that the likelihood of off-farm participation is lower for farm operators willing to accept more risk is found true.

McNamara and Weiss (2005) found that both on-farm diversifications and non-farm labour allocation decisions are related to farm and household characteristics in that larger farms tend to be more diversified and younger farmers are more likely to work off-farm. Likewise, large farm households tend to allocate more labour to off-farm income activities. Fafchamps and Quisumbing (1999) investigated whether human capital affects the productivity and labour allocation of rural households. They found that households with better educated males earn higher off-farm income and divert labour resources away from farm activities towards non-farm work while the results indicate that education has no impact on farm productivity and livestock production. The observed effect on household income is argued to have had realized through the reallocation of labour from low productivity farm engagements to off-farm work.

Lanjouw and Shariff (2004) analysed the contribution of the non-farm sector to household income across population quintiles. The correlates of employment in the non-farm sector have also been examined based on rural data from 32,000 households in 1,765 villages across India. The results from Multinomial Logit and Censored Least Absolute Deviation Model for the probabilities and non-farm income, respectively, showed that non-farm incomes account for a significant proportion of household income in rural India, with considerable variation across quintiles and across the nation's major states. Education, wealth, caste, village level agricultural conditions, population densities and other regional effects influence access to non-farm occupations.

Regarding the role of off-farm income for the farm household, Hopkins *et al* (2002) argued that while farm business income exhibits considerable variability, farm household income is relatively stable. Fluctuations in farm output, commodity prices, and business

cycles, along with macroeconomic policies all contribute to the variability in farm income. Since these factors are beyond any farmer's control, many farm households have relied successfully on off-farm income to stabilize their total household income. Similarly, Ahearn *et al.*, (1993) decomposes the distribution of income among farm households by income source closely looking at the cross-sectional variation in total household income in terms of the importance of income from farm and off-farm sources.

Kimhi (1994) studied the choice to engage in farm and off-farm activities for farmers in Israel where a Multinomial Logit model using a pooled survey data over three different time periods is employed for the analysis. The study argued that the decision to work off the farm could be explained by the personal and farm family characteristics apart from the farm attributes and location of the farm in which farm owners who do not actually work on the farm are also included. The results indicated that the operators' age, education, land holdings, capital stock, presence of dairy operations, family size, and topography of the farm influenced off-farm labour hours of farm households.

Abdulai and Delgado (1999) studied the joint and separate decision to participate in non-farm work for a married couple in Ghana using a Bivariate Probit model. The results showed that education, experience, infrastructure, distance to the capital, population density, interactions between education and infrastructure; and interactions between education and distance to the city are found significantly related to the probability of non-farm engagements, the amount of non-farm labour hours and wages.

Weersink, Nicholson and Weerahewa (1998) analysed the multiple job holdings of farm households using a Bivariate Probit Estimation of the off-farm labour participation. The

results revealed that off-farm wage are insignificant in spouse participation whereas farm and family characteristics are significant in determining off-farm labour participation. Moreover, the study concluded that the influence of regional effect is insignificant and dissatisfaction with farm life influences off-farm work hours significantly. Yet, the study equally argued that the distance to major labour market centres affects the off-farm labour market participation but not the number of hours of off-farm engagement.

De Janvry and Sadoulet (2001) studied the role of off-farm activities in rural households of Mexico. The result shows that participation in off farm activities helps reduce poverty and contributes to greater equality in the distribution of income. Results of the Multinomial Estimation Method (where no participation in off-farm work is the choice comparison) show that education, ethnic origin and regional availability of off-farm employment are found to affect participation in off-farm activities.

Gould and Saupe (1989) analysed the entry into and exit from dynamics of the off-farm engagement using a panel data. The results of the study showed that education, vocational training and family characteristics are significant in deciding to enter into and exit from off-farm engagements. Another insightful finding with greater implication for policy making is that family conditions like childbirth increases female households' probability of exit from off-farm activity significantly. Childcare facilities in rural areas may significantly improve household engagement in off-farm employment and income.

Huffman (1980) studied the role of human capital in farm and off-farm work decision where the results suggest that farmers with more education, even when they have not migrated, have reallocated their labour services from self-employed farm work to off-farm work faster than farmers with lower levels of education.

Olfert *et al* (1993) studied the difference between men and women in their off-farm engagements using primary farm survey data from Saskatchewan. The results show that farm characteristics are significant determinants only for males and labour market conditions, as measured by the closeness to a shopping centre, is a significant determinant of off-farm employment only for males as well. More so, the number of children and education are significant only for women while age is significant for both.

Tokle and Huffman (1991) examined the impact of local economic conditions on wage employment decisions of farm and rural non-farm households using population survey data. The analysis concluded that the local market conditions have far stronger influence on the off-farm labour market participation of males than females whereas farm output prices negatively influence farm households' engagement in off-farm activities.

Mishra and Goodwn (1997) have empirically tested the hypothesis that greater farm income variability may increase off-farm engagements if farmers are risk-averse in their behaviour. The results confirmed that greater farm income variability increases off-farm labour allocation for households in Kansas State. More so, off-farm employment of farm households is found to be significantly influenced by farm experience, off-farm work experience, farm size, leverage, efficiency and farm-specific education. Income support program beneficiaries are also less likely to work off their farm.

2.3 Off-farm Engagements in Ethiopia

> "In spite of the high potential of the non-farm sector in generating employment, they are not covered by government policies and strategies." [In Ethiopia] Beyene (2008:141)

Ethiopia has one of the highest levels of dependency on agriculture of any country in the world. Agriculture employs some 80 percent of the economically active population and contributed to about 42 percent of GDP. Over 95 percent of the agricultural output is produced by smallholder and subsistence-oriented farmers (CSA, 2007). In very poor countries that have a dominant agrarian economy, off-farm employment can be an important source of alternative income (Reardon 1997). Off-farm income has generally been positively correlated with farm income (Chikwama, 2004), and non-farm activities show a positive, broader role in poverty reduction, total household income, and household wealth (Barrett *et al.,* 2001). However, in Ethiopia, the limited and scattered empirical evidence suggests that only some 10-35 percent of rural households are engaged in non-farm enterprise activities where some 20 percent of rural income originates from off-farm sources (Deavis, 2003).

Such a low participation compares to an estimated average of about 40-45 percent of average rural household non-farm participation in Africa. As employment opportunities within agriculture are unable to keep up with growth in the labour force, there is a need to diversify rural incomes (Olapade and Guenther, 2007).

This seemed to have emanated from the government's primary focus on the intensification of agricultural production within the context of an agricultural development led industrialization strategy, in its approach to rural development. As

elaborated in the Plan for Accelerated and Sustainable Development to End Poverty, the rural development strategy has been broadened beyond its initial focus on farm intensification where a more balanced approach is advocated emphasizing on the importance of private initiative of rural households and rural income diversification (World Bank, 2009). In the face of acute weather variability, off-farm activities could become attractive adaptation options to farm activities.

There is a dearth of literature on the subject matter as we go through it except few which are reviewed in the ensuing paragraphs. Bezabih *et al.,* (2010) have recently tested a hypothesis that rainfall availability increases agricultural activities leading to lower participation while rainfall variability leads to increased off-farm participation. The results confirmed that households use off-farm employment as a coping mechanism for weather shocks. Beside this, the effect of rate-of-time preferences of farmers on the decision to participate in off-farm activities shows that lower rate-of-time preferences significantly and positively increase participation which indicates that financial constraints have a negative impact on the decision to participate in off-farm employment.

Beyene (2008) studied the determinants of off-farm work participation decisions of farm households in Ethiopia in which he estimated a Bivariate Probit model for the head and the spouse. The results showed that human capital variables including health and training on non-farm activities have positive effect on participation of male members of the farm household. Contrarily, the education variable has no significant impact whereas access to credit and transfer incomes promote off-farm engagements. Woldehanna (2000) has extensively explored the impact of off-farm employment and income on farm households and agricultural production. The study showed that off-farm income can be

complementary to farm income if farm households are constrained in their borrowing which is proved theoretically by imposing liquidity constraints into the standard farm household model. The empirical results inform that farm households with more diversified sources of income have a higher agricultural productivity. Expenditure on farm input is dependent not only on agricultural production, but also on off-farm income because of capital market imperfections (borrowing constraints).

Lemi (2006) explored how demographic and economic variables factor the dynamics of rural income diversification into farm and off-farm sources in Ethiopia. Focusing on how what he termed as initial conditions [including asset holdings, production, and crop income] prompt farm households to diversify into off-farm engagements over time, the results of the study showed that participation in off-farm activities is mainly driven by demographic factors. On the other hand, land and other asset ownership as well as crop production and income affected only the intensity of off-farm engagements. Moreover, farm households who have initially diversified to more off-farm activities subsequently realized less income diversification whereas households with more initial crop production from slack harvest season subsequently realize greater income from off-farm activities. The study has confirmed that on-farm and off-farm engagements are complementary to each other only during slack harvest seasons.

Using survey data from Tigray region, Woldenhanna and Oskam (2001) argue that farm incomes and off-farm incomes are substitutes. They divided the off-farm employment into off-farm wage employment and off-farm self employment and arrive at the finding that farm households diversify their income sources into off-farm wage employment motivated by low farm income and availability of surplus family labour, whereas they enter into off-farm self employment to earn an attractive return.

Block and Webb (2001) attempts to see if there are household who increased their share of income from non-cropping activities during the inter-survey years of the well known Ethiopian Rural Household Survey. They found that wealthier households tend to have more diversified income streams; households with a greater concentration of assets were more likely to fall in their relative outcome ranking; and, initially less diversified households subsequently realized greater gains in income diversification.

To summarize, the selected literature reviewed under different sections helps us understand how household characteristics, farm characteristics and labour market conditions influence off-farm work decisions as well as the level of off-farm engagements – hours of work and/or income from it. And, a variety of individual, family, and farm/financial characteristics, as well as local labour markets, are argued to affect farm labour choices. From among many others, age, family size, size and type of farm, location and employment characteristics of nonfarm labour markets, skills and experiences of household members and costs of commuting appeared to influence off-farm engagements in varied contexts.

Yet, the empirical evidence remained inconclusive in that what is important to explain off-farm engagement in US may not hold true in Ethiopia, India, Sub-Saharan Africa or so. In fact, the theoretical model of off-farm engagements used, the data and empirical methodology employed can significantly attribute to the inconclusive nature of the literature on the subject matter.

CHAPTER THREE

3. METHODOLOGY AND DATA

3.1 Modelling the Farm Household

The rural economy in low income countries is arguably characterised by a structural feature of specificity and heterogeneous market participation of farm households in which some farm households are net-sellers and some are net-buyers while others are still self-sufficient and autarkic in supply – both in product and factor markets (Taylor and Adelman, 2003). The specificity of farm households extends the fact that they integrate production, consumption and reproduction decisions in a single institution.

Equally important is the stylized fact that these farm households are partially integrated to the market mechanism in the sense that some of their production is kept for home consumption and some of their labour is employed in home production irrespective of the nature of the market (Sadoulet, and De Janvry, 1995). In a complete market case, this entails us that production in excess of subsistence and family labour in excess of on-farm use will be sold in the product and labour market, respectively, while deficit production for subsistence and more labour for on-farm use will be bought/or hired. If all markets do not work, as missing and/or incomplete markets feature rural economies, some households end up with a complete autonomy in household consumption and/or labour use while still participating in cash crop, inputs and credit markets.

In a precursor work, Thorbecke (1993) argued that rural households are systematically exposed to market imperfections and constraints – collectively 'market failures' – and their behaviour cannot be understood without reference to the specificity of these failures

that has important bearings [costs] on rural welfare. Hence, economic analysis of policy changes that influence the functioning of the rural economy and/or the study of farm households' joint decision of production, consumption and labour supply [market participation thereof] requires an economic model that provides a sufficient specification of the structural context in which such decisions are made. Agricultural Household Models (AHM), microeconomic models of farm households that combine producer, consumer and labour supply decisions in a theoretically consistent manner, is essentially designed to adequately specify much of the structural peculiarities within which farm households make their choices. Its predictions are empirically testable to illuminate on the effects of economic policies (Singh *et al.*, 1986).

First developed in an effort to explain the then counterintuitive empirical evidence, including the apparent paradox of a positive own-price elasticity of demand for food in farm households and the puzzle of sluggish response of marketed surplus to increased staple prices, AHMs appeared to capture and explain the interlinked production and consumption/labour supply decisions of farm households (Taylor and Adelman, 2003). Apparently, the decision making unit happen to be a producer as it chooses the allocation of labour and other inputs to farm production; and a consumer as it chooses the allocation of household income to consumption of commodities and services.

Farm households, as a joint production, labour allocation and consumption decision making unit, maximizes a stream of expected utility from a vector of consumption goods [home produced goods and purchased goods] and leisure subject to a set of income, technology and time constraints in the AHM framework. The solution to the household problem is always for the household to situate on the highest possible indifference curve

attainable as the set of constraints assume different forms in accordance with the market environment in which households' behavioural choices are embedded. Later theoretical and methodological developments showed that different model assumptions regarding the structure of markets in which households are embedded [complete market versus imperfect market], implies different theoretical models, model solution, analytical tractability and empirical relevance (Sadoulet & De Janvry, 1995).

Conceptually, this corresponds to the question of whether households' production decision is separable from their preferences. Studies on agricultural household behaviour and policy effects indicated that different model results are obtained under the two different assumptions (Singh *et al*., 1986). If all markets work and there is no transaction cost, farm profit/income is the only hinge between the production and consumption decisions and the model is recursive/separable in the sense that the household can solve the production problem first and the consumption problem thereof, recursively [sequentially by integrating the farm income into its household budget]. Production decision affects consumption decisions through farm income while consumption decision does not affect production choice, hence separable from household preferences and income. Because farm households are fully integrated to the market, it is immaterial whether households consume/use its own product/labour or sells them to buy/hire what is preferred at the product/labour market, respectively.

Contrarily, there are direct interrelationships between production and consumption decisions if all markets do not work and/or there are transaction costs. In this case, households are not fully integrated to the market and possibilities of self-sufficiency, net-seller and net-buyer are pervasive. Market failure, typically the presence of transaction

costs, are argued responsible for such an outcome as the effective product and/or factor prices received when households sell their product/labour diverge from the prices they pay for goods/or hired labour (Taylor and Adelman, 2003; De Janvry *et al.*, 1991).

Thus, the production and consumption/labour supply decisions shall be considered simultaneously where household preferences become equally important determinants of the production choice as farm income does in the consumption/labour supply decision. That way, modelling rural farm households' behaviour in the context of market failure implies non-separability between production and consumption/labour supply decisions.

Furthermore, the existing literature on agricultural household models entails us that the theoretical and empirical developments can be systematically grouped in to two strands of unitary and collective household models. The underlying distinction lies on the decision making process in that there is [assumed to] a single decision making process in unitary models – characterising either a 'patriarchal' situation where a single household member makes the choices on behalf of all other members or a situation where there is unanimous consensus among the members on issues of internal dissensions in intra-household allocations. Thus, resources are pooled into a unique household strategy and consumption is shared accordingly with a reasonable unanimity.

Contrarily, the collective model treats each household member as a decision making unit in which resource allocation and the share of household expenditure is decided based on intra-household bargaining either in cooperative or non-cooperative manner. The outcome depends on each member's relative earning capacity and resource command – 'bargaining power'. As such, collective models questioned: "... how do individual

preferences lead to a collective choice" (Alderman *et al.,* 1995:5). In this manner, the collective model posits that individuals within households have different preferences and do not pool their incomes. More so, the collective model predicts that intra-household allocations reflect differences in preferences and bargaining power of individuals within the household – household members.

Based on the forgoing discussion made aiming at outlining and discerning the appropriate theoretical models, the choice among the alternative approaches under the agricultural household modelling framework clearly depends on the underlying objective of the study and the model assumptions used to adequately characterise the structural specification of farm households and the economic environment in which they are embedded. It is widely discussed in the scholarly work that farm households in low income countries [with a particular emphasis to Africa] are not fully integrated into the market and they are systematically exposed to market failure in all its possible forms (De Janvry *et al.,* 1991). Differing buying and selling prices for a given commodity and/or labour unit are pervasive in the rural markets, leaving consequently endogenous market participation and both tradable and non-tradable product/labour hours. This implies that the virtual (shadow) and market prices are significantly different which is explained in terms of market imperfections due to high transaction and supervision costs. Arising from incomplete/missing markets, credit constraint is a regular phenomenon as well.

Woldehanna (2002) has unequivocally argued for the partial integration of farm households in Ethiopia, both to the product and factor markets, for which he provided empirical support from Tigray regional state. Similarly, the joint production, consumption and labour allocation decision making process is essentially undertaken by

the household head, often referred to as the 'farm operator' (Jacoby, 1993). Unlike the collective models' prediction of bargaining based allocation of household resources to productive economic activities and distribution of expenditure, household members under one abode exercise allocation and expenditure distribution geared towards a unified household objective (own survey results, 2013). The incentive structure is clear in the sense that one can hardly observe conflict of interest among members simply because that is how it is in the rural Ethiopia – the social norm and lifestyle.

3.2 Theoretical Model | Analytical Framework

The agricultural household model provides a unifying microeconomic framework to understand the joint decision on production, consumption and time allocation performed by farm households. Following (Taylor and Adelman, 2003; Goodwin and Holt, 2002; Woldehanna, 2000; Sadoulet *et al.,* 1995; Singh, *et al.,* 1986), the theoretical model, explained hereunder, is based on a unitary non-separable AHM.

Now, consider a household utility function [U] that satisfies the standard assumptions of preferences including: (1) rational farm households; (2) continuous, quasi-concave, non-decreasing in its arguments and twice differentiable. The arguments include a vector of consumption goods [C], home time including family maintenance, reproduction, socialization and leisure [H] and a vector of preference shifters [e].

$$\boldsymbol{U} = \mathbf{U}(\boldsymbol{C}, \boldsymbol{H}; \boldsymbol{e}) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad [\mathbf{1}]$$

The first resource constraint constituting the household problem for optimal choice is farm production technology [Q], which is assumed to satisfy the standard assumptions of production function in that it is given as a closed, bounded and convex production

possibility set. The technology of the farm is specified to relate individual output [q] and an inputs vector, including purchased farm variable inputs [X], hired farm labour hours [L_h], on-farm family labour hours [L_f] , farm capital hours [K] , plot of land [A], and farm characteristics [α] , as in what follows.

$$\boldsymbol{Q(q, X, L_h, A, K, L_f; \alpha) \geq 0} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [\mathbf{2}]$$

As households' endowment of land is reasonably unchanging in the present context, further assume that owned household land is fixed. This has an important bearing on the allocation of landholding to several crops in a multi-crop farm production as the total land use is required just to exhaust the landholding as: [for $I - crops$]

$$\sum_{i=1}^{\mathbf{I}} \boldsymbol{A_i = A} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [\mathbf{3}]$$

Similarly, the total family labour hours allocated to the production of several crops is required just to exhaust the total family labour hours committed to farm production as:

$$\sum_{i=1}^{\mathbf{I}} \boldsymbol{L_{fi} = L_f}$$

Labour market imperfections are introduced in the form of transaction cost [including information, commuting, supervision and search costs] and rationing. Consequently, the virtual wage (determined at the subjective equilibrium of the supplying farm household) is different from the market wage [determined by the interaction of demand and supply] offered to each hour of labour supplied. Hiring-in households pay market wage of [$\boldsymbol{w_h}$] and, as hired labour involves a supervision cost, a supervision cash and/time amounting, say [$\boldsymbol{\rho}$] . Hiring-out farm households receive a market determined off-farm wage [$\boldsymbol{w_o}$] and, as off-farm employment involves transaction cost of information, search and commuting, incurs a time/cash cost amounting, say [$\boldsymbol{\tau}$] .

Considering at least two seasons in the cycle of agricultural production, it is argued that there may be limited off-farm wok opportunities during certain periods of the cycle [post-harvesting – pre-cultivation] as there may be limited farm work during such periods [unlike cultivation and harvesting periods]. Rationing is thus modelled as a restriction on the available off-farm jobs that requires the total household labour willing to work off-farm [L_{op}] to exceed, match otherwise, the total labour allocated to off-farm work [L_o]:

$$\boldsymbol{L_o \leq L_{op}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [\mathbf{4}]$$

The second important constraint constituting the farm household problem is the time constraint. Clearly, the total household time endowment depends on the number of economically active household members. Farm households allocate their total endowment of time [$\boldsymbol{T}$] between income generating activities and home time [time spent on activities except directly productive and on the labour market]. Households further allocate the work hours of the time endowment to farm and non-farm activities aiming at generating household income, including hours of labour in farm production, on one hand; and hours of labour in the rural farm and non-farm paid work; hours of entrepreneurial self-employment in the local non-farm sector; hours of labour in migratory employment (Reardon, 1997; Singh *et al.*, 1986).

In this particular study, the time constraint is specified to reflect a situation that farm households allocate T among farm work [L_{f}], off-farm work [L_{o}], home time [H], supervision of hired labour [$\rho_{\mathrm{t}} L_{\mathrm{h}}$] and transactions in the off-farm labour market [$\tau_{\mathrm{t}} L_{\mathrm{o}}$]:

$$\boldsymbol{L_{\mathrm{f}} + L_{\mathrm{o}} + H + \rho_{\mathrm{t}} L_{\mathrm{h}} + \tau_{\mathrm{t}} L_{\mathrm{o}} = \mathbf{T}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [\mathbf{5}]$$

[for $\boldsymbol{\rho_{\mathrm{t}}, \tau_{\mathrm{t}}}$ supervision time and transaction time costs]

The third equally important constraint in the agricultural household problem is the cash/income constraint. Imperfections in the product market in which farm households are embedded are introduced in the form of transaction cost – usually marketing cost of commuting and information, $say\ [\boldsymbol{\tau}']$, while selling and buying farm produces.

For a price vector of farm outputs $[\boldsymbol{p}]$, a price vector of consumption goods $[\boldsymbol{p}']$, a vector of sold quantity of farm output $[\boldsymbol{s}]$, a vector of purchased quantity of consumption goods $[\boldsymbol{\beta}]$, non-labour income $[\boldsymbol{v}]$ and a price of purchased variable farm inputs $[\boldsymbol{p_x}]$, the cash constraint for the farm household can be given by:

$$[\boldsymbol{Ps} - \boldsymbol{\tau}'\boldsymbol{s}] + \boldsymbol{w_o L_o} + \boldsymbol{v} \geq [\boldsymbol{p}'\boldsymbol{\beta} + \boldsymbol{\tau}'\boldsymbol{\beta}] + \boldsymbol{p_x X} + \boldsymbol{w_h L_h} + \boldsymbol{\tau_c L_o} + \boldsymbol{\rho_c L_h} \quad \ldots\ldots\ldots\ldots\ldots [\mathbf{6}]$$

Moreover, farm households are required to balance the quantity of commodities consumption and produced which is termed as commodity balance in the literature.

$$C = \boldsymbol{q} + \boldsymbol{\beta} - \boldsymbol{s} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [\mathbf{7}]$$

As a non-linear programming model, the farm household problem is complemented by a set of non-negativity constraints [for given prices] including:

$$\boldsymbol{C} \geq \mathbf{0};\ \boldsymbol{\beta} \geq \mathbf{0}; \boldsymbol{q} \geq \mathbf{0};\ \boldsymbol{s} \geq \mathbf{0}; \boldsymbol{A} \geq \mathbf{0};\ \boldsymbol{L_f} \geq \mathbf{0};\ \boldsymbol{L_o} \geq \mathbf{0}; \boldsymbol{H} \geq \mathbf{0};\ \boldsymbol{L_h} \geq \mathbf{0}; \boldsymbol{X} \geq \mathbf{0} \quad \ldots\ldots\ldots\ldots\ldots [\mathbf{8}]$$

The complete farm household problem based on the structural specifications discussed is thus formulated as a maximization-optimization of the households' utility $[\mathbf{1}]$ subject to the set of constraints $[\mathbf{2}] - [\mathbf{8}]$**.** The farm household is assumed to solve the constrained utility maximization problem which is expresses in Lagrange method as:

$$\mathbf{Z} = \mathbf{U}(\boldsymbol{C}, \boldsymbol{H}; \boldsymbol{e}) \; + \; \boldsymbol{\lambda_1}[\boldsymbol{Q}(\boldsymbol{q}, \boldsymbol{X}, \boldsymbol{L_h}, \boldsymbol{A}, \boldsymbol{K}, \boldsymbol{L_f}; \boldsymbol{Z})]$$

$$+ \boldsymbol{\lambda_2}[\boldsymbol{Ps} - \boldsymbol{\tau}'\mathbf{s}] + \boldsymbol{w_o L_o} + \boldsymbol{v} - [\boldsymbol{p}'\boldsymbol{\beta} + \boldsymbol{\tau}'\boldsymbol{\beta}] - \boldsymbol{p_x X} - \boldsymbol{w_h L_h} - \boldsymbol{\tau_c L_o} - \boldsymbol{\rho_c L_h}$$

$$+ \boldsymbol{\lambda_3}\left[\boldsymbol{A} - \sum_{\boldsymbol{i=1}}^{\mathbf{I}} \boldsymbol{A_i}\right] + \boldsymbol{\lambda_4}[\mathbf{T} - \boldsymbol{L}_{\mathrm{f}} - \boldsymbol{L}_{\mathrm{o}} - \boldsymbol{H} - \boldsymbol{\rho}_{\mathrm{t}}\boldsymbol{L}_{\mathrm{h}} - \boldsymbol{\tau}_{\mathrm{t}}\boldsymbol{L}_{\mathrm{o}}]$$

$$+ \boldsymbol{\lambda_5}\left[\boldsymbol{L_{op}} - \boldsymbol{L_o}\right] + \boldsymbol{\delta}'[\boldsymbol{q} + \boldsymbol{\beta} - \boldsymbol{s} - C] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; [\mathbf{9}]$$

Here, $\boldsymbol{\lambda_1}$ – the marginal utility of the technology constraint., $\boldsymbol{\lambda_2}$ – is a lagrangian multiplier for the marginal value of households' cash whereas $\boldsymbol{\lambda_4}$ – is a measure for the marginal value of households' time. $\boldsymbol{\lambda_3}$ – is the shadow value of a unit of land. Similarly, $\boldsymbol{\lambda_5}$ – is a lagrangian multiplier for the rationing of labour measuring the shadow value of additional off-farm employment available while $\boldsymbol{\delta}'$ – is a vector of shadow values of commodity balance for the goods consumed.

Under the assumptions made for households' preference and production technology, and further assuming an interior solution, the Kuhn-Tucker [**K-T**] first order conditions for maximization of $[\mathbf{9}]$ are both the necessary and sufficient conditions that the farm household is supposed to solve simultaneously as the production and consumption/labour supply choices are not recursive. Basically, the optimal choice of the household involves the level of consumption goods $[\boldsymbol{C}^*]$, purchase of consumption goods $[\boldsymbol{\beta}^*]$, hours of farm $\left[\boldsymbol{L_f}^*\right]$ and non-farm work $[\boldsymbol{L_o}^*]$, home time (usually termed as leisure) $[\boldsymbol{H}^*]$, allocation of landholding $[\boldsymbol{A}^*]$, quantity of farm inputs $[\boldsymbol{X}^*]$ and output $[\boldsymbol{q}^*]$, marketable surplus (sales of farm output) $[\boldsymbol{s}^*]$. Sadoulet and De Janvry (1995) and subsequent studies (Woldehanna, 2000; Taylor and Adelman, 2003) argued for the analytical intractability of the solution while still important testable implications can be derived.

However, the scope of this study is limited to analyse off-farm employment for which either a reduced form or structural equation approach can be used so as to develop empirical strategies from the theoretical model (Taylor and Adelman, 2003; Goodwin and Holt, 2002; Sadoulet *et al.*, 1995).

The structural equation approach, usually used to analyse alternative policy options, involves functional specification of the household problem and numerical optimization of it applying more restrictive general equilibrium type assumptions. On the other hand, the reduced form model is derived from and represents the solution of the necessary and sufficient K-T conditions for the household problem presented and explained above. It is worth noting that there is a reduced form equation corresponding to each structural endogenous variable expressed in terms of the exogenous factors, including prices (market and shadow), wages (their determinants) and the characteristics of the utility function and production technology. That way, a reduced form equation is distinguished as it reflects that choices concerning production are determined by consumption choices [via $\boldsymbol{e}$] and so does a reduced form equation for consumption choices**.**

For brevity and mainly as the objective of the study is limited to the analysis of off-farm engagements by farm households to generate income, the reduced form equation approach is employed. Hence, from among the set of **K-T** conditions, the relevant condition for the analysis of farm households' discrete choice to engage and the optimal choice of off-farm work [**10**] is presented and discussed in the ensuing paragraphs.

$$\begin{cases} \frac{\partial \mathrm{Z}}{\partial L_o} = \lambda_2(w_o - \tau_c) - \lambda_4(1+\tau_t) - \lambda_5 \leq 0,\ L_o \geq 0 \\ \text{and} \\ L_o{}^*[\lambda_2(w_o - \tau_c) - \lambda_4(1+\tau_t) - \lambda_5] = 0 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots [10]$$

Looking closely at $[\mathbf{10}]$, the optimal hours of off-farm engagement is positive for the household if $\boldsymbol{\lambda_2(w_o - \tau_c) - \lambda_4(1 + \tau_t) - \lambda_5 = 0}$, and it is less than (equal to) zero if the $\boldsymbol{\lambda_2(w_o - \tau_c) - \lambda_4(1 + \tau_t) - \lambda_5 < 0}$**.** In this regard, the central feature of off-farm employment participation is that allocation of time to off-farm work does compete with the time allocated to on-farm work and/or household time (leisure). Accordingly, it has been widely argued that, *at the margin*, the return from work hours allocated to off-farm activities should be greater than (equal to) the return from time spent on farm work for a positive hours of off-farm engagement.

More so, equation $[10]$ implies that the market wage and the virtual wage do diverge as the influence of liquidity constraint (financial stress), transaction cost and rationing (limited opportunities off the farm) is captured in the theoretical model. Defined in $[11]$, virtual wage $[w_o{}^*]$ and households' willingness to participate in off-farm activities are affected not only by the marginal value of time$[\boldsymbol{\lambda_4}]$ but the liquidity constraint$[\boldsymbol{\lambda_2}]$, rationing $[\boldsymbol{\lambda_5}]$ and transaction costs $[\boldsymbol{\tau_c}\&\,\boldsymbol{\tau_t}]$, as well. Restating it differently, farm households' choice to engage in activities off their farm depends not only on farming and household characteristics, but also on financial and labour market conditions.

$$w_o{}^* = \frac{\boldsymbol{\lambda_2\tau_c + \lambda_4(1+\tau_t) + \lambda_5}}{\boldsymbol{\lambda_2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [\mathbf{11}]$$

With these results, it is made clear that the virtual wage is not equal to the shadow value of on-farm labour hours. Increasing the virtual wage, transaction costs negatively affect households' engagement in off-farm activities while binding liquidity constraint (financial obligations) encourages households to engage in off-farm activities by decreasing the shadow wage. Comparing the virtual wage and the market wage $[w_o]$, a rational household decides whether to engage in off-farm activities.

The choice to or not to engage in off-farm activities is endogenous and is shaped primarily by the respective households' reservation (shadow wage) and its mark-up over the market wage often referred as the price band.

3.3 Empirical Strategy and Econometric Framework

The possible empirical approaches to analyse households' off-farm employment may be distinguished based on whether the discrete decision to engage in off-farm activities or the extent of participation in the off-farm activities, is analysed. Corresponding to the empirical strategies, the empirical analysis involves estimation of the probability equation to off-farm engagement and off-farm income and/or hours of off-farm activity. Following the first approach, the participation decisions implied by the relevant necessary and sufficient k-T condition is the natural starting point. As already indicated in [10], the farm household does not engage in off-farm activities [zero hours of off-farm activity] if the first order condition is met as an inequality $[\lambda_2(w_o - \tau_c) - \lambda_4(1 + \tau_t) - \lambda_5 < 0]$ – *aka* corner solution; and the farm household does engage [positive hours of off-farm activity] if the first order condition holds as an equality $[\lambda_2(w_o - \tau_c) - \lambda_4(1 + \tau_t) - \lambda_5 = 0]$.

Assuming an interior solution does exist, the first order condition is solved to derive a reduced form model of off-farm labour supply in which non-participation of the household is conditioned on the participation status in farming. Replacing the unobserved shadow wages $[w_o{}^*]$ by their determinants including labour market conditions, farming and household characteristics, a more simplified empirical representation of the condition to engage in activities off the farm can be obtained as in what follows [12].

For a vector of exogenous variables $[Z]$, the discrete participation equation can be put as:

$$L_o(w_o^*;\ \mathrm{Z}) \leq 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ [12]$$

Then, an empirical model of off-farm engagement [adding a random error term] can be obtained and evaluated using discrete choice models by applying a linear first-order approximation to the resulting participation condition.

The second equally important empirical approach to analyse off-farm engagement considers the intensity of engagement in the off-farm economy (labour market), going beyond characterizing and explaining the discrete participation decision. In this case, the dependent variable becomes off-farm income and/or hours of off-farm activity. Similarly, the first order condition $[10]$, can be solved for a reduced form model such that the choice variable (hours of employment and/or off-farm income) is related to the exogenous variables and/or other relevant endogenous choice variables [e. g: w_o^*]. For off-farm income and/or hours of employment $[\mathrm{M}]$, empirical models take a general form:

$$\mathbf{M_i} = \boldsymbol{L_o}(\mathbf{w_o}^*; \mathbf{Z}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ [\mathbf{13}]$$

In this approach, binary choice models cannot be used to empirically estimate the off-farm engagement relationship as the type and nature of the dependent variable is now distinct. The observed data on off-farm income and/or hours of off-farm activity, the dependent variables in this empirical approach, is subject to censoring as the observed values are clustered around zero and cannot take values below zero when the household does not have any off-farm income and/or hours of engagement. Thus, the binary choice models are replaced by methods that recognize the censored nature of the dependent variable, the detail of which is up in the next section (Maddala, 1983).

3.4 Econometric Specification and Estimation

An empirical model of off-farm engagement relates off-farm work participation and/or hours of off-farm activity and earnings to observable variables relevant to explain the discrete decision to engage and/or the intensity of such engagements off the farm. Defining a discrete decision variable [**y**], the K-T condition in [**10**] provides the participation rule for the unobserved difference [$\mathbf{w}^*$] between the market wage [$\mathbf{w_o}$] and shadow value of farm labour [$\mathbf{w_o}^*$] evaluated at no engagement in off-farm activities – index of an unobserved propensity for the off-farm engagement to occur:

$$[\mathbf{14}] \qquad y_i = \begin{cases} \mathbf{1} \text{ if } \mathbf{w_i}^* > \mathbf{0} & \rightarrow A\ household\ engages\ in\ off-farm\ activity \\ \mathbf{0} \text{ if } \mathbf{w_i}^* \leq \mathbf{0} & \rightarrow A\ household\ does\ not\ engage \end{cases}$$

Note that neither the off-farm wage (income) nor the days worked is observed if the household does not engage in off-farm activity. The reduced form equation from the K-T conditions enables us to specify $\mathbf{w_i}^*$ as in [**15**] so that the above binary decision rules can be expressed in terms of the vector of observable exogenous factors [defined as $\mathbf{Z_i}$] and the unobserved heterogeneity [$\boldsymbol{\varepsilon_i}$] as in [**16**] –latent variable.

$$[\mathbf{15}] \qquad \mathbf{w_i}^* = \boldsymbol{Z_i\beta_i'} + \boldsymbol{\varepsilon_i} \qquad\qquad [\mathbf{16}] \qquad y_i = \begin{cases} \mathbf{1} \text{ if } -(\boldsymbol{Z_i\beta_i'}) < \boldsymbol{\varepsilon_i} \\ \mathbf{0} \text{ if } -(\boldsymbol{Z_i\beta_i'}) \geq \boldsymbol{\varepsilon_i} \end{cases}$$

Empirical evaluation of the discrete choice to engage in off-farm activities typically uses a version of the binary response model in[**16**] .

The statistical issue in modeling the binary choice entails the specification of the probability of observing the choice of off-farm engagement and positive days of of-farm

work and/or earnings conditioning on the attributes of farm households (decision maker) and the alternative choices – farm and off-farm activities (Maddala, 1983). i.e.

$$\Pr\{y_i = 1|Z_i\} = \Pr\{\mathrm{w_i}^* > 0\} = \Pr\{Z_i'\beta + \varepsilon_\mathrm{i} > 0\} = \Pr\{-\varepsilon_\mathrm{i} \le Z_i'\beta\} = \mathrm{F}(Z_i'\beta)$$

$$\Pr\{y_i = 0|Z_i\} = \Pr\{\mathrm{w_i}^* \le 0\} = \Pr\{Z_i'\beta + \varepsilon_\mathrm{i} \le 0\} = \Pr\{\varepsilon_\mathrm{i} \le -Z_i'\beta\} = 1 - \mathrm{F}(Z_i'\beta)$$

Because the conditional expectation is given by:

$$\mathrm{E}[\mathrm{y_i}|\mathrm{Z_i}] = 1 * \Pr[\mathrm{y_i} = 1|\mathrm{Z_i}] + 0 * \Pr[\mathrm{y_i} = 0|\mathrm{Z_i}] = \mathrm{F}(Z_i'\beta)$$

the binary specification of the dependent variable $[\mathbf{y_i}]$ can be conveniently given by:

$$\mathrm{y_i} = \mathrm{E}(\mathrm{y_i}|Z_i, \beta) + [\mathrm{y_i} - \mathrm{E}(\mathrm{y_i}|Z_i, \beta)]$$

Upon substitutions of $\mathrm{E}[\mathrm{y_i}|\mathrm{Z_i}] = \mathrm{F}(Z_i'\beta)$ and $\varepsilon_\mathrm{i} = [\mathrm{y_i} - \mathrm{E}(\mathrm{y_i}|Z_i, \beta)]$**,** we get [**17**] clearly showing that the cumulative density function, $\mathbf{F}(\boldsymbol{Z_i'\beta})$, plays an important role.

[**17**] $$\mathbf{y_i} = \mathbf{F}(\boldsymbol{Z_i'\beta}) + \boldsymbol{\varepsilon_\mathbf{i}}$$

Even though the Linear Probability Model (LPM) can be a first hand alternative here, the results get meaningless if the predicted values lie outside the range (0, 1); and the parameter estimates will get biased if the model is constrained to the range (0, 1) – suffers from heteroscedasticity. The LPM, which does not consider the cumulative density function, specifies a linear regression model with uniform distribution over [0, 1]:

$$\mathrm{y_i} = \mathrm{F}(Z_i'\beta) = \begin{cases} 0, & Z_i'\beta < 0 \\ Z_i'\beta, & 0 \le Z_i'\beta \le 1 \\ Z_i'\beta, & Z_i'\beta > 1 \end{cases}$$

$$\mathrm{y_i} = \mathrm{E}(\mathrm{y_i}|Z_i, \beta) + [\mathrm{y_i} - \mathrm{E}(\mathrm{y_i}|Z_i, \beta)]$$

[**18**] $$\therefore\ \mathbf{y_i} = \boldsymbol{Z_i'\beta} + \boldsymbol{\varepsilon_\mathbf{i}},$$ where $\boldsymbol{\varepsilon_\mathbf{i}}$ has a standard normal distribution.

Under such a specification, the Ordinary Least Square (OLS) estimation procedure results both inconsistent and biased estimates of the model parameters (Verbeek, 2004).

Under a normal distributional assumption for the cumulative density function, a Probit Model (PM) circumvents such limitations of the LPM in which case:

$$\Pr[y_i = 1|Z_i] = \Phi(X_i'\beta) = \int_{-\infty}^{X_i'\beta} \left(\frac{1}{\sqrt{2\pi}}\exp[-0.5u^2]\right) du$$

$$\Pr[y_i = 0|Z_i] = 1 - \Phi(X_i'\beta) = 1 - \int_{-\infty}^{X_i'\beta} \left(\frac{1}{\sqrt{2\pi}}\exp[-0.5u^2]\right) du$$

Where, $\phi(u) = \frac{1}{\sqrt{2\pi}}\exp[-0.5u^2] \longrightarrow \boldsymbol{pdf}$

[19] $\therefore \mathbf{y_i} = \boldsymbol{\Phi}(\boldsymbol{X_i'\beta}) + \boldsymbol{\varepsilon_i}$, where $\boldsymbol{\varepsilon_i}$ has a standard normal distribution.

In effect, it is a transformation of the LPM such that the predictions will lie within (0, 1) for all values of the independent variables; and it has the property that increases in the independent variables are associated with the increase in the dependent variable which has an important bearing for interpretation.

The other commonly chosen empirical assumption is the standard logistic distribution function which results the Logit model as in what follows:

$$\Pr[y_i = 1|Z_i] = \Lambda(X_i'\beta) = \frac{exp(X_i'\beta)}{1 + exp(X_i'\beta)}$$

$$\Pr[y_i = 0|Z_i] = 1 - \Lambda(X_i'\beta) = 1 - \frac{exp(X_i'\beta)}{1 + exp(X_i'\beta)} = \frac{1}{1 + exp(X_i'\beta)}$$

Where, $\lambda(X_i'\beta) = \frac{e^{-X_i'\beta}}{\left(1+e^{-X_i'\beta}\right)^2}$, $\quad -\infty < X_i'\beta < \infty \quad \longrightarrow \boldsymbol{pdf}$

$$\text{The odds} - \text{ratio} = \frac{\Lambda(X_i'\beta)}{1 - \Lambda(X_i'\beta)} = exp(X_i'\beta)$$

$$\text{The log odds} - \text{ratio} = ln\left(\frac{\Lambda(X_i'\beta)}{1 - \Lambda(X_i'\beta)}\right) = X_i'\beta$$

[20] $\boldsymbol{ln\left(\frac{\Lambda(X_i'\beta)}{1-\Lambda(X_i'\beta)}\right) = X_i'\beta + \varepsilon_i}$, where $\boldsymbol{\varepsilon_i}$ has a standard logistic distribution.

{Note also that the log odds-ratio is a fully linear function of 'X'}

Having this in mind, Maximum Likelihood Estimation is the standard approach to estimate the discrete choice models for which 'sample information' is the underlying philosophy. Hence, the maximum likelihood estimator of the Probit Model in [**21**] yields consistent and asymptotically efficient estimators of the model parameters [$\boldsymbol{\beta's}$]**:**

$$[\mathbf{21}] \qquad \mathbf{w_i}^{*} = \boldsymbol{Z_i\beta_i'} + \boldsymbol{\varepsilon_i} \qquad\qquad \mathbf{y_i} = \begin{cases} \mathbf{1}, & \textbf{if } \beta'X + \varepsilon > 0 \\ \mathbf{0}, & Otherwise \end{cases}$$

$$Where: \ \boldsymbol{Y}\ is\ engagement\ in\ off-farm\ activities,$$
$$\boldsymbol{X}\ is\ a\ vector\ of\ independent\ variables$$
$$\boldsymbol{B}\ is\ a\ vector\ of\ parameters,\ and\ \ \boldsymbol{\varepsilon}\ is\ stochastic\ error\ term.$$

To estimate the extent of engagement in off-farm activities, the second empirical strategy is followed. Here, the off-farm work function is conditional upon the households' engagement in off-farm activities. The other equally important issue is the censored nature of the possible dependent variables – hours worked and/or income from off-farm activities – as only positive outcomes are completely observed. To distinguish between, truncation arises when one attempts to make inferences about a larger population from a sample that is drawn from distinct sub-population while censoring takes place when values in a certain range are transformed (reported) as a single value. Only information on the dependent variable is lost for censored data whereas the loss of information is both on the dependent and independent variables for truncated data – a greater loss by implication (Cameron and Trivedi, 2006).

As off-farm hours and income are conditional on households' decision to engage in off-farm activities, a substantial part of the population may have no days of off-farm work and income whereas the rest of the population may have positive off-farm days and

income with many different outcomes. The dependent variables are thus continuous but with constrained range for which Tobit Models are particularly suited (Verbeek, 2004).

Using the agricultural household model to describe farm household's decision problem, we showed that the solution for off-farm engagement can be zero or positive in which there will be a corner solution for a substantial proportion of households. For a latent variable resulted from the optimal choice of off-farm hours/income in the agricultural household model (other variables as already defined), the tobit Model specifies:

$$\boldsymbol{y_i}^* = \boldsymbol{Z_i\beta_i'} + \boldsymbol{\varepsilon_i}, \text{ where } i = 1,2 \ldots N \,.$$

$$\mathbf{y_i} = \begin{cases} \boldsymbol{Z_i\beta_i'} + \boldsymbol{\varepsilon_i} & \textbf{if } \boldsymbol{Z_i\beta_i'} + \boldsymbol{\varepsilon_i} > 0 \\ \mathbf{0} & \textbf{if } \boldsymbol{Z_i\beta_i'} + \boldsymbol{\varepsilon_i} \leq \mathbf{0} \end{cases} \qquad [\mathbf{22}]$$

Where, $\varepsilon_i \sim \text{NID}(0, \sigma^2)$ and independent of $\boldsymbol{Z_i}$

Thus, [**22**] is basically a censored regression model where all non-positive values are mapped to zeros as observations are censored at zero from below. The statistical issue in modeling the censored variable entails the specification of the probability of observing positive hours of off-farm work and/or income conditioning on the attributes of farm households (decision maker) and the alternatives. It involves two parts, the probability that ($y_i = 0$) and the distribution of 'y_i' given that it is positive as:

$$\Pr\{y_i = 0|Z_i\} = \Pr\{y_i^* \leq 0\} = \Pr\{Z_i'\beta + \varepsilon_i \leq 0\} = \Pr\{\varepsilon_i \leq -Z_i'\beta\}$$

$$= \Pr\left\{\frac{\varepsilon_i}{\sigma} \leq -\frac{Z_i'\beta}{\sigma}\right\} = \Phi\left(-\frac{Z_i'\beta}{\sigma}\right) = 1 - \Phi\left(-\frac{Z_i'\beta}{\sigma}\right)$$

$$\mathrm{E}\{y_i|y_i > 0\} = Z_i'\beta + \mathrm{E}\{\varepsilon_i|\varepsilon_i > -Z_i'\beta\} = Z_i'\beta + \sigma\frac{\phi\left(\frac{Z_i'\beta}{\sigma}\right)}{\Phi\left(\frac{Z_i'\beta}{\sigma}\right)}$$

The Tobit model describes the expected value of [$\boldsymbol{y_i}$], given that it is positive. That is,

$$\mathrm{E}\{y_i\} = Z_i'\beta\ \Phi\left(\frac{Z_i'\beta}{\sigma}\right) + \sigma\ \phi\left(\frac{Z_i'\beta}{\sigma}\right) \qquad [\mathbf{23}]$$

Thus, it is inappropriate to restrict attention to the positive observations and estimate the linear model from the sub-sample as the conditional expectation of $\boldsymbol{y_i}$ is no longer equates to '$\boldsymbol{Z_i'\beta}$' but also non-linearly depends on 'x_i' through $\frac{\phi(.)}{\Phi(.)}$. Recognizing the censored nature of the dependent variables at zero (from below), left-censored Tobit Model can be specified to estimate the coefficients of hours of off-farm work/ income.

$$[\mathbf{24}] \qquad \mathbf{Y} = \begin{cases} \mathbf{X'\beta} + \boldsymbol{\varepsilon}, & \text{if } \beta'X + \varepsilon > 0 \\ \mathbf{0}, & Otherwise \end{cases}$$

Where: $\boldsymbol{Y} - hours\ of\ off - farm\ activitie/income, \boldsymbol{X} -$ *a vector of independent variables*
$\boldsymbol{B}$ *is a vector of unkown Tobit Coefficients, and*
$\boldsymbol{\varepsilon}$ *is a vector of random error variables,* $\boldsymbol{iid}$ *with mean zero*
and constant variance of $\boldsymbol{\sigma^2}$ *with a lower limit at zero*

Standard estimators for this model are based on maximum likelihood estimation (MLE). MLE produces consistent estimates of the parameters of the Tobit model under appropriate assumptions such as homoscedasticity and normality of the error terms. The consistency of MLE requires a complete and correct specification of a parametric family of the error distribution. If the model is misspecified, model assumptions will have to be relaxed for consistent estimators are needed under more general assumptions.

Semi-parametric estimators are developed as hybrids of parametric and non-parametric approaches for this purpose. Powell (1994) argued that such estimators allow for a more general specification of the nuisance parameters; are more consistent than corresponding parametric models; and are typically more precise than non-parametric counterparts.[4] In response to the possible heteroscedastic and non-normality of the error terms, we considered censored least absolute deviation and symmetrically censored least square

[4] Powell (1994), on the other hand, argued that semi-parametric estimators are in general less efficient than the corresponding maximum likelihood estimates if the parametric model is correctly specified.

estimators important in so far as the concern is a cross-sectional type of analysis (Powell, 1984; 1986). The median-based censored least absolute deviation (CLAD) estimator and symmetrically censored least square (SCLS) estimator were both first proposed by Powell (1984, 1986). To make the estimator robust to problems of mis-specification, the sample is reduced eliminating data points and observations that fall outside the uncensored region of the sample (also known as the re-censoring step).

Least absolute deviations are applied to the remaining observations (also known as the regression step). Bootstrapping is used to compute the residuals. The CLAD estimator is robust to heteroscedasticity and non-normality and provides consistent estimates in the presence of censored data. The estimator, however, may be less efficient than its parametric alternative depending on the extent to which outliers are a problem in the dataset used in the empirical estimation.[5]

The SCLS estimator is built on the CLAD estimator but uses symmetric trimming. By assuming that the true dependent variable is symmetrically distributed around the regression function, and that the observed dependent variable will have an asymmetric distribution, symmetry can be restored by symmetrically censoring the dependent variable. The coefficients can be estimated by least squares with observations falling outside the uncensored region purged, using the symmetrically trimmed data to arrive at the SCLS estimator. The motivation for using symmetric trimming approach is that consistency will not be dependent on either homoscedasticity or known distribution of error terms (Powell, 1986).

[5] For example: Blisard *et al.* (2004) applied CLAD to analyse household expenditure on fruits and vegetables finding it to be more robust to outliers than least squares estimation. Chay and Powell (2001), analysing the earnings gap between black and white households, found that the semi-parametric estimation produced much more precise estimates than MLE and CLAD is found superior to SCLS for its consistency under more assumptions. See also Goodwin and Holt (2002) for details.

Regarding interpretation, the Tobit model is considered as a combination of OLS and Probit model analysis. As such, depending on the nature of the observation, the Tobit model coefficients estimates can be interpreted both as OLS coefficients and Probit Model coefficients. The Tobit model describes the probability of a zero outcome as:

$$\Pr\{y_i = 0\} = 1 - \Phi\left(-\frac{Z_i'\beta}{\sigma}\right), \qquad \frac{\partial \Pr\{y_i=0\}}{\partial Z_{ik}} = -\phi\left(\frac{Z_i'\beta}{\sigma}\right)\frac{\beta_k}{\sigma}$$

$\frac{\boldsymbol{\beta_k}}{\boldsymbol{\sigma}}-$ can thus be interpreted in a similar fashion as $\boldsymbol{\beta}$ in the Probit Model to determine the marginal effect of a change in $\boldsymbol{Z_{ik}}$ upon the probability of observing. More so, the expected value [**22**] shows that the marginal effect of a change in $\boldsymbol{Z_{ik}}$ upon the value of $\boldsymbol{y_i}$, given the censoring, will be different from β_k.

$$\mathrm{E}\{y_i\} = Z_i'\beta\ \Phi\left(\frac{Z_i'\beta}{\sigma}\right) + \sigma\ \phi\left(\frac{Z_i'\beta}{\sigma}\right) \quad \Rightarrow \quad \frac{\partial\, \mathrm{E}\{y_i\}}{\partial Z_{ik}} = \beta_k\left(\frac{Z_i'\beta}{\sigma}\right)$$

Thus, the marginal effect of a change in $\boldsymbol{Z_{ik}}$ upon the expected outcome $\boldsymbol{y_i}$ is given by the model's coefficient multiplied by the probability of having a positive outcome. If this probability is one for a particular individual, the marginal effect is simply $\boldsymbol{\beta_k}$, as in the linear model. Aiming at breaking the effect of independent variables on the dependent variable into that applicable to censored and non censored observations, McDonald and Moffitt (1980) decomposed the Tobit coefficients as in what follows. For a cumulative standard normal distribution function $\Phi(*)$ and a standard normal density function $\phi(*)$:

$$\mathrm{E[Y]} = Z_i'\beta\ \Phi(*) + \sigma\ \phi(*), \quad \mathrm{E[Y^*]} = Z_i'\beta + \sigma\ \frac{\phi(*)}{\Phi(*)} \Rightarrow\ \mathrm{E[Y^*]}\ \Phi(*) = \mathrm{E[Y]}$$

where**,** $\boldsymbol{\Phi}(*)$ is the probability of being a non-limit observation measuring the proportion of cases with non-limit values for the level of off-farm activity [**Y**]**.**

$$\frac{\partial \mathrm{E[Y]}}{\partial Z} = \Phi(*)\left(\frac{\partial\, \mathrm{E[Y^*]}}{\partial\, Z}\right) + \mathrm{E[Y^*]}\ \left(\frac{\partial\ \Phi(*)}{\partial\, Z}\right)$$

Hence, the first term, $\boldsymbol{\Phi}(*)\left(\frac{\partial\, \mathbf{E}[\mathbf{Y}^*]}{\partial Z}\right)$, represents the change in '**Y**' for non-censored observations, weighted by the probability of being above the censor point while the second term, $\mathbf{E}[\mathbf{Y}^*]\left(\frac{\partial\, \boldsymbol{\Phi}(\mathbf{z})}{\partial\, Z}\right)$, represents the change in the probability of being in a non-censored observation weighted by the expected value of '**Y**' if it is non-censored. With such decomposition, meaningful Tobit coefficients can be estimated and interpreted from a Maximum Likelihood technique (McDonald and Moffitt (1980)).

However, the standard tobit Model is said to have suffered from two limitations. One is the fact that the same set of variables and coefficients determine both the probability that an observation will be censored and the value of dependent variable of interest. Similarly, the Tobit model is argued not to have allowed a full theoretical explanation of why observations that are censored are indeed censored. This is all because the standard tobit model imposes too restrictive structure that exactly the same variables affecting the probability of nonzero observation determine the level of positive observations and, more so, with the same sign. As such, the structure imposed in the standard tobit Model is never considered an appropriate econometric specification criticised for the same set of variables determine the probability of off-farm work and hours of off-farm work, given participation occur (Maddala,1984).

Huffman (2004) recommended the Probit specification to fit the off-farm work outcome using a complete sample than the tobit model while the equation for off-farm work days/income can be fitted with a Heckman sample-selection correction terms for those farmers who reported positive off-farm days/income – *aka* tobit model –type II. In that sense, the Bivariate sample selection model specifies both the selection (engagement)

equation and the observation (level of off-farm engagement) equation in describing the joint distribution of the two endogenous variables ($h_i,\ y_i$) as:

[**24**]
$$\mathrm{h_i}^* = Z'_{2i}\beta_1 + \varepsilon_{2i} \quad \rightarrow off - farm\ engagement\ equation$$
$$h_i = \begin{cases} 1 & \text{if } \mathrm{h_i}^* > 0 \\ 0 & \text{if } \mathrm{h_i}^* \leq 0 \end{cases} \quad \rightarrow indicator\ type\ variable$$
$$y_i^* = Z'_{1i}\beta_1 + \varepsilon_{1i} \quad \rightarrow level\ of\ off - farm\ work\ equation$$
$$y_i = \begin{cases} {y_2}^* & \text{if } \mathrm{h_i} = 1 \\ - & \text{if } {y_1}^* \leq 0 \end{cases} \quad \rightarrow binary\ choice$$
$$\text{Where, } \begin{pmatrix} \varepsilon_{1i} \\ \varepsilon_{2i} \end{pmatrix} \sim NID\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & 1 \end{pmatrix}\right)$$

The conditional expectation of the level of off-farm work, given that a farm household is working, can be given by (making use of $\sigma_2^2 = 1$ and the expression for the expectation of the truncated standard normal distribution):

$$\begin{aligned} \mathrm{E}\{y_i|h_i = 1\} &= Z'_{1i}\beta_1 + \mathrm{E}\{\varepsilon_{1i}|h_i = 1\} \\ &= Z'_{1i}\beta_1 + \mathrm{E}\left\{\varepsilon_{1i}|\varepsilon_{2i} > -Z'_{2i}\beta_2\right\} \\ &= Z'_{1i}\beta_1 + \frac{\sigma_{12}}{\sigma_2^2}\mathrm{E}\left\{\varepsilon_{2i}|\varepsilon_{2i} > -Z'_{2i}\beta_2\right\} \\ &= Z'_{1i}\beta_1 + \sigma_{12}\frac{\phi\left(Z'_{2i}\beta_2\right)}{\Phi\left(Z'_{2i}\beta_2\right)} \end{aligned}$$

A sample selection bias arises if the $\sigma_{12} \neq 0$ in which the term $\lambda(Z'_{2i}\beta_2) = \frac{\phi(Z'_{2i}\beta_2)}{\Phi(Z'_{2i}\beta_2)}$ becomes the inverse Mill's ratio (*aka* Heckman's lambda). A two-step estimator of the sample selection model is one of the most often used estimator in empirical micro-econometrics in which the inclusion of the inverse Mill's ratio correction term is believed to solve all problems of selection bias. As a result, Heckman (1979) argued that the problem of sample selection becomes a problem of misspecification through the omission of the regressor $\lambda(*)$. The inclusion of more variables in $\boldsymbol{Z_{2i}}$, in addition to variables in $\boldsymbol{Z_{1i}}$, is important for identification in the second step – exclusion restriction.

3.5 Variables and Expected Results

The relevant literature reviewed and the theoretical models explained in the forgoing sections help us conceptualize how several factors determine farm households' decision to engage in off-farm activities and the intensity of their engagement. Informed by the theoretical and empirical literature and the implications of the theoretical model discussed (Robinson, *et al.,* 1982; Singh *et al.,* 1986; Sadoulet and De Janvry, 1995; Mishra and Goodwin, 1997; Reardon, 1997; Huffman and Lange, 1989; Woldehanna, 2000; Goodwin and Holt, 2002; Taylor and Adelman, 2003; among others), such factors as individual and household characteristics; farm production and financial conditions; institutional and labour market conditions are considered in the empirical analysis.

The analysis of household's engagement in the off-farm economy is empirically modelled by specifying two sets of dependent variables including: (1) the engagement of farm households in off-farm activities; (2) the total number of days that farm households allocated to off-farm activities; and total household income earned from engagements in off-farm activities. The proportion of farm households reporting any off-farm work days is interpreted as measuring the number of farm households switching from a corner solution to some positive days of off-farm engagement and/or increased efficiency of the rural labour market (i.e. no labour market rationing and prohibiting transaction costs). The average total days of off-farm work and/or earnings are interpreted as measuring the intensity of off-farm engagements – its importance in the rural economy by implication.

Thus, engagement in off-farm work is a binary outcome variable used as a proxy for the labour allocation decision of the farm household in which it assumes one if any member

of the household allocated hours of labour in off-farm activities and zero otherwise. The total number of days of off-farm work is a continuous variable measured as the reported effective number of days that the farm household engaged in off-farm activities. However, an off-farm day of labour is generally censored at zero as we can observe it only for sample farm households who are diversifying into off-farm activities. Similarly, off-farm household income is a continuous variable that indicates the estimated total earning from off-farm activities which is also censored at zero as we cannot observe it for non-participating sample farm households in off-farm activities.

Several vectors of independent variables are considered as the theory basically suggests that all exogenous variables affecting the marginal value of time in any activity can be included in the reduced form equations to be estimated. For analytical purposes, such factors are grouped as in what follows.

Household Characteristics: Demographic characteristics of farm households may have important influences on the demand for leisure and households' choice to engage and level of off-farm engagement. Off-farm work and the level of engagement may vary across households of different sex heads. For instance, the participation decision and hours of off-farm work (amount of earning thereof) may be high for male-headed households due mainly to differences in wage rate among male and female workers in most developing countries. Thus, sex of the household head is included in the empirical model to capture the difference in participation and level of off-farm work between female and male headed households. Similarly, age and age square are included in the empirical model to capture the effect of general experience which may increase the marginal value of time in each activity.

It is expected that an increase in age initially increase the probability and intensity of off-farm engagements and the effect is expected to result a humped-shaped life cycle for farm households in a normal condition (Reardon, 2006). The presence of children in a household is likely to imply less work outside the home. On the other hand, households with more members may have labour supply advantages in the sense that their on-farm marginal productivity may be diminished by the greater availability of farm labour, thus making off-farm employment relatively more attractive. Besides, household tasks such as childcare may be simplified if the household contains several members. That way, family size and dependency ratio could be translated as labour endowment. The presence of children in the household is expected to have a negative influence on off-farm work while the household size and dependency ratio are expected to increase off-farm engagements. Thus, household size in adult equivalence, dependency ratio and the presence (number) of children in the household are included in the empirical model to capture the effect of demographic factors.

Human capital is the most researched variable among the household characteristics variables though the empirical evidence usually goes either way (Huffman, 1980; Woldehanna, 2000). One strand of the empirical literature evidenced that raising the education level of farmers and increasing agricultural extension input leads to more off-farm labour supply. This implies that part of the return to education arises from its effect on the reallocation of labour services between farm and nonfarm labour markets.

Normally, education would be expected to enhance both farm and off-farm productivity by enhancing managerial efficiency on the farm and equipping the required skills in the labour market, respectively. More so, education may affect the quantity of off-farm work

as it has a positive effect on farm output and farm wage, and each of these variables enters the off-farm labour supply function. Akin, education has a separate positive direct effect on off-farm work. The net effect of farmers' education on off-farm engagement is argued positive. The level of education is thus expected to be positively associated with off-farm employment although the possibility exists that education could increase household productivity on the farm more than it increases their returns from off-farm employment. The level of education and literacy variables are included in the empirical model to capture the effect of human capital on participation and intensity of off-farm engagement. Likewise, household farm experience is expected to decrease off-farm work participation of farm households as households' labour may be more productive on the farm as a result of accumulated farm knowledge and skills.

The other equally important characteristic is farm household's socio-political capital which can be conceptualized as the households' network in the locality and participation in local governance and administration. For example, despite the preference to work off their farm, farm households who do not enjoy a relatively high socio-political connection in their locality may have limited off-farm labour market opportunity for many reasons. Cadre families and their relatives are expected to have a broader off-farm labour opportunity. Thus, participation in local governance is included in the empirical analysis to capture the effect of such differences on off-farm engagements.

Farm Characteristics and Wealth: It has been argued in the literature that large farms are likely to have full-time farmers, who are involved in crop production and are more likely to be working on the farm. Similarly, off-farm employment of farm household members is likely to be significantly influenced by their on-farm productivity. Assuming

that land holdings are likely to be predetermined (known) relative to off-farm employment, household farm size and productivity index are included to capture the scale of agricultural production and farm productivity effects on off-farm engagement. Application of fertilizer, high-yielding variety, water harvesting system, soil conservation method and participation in agricultural extension program are the common practise in intensifying farm production. Such farm intensification practices and household endeavours increase the opportunity cost of off-farm engagements. As a result, agricultural intensification practices are expected to decrease off-farm engagement and its intensity for farm households. Thus, application of fertilizer, the share of irrigated farm in the total cultivated land, participation in agricultural extension and farm training are considered in the empirical analysis to capture the effect of agricultural intensification on farm households' off-farm engagement.

The role of farm implements and livestock wealth is even more than often thought in shaping the decision mechanism of farm households. In the actual economic life of farm households, livestock is used not only as farm input but also as a saving to substitute imperfect, missing otherwise, credit market. Recognizing the fact that farm households consider the two sets of possessions as wealth, reported farm implements and livestock possessions are used to proxy the broader household wealth. The household wealth variable is however expected to have different effects on the participation and intensity of off-farm engagements. An increase in wealth could possibly allow households to have better opportunities to engage in better earning activities while more wealth may tremendously increase farm income and lower off-farm engagement through the possible income effect. In the context of Ethiopia, we expect that wealthy households may prefer to allocate less labour to the off-farm economy as they enjoy more return on their farm.

Thus, wealth variables are included in the empirical analysis to capture such effects. Similarly, farm households in Ethiopia may be experiencing financial stress since several forms of financial resource arrangements are made available for them to borrow to pay for variable farm inputs and other related farm business. So, households with farm debt may prefer to engage in and have more off-farm hours of work to settle their debt whenever there is farm income shortfall or so. The amount of farm debt is included in the empirical analysis to capture the effect of such farm debt.

Financial Characteristics of the Household: Income from other sources (e.g. remittances, and all forms of transfers) may also have an effect on the off-farm labour supply of farm households. To the extent that leisure has positive wealth effects, higher household income because of other income sources may reduce off-farm days of work and participation decision of farm households. So, farm households with income from other sources are expected to have lower off-farm engagement and/or participation rate.

On the other hand, income from off-farm sources may be critical to some farm families as they endeavour to meet financial obligations; and some farm households may seek off-farm employment in order to supplement inadequate farm income for subsistence. Many farm households may aim to generate sufficient income from both farm and off-farm engagements to meet financial obligations of different kind – household debt. Such farm households may choose to trade leisure for additional income by expanding off-farm engagements and/or days if they are already engaged. For this reason, it is important to reconsider the financial condition of farm households as one factor which may affect farm households' off-farm engagement in developing countries. Household income from non-labour sources and indebtedness are included in the model to capture such an effect.

Risk and Labour Market Conditions: Several factors may interplay for the farm household to perceive production risk, among which unpredictable weather and the nature (fertility) of landholding can be mentioned. One of the signs for farmers to perceive risk is the quality of their land. The lower the quality of land is, the higher the possibility that farmers may experience crop failures and farm income variability. Similarly, farm households diversify their crop production by planting different crops at the same time partly as a mechanism to avoid the risk of a particular crop failure. Thus, the number of crops farmers harvest each year may indicate the risk diversification strategy (behaviour) of farm households and risk perception by implication. Hence, a weighted average quality of land and the total number of crops cultivated are included in the empirical model to proxy the risk variable.

The rural labour market characteristics may include such factors as the total number of jobs available, geographic distance to work places, greater share of labour intensive economic activities of different kind, greater mobility of people, ease and opportunities of doing business among many others. Labour market condition variables are thus generally related to off-farm engagements in which good labour market conditions are expected to induce more off-farm engagements. In this particular study, distance to the nearest town in kilometres and number of job offers are included in the empirical model to capture the effect of labour market characteristics on off-farm work.

Based on the forgoing description of the dependent and explanatory variables, the operationalisation and direction of relationship (hypothesis) is annexed in the ensuing tabular presentation sought for succinct summary and partly for brevity.

Table – 3.2 Descriptions of Variables and Operationalisation

Variable Name	Definition	Measurement
Dependent Variables:		
Off-farm engagements	Household engagement in off-farm activities (1 if at least one member engages, 0 otherwise)	*Nominal*
Off-farm days	Days of off-farm engagement (No of off-farm days)	*Scale*
Off-farm earnings	Income from off-farm engagements (in ETB)	*Scale*
Explanatory Variables:		
	Household Characteristics	
Sex	Sex of the household head (1 if the household head is male, 0 otherwise)	*Nominal*
Age	Average age of earning household members in year	*Scale*
Age square	Squared age (average) of earning members in years	*Scale*
Household size	Household size in adult equivalence (Count)	*Scale*
Number of dependents	Number of non-earning household members (Count)	*Scale*
Children	Presence of children as members in the households (1 if there are children, 0 otherwise)	*Nominal*
Number of children	Number of children members of the household (Count)	*Scale*
Human capital	Average education level for earning members (years)	*Scale*
Farm experience	Farm Experience of the household in years	*Scale*
Socio-political capital	Socio-political capital of the household (1 if any of the household members participate in local governance, 0 otherwise)	*Nominal*
	Farm Characteristics and Wealth	
Farm size	Size of households' landholding in hectares	*Scale*
Farm productivity	On-farm productivity (value of output/cultivated land)	*Scale*
Fertilizer	Application of fertilizer in crop production in kg	*Scale*
Fertilizer dummy	Application of fertilizer in crop production (1 if the household applied fertilizer, 0 otherwise)	*Nominal*
Irrigated	Share of irrigated land (irrigated land/cultivated land)	*Scale*
Irrigation dummy	Use of irrigation in crop production (1 if the household used irrigation, 0 otherwise)	*Nominal*
Extension	Participation in agricultural extension programs (1 if the household participate, 0 otherwise)	*Nominal*
Livestock wealth	Possession of livestock in Tropical Livestock Unit (Count)	*Scale*
Farm implement	Value of farm implement possessions in ETB	*Scale*
Farm debt	Farm debt in ETB	*Scale*
	Risk, Financial and Labour Market Conditions	
Other earnings	Non-labour income from other sources in ETB	*Scale*
Indebtedness	Household level of indebtedness (Total debt/assets)	*Scale*
Risk indicator1	Weighted average quality of land (slope & soil type)	*Ordinal*
Risk indicator2	Number of crops cultivated and harvested (Count)	*Scale*
Distance	Distance to the nearest town in kms	*Scale*
No. Of job opportunities	Number of job opportunities - offers (Count)	*Scale*

3.6 Specification Tests

For the maximum likelihood estimators to have the property of consistency, the correct specification of the likelihood function is an important condition to be satisfied. This has an implication on the entire distribution that is imposed on the data which implies in turn the correct specification of the probability ($\mathbf{y_i = 1}$) in binary choice models. The misspecification is fundamentally motivated from the latent variable model reflecting heteroscedasticity and/or non-normality of the error term ($\boldsymbol{\varepsilon_i}$). Moreover, there may be a need to test for omitted variables (Verbeek, 2004). For the estimated Probit and Tobit Models, several tests of specification are performed under the Lagrangian Multiplier (LM) framework including tests for heteroscedasticity, normality and a general test of the tobit specification to ensure the robustness and consistency of estimates.

3.7 Research Design and Data

The motivation of the study is to draw implications for possible transformation of the rural economy by examining farm households' choice to engage in off-farm activities and explain the extent of their engagement. Thus, the study seeks to establish an empirical relationship between the binary decision variable to engage and a vector of factors to explain it, on one hand, and between the level of engagement in off-farm activities and a vector of factors to explain the intensity as informed by economic theory and the existing literature. To generate the required data for the study, a cross sectional research design is used. A survey of land farm households, using a standardized questionnaire as an instrument of data collection, is managed in Libo Kemkem Woreda.

Libo Kemkem Woreda is selected for two main reasons among others. First, the Woreda has long been identified with problems of high poverty incidence and food insecurity for which several poverty alleviation and food security projects are put in place since 1995. Recently, the rural people are observed diversifying their livelihood activities to on-farm and off-farm engagements. Second, the rural people are observed to send some members of the household out (respond) to several calls of employment opportunities specifically from commercial farms in Metema and Humera. Up on their return, farm households prefer to use the off-farm earnings to settle farm (household otherwise) debt and establish small nonfarm business. In fact, it is no more a tradition for farm households in the Woreda to spend the lean season doing purely social undertakings as we normally observe significant engagement of the rural people in income earning activities other that on-farm cultivation and livestock production.

There are **29** Kebeles in the Woreda under consideration. The project data from the Environmental Protection, Land Administration and Use office (EPLAUO) revealed that there are about **38, 283** land farm households fairly distributed among the **29** Kebeles (EPLAUO, 2012). This number of households is specifically identified as the number of farm households that has use right for farm land – which we call them 'land farm households' in this study. The office of land administration has conducted the survey after an enduring program of land use certification in the region. As we are particularly interested to analyse the engagement of farm households in the off-farm economy, land farm households in the Woreda, than the census households, are considered as a relevant population of the study. Thus, we are referring to the relevant population of land farm households while using the term 'household' in this paper.

3.7.1 Sampling Procedure, Sampling Frame and Sample Size

A multi-stage random sampling design is employed to draw sample land farm households. Due consideration is however given to the financial and time resource that the researcher was able to command and/or is made available by the institution for this specific purpose. Accordingly, two Kebeles, namely Tara Gedam and Yifag Akababi, are randomly selected as enumeration areas using the administrative list of Kebeles in the Woreda as a sampling frame. Then, 200 farm households are drawn from a sampling frame of land farm households' roster documented by EPLAUO.

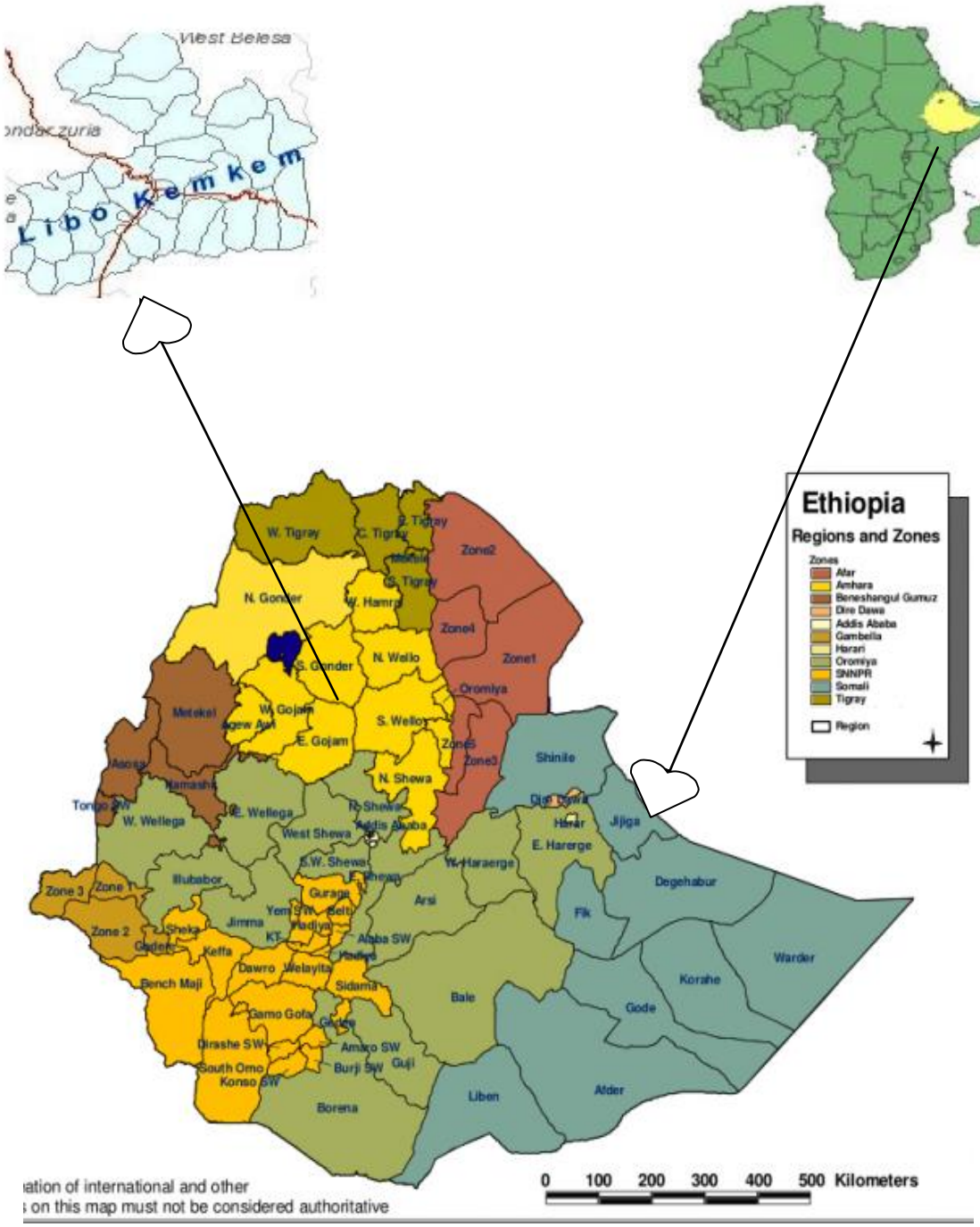
The total sample of 200 land farm households are drawn from the randomly selected enumeration Kebeles on equal proportion as they accommodate nearly equal number of land farm households (EPLAUO, 2012)[6]. The final administration of the questionnaire (data collection) is undertaken by two trained rural Development Agents (DAs) working at the respective Kebeles under a regular supervision of the researcher (weekends). Development Agents are recruited to exploit their close work contact with and familiarity to the enumeration Kebeles. It is well known that DAs are stationed in peasant association centres. Using DAs is thus believed to have minimized response failures and incorrect responses to the extent it would have matter otherwise.

[6] See Annex – 1: Sampling Frame and the Distribution of Land Farm Households.

3.7.2 Map of the Study Area

Panel 3: Libo Kemkem Woreda Showing Kebeles

Panel 1: Map of Africa (Ethiopia Marked Yellow)



Panel 2: Map of Ethiopia Showing Administrative Regions and Zones

CHAPTER FOUR

4. DATA ANALYSIS AND DISCUSSION

The main purpose of this chapter is to present results of the empirical analysis accompanied by a discussion of major findings. The empirical analysis encompass both descriptive results and econometric estimation of farm households' engagement in the off-farm economy in terms of choice models to off-farm engagement and models that estimate the intensity of farm households' off-farm engagements. The presentation of results is preceded by a comprehensive, but succinct, introduction that details the empirical context within which the analysis is made. This included the nature of the data used and household level aggregations made; the standard measures considered for some variables in the analysis; the empirical definition and scope of off-farm engagement in this particular study. This is sought to address the possible ambiguities in making sense of the results that may arise in subsequent sections where the main results are presented and implications are discussed.

4.1 The Data and Some Empirical Issues

The analysis made use of the data generated from a field survey of 200 Land Farm Households that are randomly selected from 2 Kebeles (sub-districts) in Libo Kemkem Woreda (district), the selection of which is similarly random. As already discussed in the research design section of the methodological chapter, the EPLAUO documented list of Land Farm Households is used as a sampling frame to randomly draw the primary study units whereas the Woreda administration documented list of Kebeles is used to draw the two sample Kebeles randomly. Despite the fact that the field survey is undertaken during

the months of March-April (2013), the information sought and elicited for questions of inter-temporal dimension refers to the year 2012 on a recall basis.

To generate the data we mentioned, of standard and structured questionnaire is administered in which sample Land Farm Households are asked a set of questions including demographic and household characteristics; livestock wealth and farm implements; labour allocation into and output/earnings from farm and off-farm activities; household land use and farm output; variable farm inputs and financial conditions; and sources of household income and debt. As part of the carefully undertaken research design, standard but contextualized set of codes and notes are developed with a close consultation to the office of EPLAU before the questions are set.

At the closing date of the field survey, the collected data is checked for errors, non-response and incompleteness during which sixteen (16) observations are singled out as only partially completed. Even though we kept them until data management and cleaning is performed, the analysis is based on the successfully completed 184 observations as we initially keep the incomplete ones for purposes of documentation and a (possible) forthcoming follow-up survey.

Many of the measurement units referred while designing the questions are local units partly to facilitate information elicit on the field. For instance, Land Farm households are asked Timads of landholding and/cultivated land than the standard unit of hectares; farm output in madiga and/or kuntals than the standard unit of kilograms; (annual) days of off-farm/farm labour than the standard hours of labour in the previous week or so. In fact, the very structural specificity of production and labour use in the rural economy is equally

taken into account in deciding on how to seek the information. Farm households may behave in a particular way than households in standard microeconomic theory to optimize with respect to the seasonal swing in labour use and labour market opportunities off their own farm. This structural specificity, we believed, calls forth examining annual days of labour and/or income. The remaining measurement units are then transformed to the respective standard units adopting conversion factors during which we lend much from the Ethiopian Rural Household Survey.

More so and as is required for the household level analysis, members of farm households are expressed in adult equivalence unit lending the European Union Adult Equivalence Scale (EUAES) that is specific to the context of developing countries for they have no accepted equivalence scale thus far. Hence, household composition, household level aggregation of data and further analysis is performed based on conversion to adult equivalence units first. A similar effort is made to express households' livestock wealth in terms of Tropical Livestock Unit (TLU) to facilitate and get a household level aggregate besides the market value expression based on surveyed livestock prices[7].

Akin, two indicators of the risk behaviour of land farm households are considered and for which an index is computed. As already discussed, the indicators are based on the premises that more risk-averse land households tend to diversify farm production into several crops and land households with less fertile land may appear more risky and sensitive to income diversification opportunities. Thus, we simply count the number of crop types for which a positive output is reported for the relevant time period to proxy part of the risk behaviour (indicator one). In the second case, we developed a composite

[7] Conversion factors are annexed: see Annex -3

weighted index from the land quality measures of soil type and the slope of several plots of land with a use right. Each quality measure is designed to have three values in which the smaller value (lem soil type and meda slope) induce less risk behaviour by implication. The risk behaviour is presumed thus to increase with lem-teuf and teuf soil type and the steepness of plots with a use-right.

The other equally important, perhaps challenging, data issue is the household level aggregation for many of the variables. In this regard, proactive effort is put on the very design of the questions in view of facilitating aggregation to household level. Hence, we believed that a proper household level aggregation of the collected information is performed for (variables) questions applicable to all household members; different plots and other several aspects of the same data unit.

A typical case in point as an example is the days of off-farm activity for it is applicable to household members in the age bracket {15, 65} and for it encompasses all forms of income-earning activities other than own farm work {farm wage work, nonfarm wage work and self employment} during the reference year. Supported by procedures available at the statistical software used[8], days of off-farm engagement is computed as a row sum of the empirical categories of off-farm activities defined in the questionnaire, followed by a collapse of the row sum by households' uniquely identifying code. In fact, this is performed after reported off-farm days are converted into adult equivalence units first. In the same vein and in accordance with specific definitions, similar data procedure is employed for the required household level aggregations.

[8] Stata {version 11.2} is used throughout the study except for some user written programs which is not supported by this version. E.g. we use version 8.2 to decompose marginal effects from a Tobit model.

As it is maintained throughout the forgoing chapters, off-farm work is conceptualized to encompass any activity pursued by the farm household in return for a positive compensation excluding activities on their own farm. In view of this, off-farm engagement reflects the choice of farm households to depart some of the household labour days from own farm work to allocate it in off-farm activities. And, days of off-farm engagement reflects the extent of household labour days allocated to off-farm activities. Similarly and implied by days of off-farm labour, off-farm income reflects the total earning from off-farm activities during the relevant time period referred (2012).

For analytical and data generation purposes, off-farm pursuits are generally grouped into farm wage work, non-farm wage work and entrepreneurial self-employment. This is further dissected analytically into off-farm engagements during period of high farm activity and periods of low farm activity. For detailed information to learn more on data related issues and the instrument used to generate the information, see the questionnaire.[9]

4.2 Important Features of Land Farm Households (Descriptives)

Given the structural specificity of farm households, neither conventional theory of consumer behaviour nor the theory of production fully captures the joint decision making behaviour of farm households. This has given rise to the theoretical modelling and policy analysis framework – well established in the literature as agricultural household model. More so and under the agricultural household model, the farm household may be considered either as a unified decision making unit with a single member in charge of

[9] The questionnaire is annexed in the appendix: See Annex – 2

undertaking the simultaneous choice regarding production, consumption and labour allocation or a collection of individual economic units with independent interest to serve. In the later case, each member will be represented by a separate consumption, production and labour allocation preferences and collective choices calls forth a process of allocation based on collective bargaining.

Having this in mind and to empirically reinforce the structural assumption made in the analytical framework (p-36), sample farm households are asked to elicit information on who is in charge of economic choices concerning the farm household. Based on the theoretical fundamentals and the literature survey, we dissected the possible decision mechanisms into three {household head, husband and spouse based on discussion with unanimous agreement and collective choice implied by a process of bargaining}; and choices into two {major and miscellaneous}. As expected, survey results reaffirmed the structural assumption we made about the farm household generally in Ethiopia in that almost all sample farm households (99.46%) make choices in a unitary framework by the household head, the spouse and the husband with a unanimous agreement of the two otherwise, for both choice categories[10].

As it is maintained up until this point, farm households are argued to make a joint decision regarding farm production, household consumption and/or efficient allocation of household labour. Employment decision, which involves the allocation of family labour to income earning activity and home time (usually termed as leisure), on one hand; and the allocation of household labour days to competing income earning activities, on the

[10] For brevity, results of the descriptive analyses that we are referring to discuss some of the important features of farm households (**Section 4.2**) is not presented in tandem with the discussion. It is however annexed as an integral part of the appendix for purposes of reference.

other hand, has been the focus of this study. Accordingly, sample land farm households are asked if (any member) they have allocated part of their family labour to the off-farm income earning activities and the earnings from their engagements. The data shows that 52.71% of sample farm households engaged in off-farm activities during the reference year for the survey (2012).

A closer look at farm households' choice to engage in off-farm activities clearly informs that participating farm households do allocate positive labour days throughout the year irrespective of the long-held view of seasonal swing in off-farm labour supply. The data shows positive mean days of off-farm engagement for all empirical categories except days of non-farm wage work which has zero mean for the lean season.[11] In fact, we found a statistically significant mean difference in days of off-farm activity between peak and lean seasons. This is true for all categories of employment we considered – farm work, farm wage work, non-farm wage work, self employment work. Days of farm and off-farm work are significantly higher during the peak season compared to the lean.

More so, results from two-sample mean comparison tests entail us that there is a significant positive mean difference between days of farm work and off-farm work analysed for both the peak and lean seasons separately. The other interesting result is a significant mean difference among the off-farm work activities in that the mean days of farm wage work is significantly higher than both the non-farm wage work and entrepreneurial self-employment during the peak season. Contrarily, days of farm wage work are significantly the lowest during the lean season compared to the peak season.

[11] For analytical purposes and based on the structural specificities we argued so far, we divided a year into two broad periods as: Peak season running from 1st of May to 1st of January; and the remaining as Lean season.

The other integral element of employment analysis is earnings from days of household labour and specifically days of off-farm engagements in this particular study. That way, the total earning from off-farm engagements is equally considered in which we found a statistically significant mean difference in earnings from farm wage work, non-farm wage work and entrepreneurial self-employment work. For diversifying sample farm households, the results contradict the previous evidence regarding days of off-farm work in the sense that farm wage work, with the highest mean days of off-farm labour, is significantly fetching the lowest mean off-farm earning compared to others.

These results may have substantial implication in labour economics and agricultural policy in that labour supply appeared less elastic to wage factors. Other non-wage factors may be working to induce more days of labour in the case of rural land farm households. On top of this is however the less attention given to the structural specificities behind land farm households' labour market participation behaviour and the intensity thereof. Less policy attention regarding the promotion of rural markets in general and regulation of the labour market (wages and working hours) specifically seemed has prevailed so far.

As an integral part of characterizing households, we asked sample farm households the primary occupation that each household member pursued during the reference period. Farming appeared to be the primary occupation for both the husband and the spouse in almost all farm households included in the sample (99%). This is not however the case with regard to the remaining members. Except in some cases, members other than the husband and spouse appeared primarily nonearning for they are either students or out of the age bracket {15, 65} to consider them as family labour, at least in order of standard economic analysis of labour force and employment.

The establishment of a farm household as an economic decision making unit involves pulling individual assets and other resources together, among others, livestock, plots of land and farm implements and in some cases cash. It is also apparent that farm households consider landholdings as, perhaps, the most important factor in their livelihood strategy. More so, assets including livestock wealth and landholdings are used to explain the decision making process assuming that such possession may significantly determine the bargaining power of, to be specific, the husband and the spouse.

In light of the above theoretical proposition, sample farm households are asked the Timad of land they brought to marriage. Summary results show that both the husband and the spouse contributed positive mean Timad of land, 4.11 and 1.32 respectively, to the institution of marriage. However, we found a statistically significant mean difference in Timad of land brought to marriage between the husband and spouse partners of sample farm households. Similarly, farm households who diversified into the off-farm economy are found to have brought less Timad of land to their marriage than those non-diversifying households.

Similarly, data from sample farm households made it clear that both the husband and the spouse have brought to marriage some positive mean livestock wealth. On the average, husbands brought about 1.34 livestock wealth in tropical livestock unit which is not statistically and significantly different from the mean livestock wealth brought to marriage by the spouse (1.37 livestock wealth in tropical livestock unit). Looking further at the distribution by the choice to off-farm engagement and if the there is a statistically significant mean difference between the husband and the spouse; the data does support neither of the propositions. We found no statistically significant mean difference in

livestock wealth brought to marriage between the two groups of farm households who diversify their livelihood to the off-farm economy and those who does not diversify. These results may have substantial implications in that farm households with less farm assets of land and livestock wealth diversify their livelihood into the off-farm economy by supplying more labour to farm and non-farm wage work and/or by appropriating prevailing entrepreneurial opportunities. And, households who command abundant land and livestock may prefer farm business than diversifying into off-farm activities.

Access to credit is apparently an important factor that influences farm households' economic choice. In our sample, we were specific in that we asked if farm households had credit access to finance farm input demand; to build assets; and to invest on livestock wealth. Interestingly, the data shows that about 43% of sample farm households had credit access for livestock – which we call it livestock credit in subsequent discussions. But, not more than 14% of sample households reported credit access for farm implements including modern plough, water pump machine for irrigation purposes and so forth. Evaluating the possibilities of association between the choice to off-farm engagement and access to credit, the data supported no statistically significant association between the observed values of the two variables.

As an important step to capture the labour market conditions for land farm households, sample households were asked to count off-farm employment opportunities that are pursued, could have been appropriated otherwise, for each household member. The job offers and the possibilities of entrepreneurial undertaking to self-employment are structured to include local private jobs, paid rural development work and possible opportunities for self-employment. In all cases, both realized and potential employment

opportunities are considered. Survey results indicate that 94.57% of the sample farm households reported zero number of local private job offers during the period referred in the survey. But, a significant proportion of sample farm households reported positive number of paid rural development work (31%) and self-employment (59.24%). More so, a significant mean difference in all forms of job offers and opportunities is found for households who diversified into the off-farm economy and households who do not.

Asked if they incurred some expense to operate their farm production, 85.87% of sample farm households reported that they incurred positive expenses related to farm inputs including chemical fertilizer, pesticides, modern seeds and so forth. Examining the mean farm production expense between sample households who diversified to the off-farm economy and those who do not diversify, the data supports somewhat significant mean difference in farm production expense.

Rural infrastructure and roads that connect rural areas and urban centres particularly play a pivotal role in facilitating farm–off-farm linkages and rural development at large. In line with this, distance to the nearest market has been investigated extensively in the literature in one's attempt to capture local labour market opportunities given the inherently imperfect, missing otherwise, market institutions in the rural economy. Reaffirming the non-separable link assumption made for the labour market, sample farm households have to walk a mean distance of 8.5 kilometres to get the nearest possible market to exchange goods, labour and/or information regarding several economic issues. However, the mean distance in kilometres is not significantly different between diversifying and non-diversifying households.

Crop failure in its all possible forms is perhaps the most uncertain shock in the economic life of farm households where traditional farming highly hinges on rainfall that is quiet sporadic in nature. Survey results of our sample farm households clearly supported this line of argument in that 70.11% of farm households in the sample reported an experience of crop failure a year back from the reference year of the survey (in 2011). A simple analyse to associate crop failure experience (in 2011) with off-farm diversification by choosing to and supplying more days of off-farm work (in 2012) is strongly and significantly rejected suggesting no association.

This partly strengthens one strand of the argument that off-farm engagements are rational choices as a permanent pursuit than abrupt move to temporarily remedy household livelihood shocks. As a result of crop failure, for some understandable reason otherwise, about 68% of sample households reported a decline in yield during the reference year (2012) compared to the year 2011. A similar attempt to correlate the perceived (reported) decline in yield with the observed choice to engage in off-farm activity is performed and the result does not suggest any significant statistical association.

During the sample survey, farm households are asked if they are beneficiaries of the productive safety net program for which only about 31% are participating in the program. Yet, an attempt to correlate households' choice to off-farm engagement and the program participation in the productive safety net program reveals no statistically significant association. Libo Kemkem Woreda has long been one of the beneficiaries of several food security and poverty alleviation programs for it is identified as one of the most vulnerable and food insecured districts in the region. Several studies are also undertaken to measure

the impact of productive safety net program on food security and labour supply in Ethiopia, the result of which remained mixed to the best knowledge of us.

Sample farm households are also asked if they do consider migration to urban centres and/or other places as one option looking for a better income and standard of living, in effect seeking for productive employment. The results indicated that only 11.41% of the total surveyed farm households considered migration as an economic option which is not in support of our expectation. Normally, we expected to observe diversifying farm households to consider migration as an alternative option in view of migratory labour market opportunities and for they may be relatively information-rich about opportunities associated with migration. However, the empirical evidence does not support any significant association between farm households' choice to engage in off-farm activities and migration as a viable economic option to consider.

Financial stress has recently become a distinguishing feature of farm households as a result of the failure to fully settle borrowings that can be broadly grouped as private and public borrowings. Private borrowings are considered to include loans obtained from friends and relatives, formal and informal financial institutions while public borrowings are considered to include loans obtained from the government for acquisition of farm inputs, asset building and employment generation schemes. In line with this, more than half of sample farm households (52%) reported some cumulated positive outstanding loan at the beginning of the reference year in the survey and 40% of sample farm households received fresh borrowings during the year referred in the survey (2012). More so, the mean outstanding loan (1412.5 ETB) appeared significantly higher than the mean value of fresh borrowings (918.1 ETB).

More interestingly, we found a statistically significant mean difference in outstanding loan between farm households who choose to diversify into the off-farm economy and those who relied on farming in that diversifying farm households have higher mean outstanding loan. The significant mean difference does not hold for fresh borrowings which may have interesting implication that farm households with high outstanding loan may be sensitive to opportunities of off-farm activities to diversify income sources as they are not taking up more fresh borrowings. Yet, this requires further study.

Thus far, we focused on the descriptive analyses and discussion of some important features of farm households as a prelude to the more subtle discussion based on empirical estimation of both farm households' choice to engage in off-farm pursuits and the extent to which their engagement is exercised. The idea is that farm households efficiently allocate their endowment of time among competing farm and off-farm activities seeking for an efficient combination of farm and off-farm income. In the ensuing sections, we present and discuss estimation results of off-farm engagements by farm households.

4.3 The Choice and Level of Off-farm Engagements

The analysis of off-farm engagements, as already discussed in the methodology, is approached from two perspectives: (1) estimation of the discrete choice to engage in off-farm activities followed by (2) estimation of the intensity of engagement that goes beyond the simple characterization of farm households' choice in allocating their family labour. The empirical estimation can generally be accomplished by employing either parametric or semiparametric estimation framework that generates the respective estimates for it depends on the underlying statistical assumptions made.

Thus, parametric analyses of off-farm engagement, making use of maximum likelihood estimators that are applied however under strong distributional assumptions, is performed in order to (1) estimate the discrete choice model of the decision to engage in off-farm activities; (2) estimate the tobit model to evaluate the level of off-farm engagement in terms of reported annual days of labour supplied and/or reported earnings from off-farm activities. To complement, supplement the parametric analysis otherwise, alternative empirical framework that gives careful attention to the distributional properties underlying parametric estimators is also considered and implemented. This includes semiparametric estimators appropriate for censored off-farm days and/or earnings.

To fix ideas, the theoretical and analytical framework discussed up until this point suggest that days of off-farm labour may be causally linked to the off-farm wage, farm productivity and other demographic and socio-economic characteristics of the farm household. This is primarily because consumption and production choices are inseparable with imperfect markets and implies the inclusion of endogenous wage variables in the off-farm labour supply and earnings function.

In accordance with this, the available data and specific objectives of a given study, the empirical estimation often times take either of the following two approaches. (1) Adhering to the standard theory of labour supply and estimating the shadow wage from a fitted production function along with a predicted off-farm wage from a fitted wage-offer equation, the first approach estimates off-farm days of labour as a function of wages, variable farm inputs, farm characteristics, household wealth owned, non-labour income, human capital variables and household composition. (2) The other equally applied specification estimates the days of off-farm labour as a function of variables relevant to

explain off-farm wages, farm productivity, and other household characteristics that separately and/or jointly explain households' demand for home time and work – marginal value of time. Mostly, it remedies inconsistent and wrongly reported data, incomplete and missing otherwise, on wage variables.

In this particular study, where the unit of analysis is land farm households than an individual operator, the empirical problem associated with wage variables become even more intractable. Neither predicted shadow wages from a fitted production function nor predicted off-farm wages from a fitted wage-offer equation can be a palatable remedy to consider and implement thereof. More so, we have collected the gross annual earnings from off-farm engagements by the household as a unified decision making unit for the same reason of wage rates intractability as diverse off-farm activities are considered in an attempt to fully capture the issue of interest. In fact, the use of predicted wages is based on the perfect market hypothesis in that it equates shadow wages with marginal productivities of factors and in that sense it contradicts the structural specification of farm households in which market imperfection is introduced to better capture the reality.

Therefore, we choose the second approach in which we utilize a number of variables relevant to the off-farm earning potentials that in effect instruments wage variables by a wage function. In the context of Ethiopia, where there exists imperfect labour market, such an approach is believed to be more sound than using the wage rate variables.

4.3.1 Farm Households' Choice to Off-farm Engagement

In this section, we present and discuss the estimation of the binary choice model to off-farm engagements. The analysis focuses on the characterization of farm households' off-farm engagement and its determinant factors based on estimation results from alternative model assumptions about farm households' engagement in off-farm activities. As already indicated, the choice of a farm household to engage in off-farm activities – specifically the probability of off-farm engagements – is modelled and explained in terms of household characteristics; wealth variables and farm characteristics; risk, financial and indicators of the labour market condition. To help fix ideas, the summary statistics of variables used in the estimation is presented in Table 4.1 first.

It is noteworthy to explain the operational definition of the intensification variable we used to characterize the level of agricultural intensification performed by sample land farm households as it was constructed after the data collection is administered. The intensification indicator is constructed from three questions asked about the application of chemical fertilizer, irrigation technology and agricultural extension services on their farm. In this regard, farm households are characterised as intensifying if their farm production involves the application of either of such intensification factors as chemical fertilizer, irrigation technology and agricultural extension services; non-intensifying otherwise. For intensifying households that apply all forms of the intensification factors, high intensification characterization is labelled in the analysis. For intensifying households that apply only one or two of the intensifying factors in their production, low intensification characterization is labelled to better understand the empirical link that goes from agricultural intensification to allocation of labour to the off-farm economy.

Table 4.1: Summary of Descriptive Statistics (Off-farm Choice)

Variable	Variable Definition	Mean	Std. Dev	Min	Max
Off-farm work	1 if engaged off the farm, 0 otherwise	0.527	0.501	0.000	1.000
Socio-political capital	1 if a household member serves in local governance, 0 otherwise	0.348	0.478	0.000	1.000
	Household Characteristics:				
Sex (household head)	1 if male, 0 otherwise	0.946	0.227	0.000	1.000
ln(Age)	Age in years	3.821	0.388	0.000	4.489
ln(Squared age)	Squared age in years	7.595	0.780	0.000	8.955
Household size	No of members in adult equivalence	3.882	1.135	1.000	7.300
Children	No of children in the household	2.065	1.440	0.000	7.000
ln(Farm experience)	Years of farm work for the household	3.111	0.636	0.000	4.248
	Human Capital Variables:				
Literacy	1 if head can read | write | read & write, 0 otherwise	0.500	0.501	0.000	1.000
ln(Human capital)	Average years of schooling completed for members in the age bracket (15, 65)	1.228	0.737	0.000	2.351
	Farm Characteristics and Wealth variables:				
ln(Farm size)	Size of landholding in hectares	0.770	0.234	0.223	1.386
ln(Farm productivity)	On-farm productivity indicator (Val. output/hectares cultivated)	9.427	0.423	7.908	11.047
Livestock	Livestock in tropical livestock unit	6.021	4.643	0.000	34.410
ln(Farm debt)	Farm debt in ETB (beginning of 2012)	4.137	3.727	0.000	9.211
High intensification	1 if a household applied chem. fertilizer, irrigation & extension, 0 otherwise	0.136	0.344	0.000	1.000
Low intensification	1 if a household applied one | none of {fertlzr, irrigation, extension}, 0 otherwise	1.598	1.501	0.000	3.000
	Risk and Financial Conditions:				
Risk indicator1	No of crops cultivated & harvested	1.007	0.613	0.250	2.250
Risk indicator2	Weighted average quality of land	4.777	1.609	1.000	9.000
ln(Non-labour income)	Income from remittances, transfers & other sources in ETB	2.570	3.471	0.000	8.700
ln(indebtedness)	Households estimated debt-asset ratio	0.182	0.302	0.000	2.663
	Labour Market Conditions:				
Distance	Distance to the nearest market in Kms	8.440	5.329	1.000	19.000
Jobs	No of jobs (labour market condition)	1.457	1.338	0.000	5.000

- Number of observations: N=184
- ln(*) stands for the natural logarithmic transformation of level variables in the bracket '*'.

Estimation of Farm Households' Choice to Off-farm Engagements: The estimation of the probability equation for households' choice to off-farm engagements is performed under different distributional assumptions. Interpretation is made based on the Probit results as the purpose of reporting Logit and LPM results is to make references if the Probit distributional assumption is somewhat insufficient. Apparently, Probit/Logit is a non-linear estimation technique that makes direct interpretation of coefficient estimates implausible. So, the reported coefficient estimates are marginal effects and interpretation is based on these marginal effects computed at mean values of observed quantities.

The estimated model relates land farm households' choice of off-farm engagement to a long –list of socio-political and economic factors which we systematically grouped them into household characteristics, human capital variables, farm characteristics and wealth variables, risk and financial conditions, labour market conditions and socio-political capital indicator variable (table 4.1). By implication, the choice to participate in off-farm work is thus modelled to depend on factors that influence the marginal value of time; factors related to off-farm work opportunities; and any associated with working off-farm.

The estimation result is presented in Table 4.2 in which coefficient estimates are organized in three columns corresponding to the three alternative distributional assumptions made. As it can be read directly from the table, the first column captures estimation result from the LPM which does not consider the density function. The second column captures the estimation result from the Logit model while the last column captures estimation results from the Probit model.

Table 4.2: Choice of Off-farm Engagement: LPM, Logit and Probit Model Results

The Probability to Off-farm Engagements:	(1) LPM	(2) Logit	(3) Probit
Dummy for socio-political capital	0.2134***	0.4482**	0.4171***
	(0.0628)	(0.1392)	(0.1196)
Sex of the household head	- 0.2458	- 0.5614***	- 0.5763***
	(0.1322)	(0.0901)	(0.0711)
Average age of earning members in years^	- 0.4133	- 3.0895	- 2.9733
	(0.8349)	(2.8457)	(2.2956)
Squared average age of earning members^	0.1982	1.5249	1.4841
	(0.4187)	(1.5841)	(1.2618)
Household size in adult equivalence	0.0286	0.1779	0.1621*
	(0.0341)	(0.0997)	(0.0792)
Number of children members	0.0022	- 0.0042	- 0.0030
	(0.0263)	(0.0764)	(0.0634)
Farm experience in years^	- 0.0176	- 0.0654	- 0.0644
	(0.0437)	(0.1861)	(0.1645)
Literacy status of the household head	0.0933	0.2981	0.2812
	(0.0647)	(0.2037)	(0.1627)
Average years of schooling for earning members	0.0013	- 0.0144	- 0.0155
	(0.0131)	(0.0455)	(0.0336)
Farm size in hectares^	0.1486*	0.6447*	0.5925**
	(0.0674)	(0.2882)	(0.2239)
On-farm productivity indicator^	- 0.0013	- 0.1832	- 0.1747
	(0.0698)	(0.2020)	(0.1582)
Livestock wealth in tropical livestock unit	- 0.0017	- 0.0005	- 0.0005
	(0.0057)	(0.0173)	(0.0141)
Farm debt at the beginning of 2012 in ETB	0.00007***	0.0002***	0.0002***
	(0.00002)	(0.00006)	(0.00005)
Dummy for high level of intensification	- 0.1723	- 0.4494***	- 0.4583***
	(0.0898)	(0.1364)	(0.1092)
Dummy for low level of intensification	0.0027	- 0.0712	- 0.0712
	(0.0220)	(0.0793)	(0.0584)
Weighted average quality of land (risk1)	0.0272	0.2400	0.2359
	(0.0619)	(0.2068)	(0.1649)
Number of crops cultivated (risk2)	- 0.0491*	- 0.1250*	- 0.1157*
	(0.0232)	(0.0625)	(0.0514)
Non-labour income from other sources in ETB	- 0.0001***	- 0.0005***	- 0.0005***
	(0.00003)	(0.0001)	(0.00008)
Computed debt-asset ratio^	0.0260	0.1811	0.1373
	(0.0698)	(0.2271)	(0.1942)
Distance to the nearest town in kilometers	0.0165*	0.0364*	0.0333*
	(0.0066)	(0.0182)	(0.0146)
Number of reported job opportunities	0.1572***	0.4626***	0.4182***
	(0.0233)	(0.0843)	(0.0625)
Constant	0.4817	7.3312	4.2704
	(0.7644)	(10.1413)	(5.2315)
Log likelihood		- 41.6766	- 41.3611
Wald's Chi square		105.9465	134.1474

No of observations =184; Marginal effects; Standard errors in parentheses; (dy/dx) are for discrete change from 0 to 1for dummy variables; ^ Logarithmic transformation applied; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As it can be clearly observed from the above table, we got a substantial gain in efficiency under the Probit model compared to the alternative model assumptions. In particular, the results of the model are quiet different when estimated using the linear probability model compared to the remaining two. While the estimated coefficients mostly have the same sign, there is a considerable difference in magnitude. More so, the estimated standard errors are much larger when the model is estimated using the Logit and Linear probability models. For heteroscedasticity may be a possible specification problem in estimating a Probit model, on one hand, and in line with the established estimation procedures, on the other hand, heteroscedasticity as a specification problem is considered before advancing to the interpretation of results and hypothesis testing.

In fact, it is noteworthy to reckon the problems that heteroscedasticity may cause in Probit and Logit models, unlike the Linear Probability Model, in that the conditional mean, beside the conditional variance, may be subject to the effects such a specification problem as heteroscedasticity may cause (Green, 2003). Despite the fact that robust standard errors can be used (reported) as a remedy to correct the problem of heteroscedasticity, the estimated conditional mean function will remain inconsistent in this case. For this reason, we re-estimate a version of the Probit model that parameterizes the variance to be a function of observables – specifically distance to the nearest market – after a considerable examination of possible sources of heteroscedasticity. Hence, the heteroscedastic Probit model is estimated in which the variance is modeled to vary as a function of the variable – distance to the nearest market – an observed variable present in the data. Table 4.3 captures the estimated heteroscedastic Probit model on which further discussion and hypothesis testing is based.

Table 4.3 Estimation Results of the Heteroscedastic Probit Model

Household Off-farm Engagement	Marginal Effects	ln(sigma square)
Dummy for socio-political capital	0.9612***	
	(0.1108)	
Sex of the household head	- 0.7679*	
	(0.3230)	
Average age of earning members in years^	- 36.6539	
	(18.9509)	
Squared average age of earning members^	20.8873*	
	(9.8604)	
Household size in adult equivalence	1.0106	
	(0.6317)	
Number of children members	0.1813	
	(0.3483)	
Farm experience in years^	- 2.7547*	
	(1.2817)	
Literacy status of the household head	0.7626	
	(0.4097)	
Average years of schooling for earning members	0.0265	
	(0.2475)	
Farm size in hectares^	4.7546**	
	(1.8427)	
On-farm productivity indicator^	- 0.5238	
	(1.2663)	
Livestock wealth in tropical livestock unit	- 0.0340	
	(0.0534)	
Farm debt at the beginning of 2012 in ETB	0.0015***	
	(0.0004)	
Dummy for high level of intensification	- 0.7641*	
	(0.3226)	
Dummy for low level of intensification	- 0.4339	
	(0.4596)	
Weighted average quality of land (risk1)	1.7841*	
	(0.8573)	
Number of crops cultivated (risk2)	- 0.9586**	
	(0.3628)	
Non-labour income from other sources in ETB	- 0.0025*	
	(0.0011)	
Computed debt-asset ratio^	2.1819*	
	(0.8998)	
Distance to the nearest town in kilometers	0.0580	0.0580***
	(0.1515)	(0.1515)
Number of reported job opportunities	1.9899**	
	(0.6824)	
Log likelihood	- 31.8539	
Wald's chi2	20.8087	

No of observations = 184; Marginal effects; Standard errors in parentheses; (dy/dx) are for discrete change from 0 to 1for dummy variables; ^ Logarithmic transformation applied; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The assumed heteroscedastic Probit model performs better with more gain in efficiency compared to the standard Probit estimates. The set of household characteristics (including age, sex, household size number of children and farm experience) are related to the households' capacity to diversify into the off-farm economy by supplying a positive number of labor days. The results indicate that male-headed land farm households are less likely to diversify to the off-farm economy than female-headed households while the number of children and household size appeared to have no causal effect on the choice of farm households' off-farm engagement.

Farm experience significantly and negatively influences land farm households' choice to diversify into the off-farm economy implying that the likelihood of diversifying into off-farm engagements is high for households with lower farm experience. This result is in line with our expectation. On the other hand, the result does not support for a quadratic relationship between the choice to off-farm engagements and the average age of earning members. We expected a humped-shaped life-cycle profile with a positive relationship for younger land farm households and negative for older ones. The result however supports a positive relationship only at later stages of the life cycle. This contradicts the well-established empirical result in the burgeoning literature.

From among the human capital variables considered, the estimation result does not support the long-held view and empirical evidence in that none of the two indicators are significant. In fact, the relationship appeared to be positive for both indicators – literacy status of the household head and average years of schooling for earning members – though not significant. Estimation results on the other set of factors – farm size, farm debt and high level of farm intensification, on-farm productivity, low level of farm

intensification and livestock wealth – shows that some (farm size, farm debt and high level of farm intensification) of farm characteristics and household wealth variables have a significant effect on farm households' choice to engage in off-farm activities. The remaining indicators do not significantly affect households' choice to off-farm activities.

The positive significant effect of farm size on the probability of diversifying into the off-farm economy contradicts the view that the likelihood of off-farm engagements is high for landless households and/or households with insufficient landholding. The positive significant effect of farm debt appeared to support our expectation that increasing and accumulated farm debt may induce more labour days in general and off-farm engagements in particular, with a farm income failing short to pay debts. Similarly, the negative significant effect of high level of farm intensification supports our expectation in that households with high level of farm intensification may realize higher productivity and/or the intensification may demand more labour days throughout the year. In effect, high intensification farm households may decide to stay on their own farm than supplying labour days to the off-farm economy. Compared to the non-intensifying farm households, the probability of diversifying into the off-farm economy is low for high intensification land farm households.

Estimation results on the other set of factors – weighted average quality of land, number of crops cultivated, non-labour income and household indebtedness – indicated that risk behavior and financial conditions of farm households does significantly influence land farm households' choice to engage in off-farm activities. The significant positive effect of the first risk indicator – weighted average quality of land – on the probability of off-farm engagement is in line with our expectation in that farm households with a good

quality landholding may exercise less risk behavior, in effect, a low likelihood of diversifying into the off-farm economy by supplying labour off the farm. Again, the significant negative effect of the second indicator – number of cultivated crops – supports the proposition that farm households cultivating several crops are less likely to engage in off-farm activities if high risk behavior farm households tackle unforeseen income (output) shocks through multiple cropping.

Similarly, the significant negative effect of the first indicator for households' financial conditions – non-labour incomes – indicates the (negative) income effect on the optimal choice of labour days in general and off-farm work in particular. Indeed, this result supports the expectation carried on in the literature of time allocation. In the same vein, the significant positive effect of the second indicator – indebtedness of households – supports the expected positive effect of financial obligations on farm households' labour market choices in that the probability to engage in off-farm activities appeared to be high for highly indebted households as expected. Under conditions of accumulating household debt because of both productive and non-productive borrowings, on one hand, and insufficient return from farm production to settle household debts, on the other hand, the financial stress induces more days of labour in general and off-farm days in particular.

Results on the last set of factors – distance to the nearest market and number of reported job opportunities created – show that labour market conditions are equally important determinants of the farm households' choice to diversify into the off-farm economy. The reported number of job opportunities created has a significantly positive effect on the probability of off-farm engagement by land farm households while distance to the nearest market does not. Finally, the estimation result on the socio-political capital variable, as it

is already defined in the methodological chapter, indicates that farm households' socio-political capital has a significant positive effect on the probability of households' off-farm engagement. Hence, land farm households with some socio-political capital are likely to diversify into the off-farm economy than households with no such a capital – this is an interesting result!

In subsequent paragraphs, the interest lies on testing the joint significance of factors under the different groups (sub-groups) that we itemized for analytical and interpretation purposes. We perform (simple) joint significance tests on the socio-political capital, household characteristic indicators, human capital variables, farm characteristic indicators, risk indicators, financial condition indicators and indicators of the labour market condition. Table 4.4 summarizes results from Wald Test and Log likelihood Ratio test procedures as in what follows.

Table 4.4: Hypothesis Testing (Summary of Results)

(Simple) Joint Linear Restriction	Wald Test		LR test	
	Wald Chi2	Prob > chi2	LR chi2	Prob > chi2
Socio-political capital	chi2(1) = 9.35	0.002	LR chi2(1) = 9.31	0.002
Household characteristics	chi2(6) = 20.74	0.002	LR chi2(6) = 12.73	0.047
Human capital variables	chi2(2) = 3.24	0.198	LR chi2(2) = 2.83	0.243
Farm characteristics	chi2(6) = 31.03	0.000	LR chi2(6) = 29.51	0.000
Risk characteristics	chi2(2) = 6.54	0.038	LR chi2(2) = 6.89	0.032
Financial conditions	chi2(2) = 33.03	0.000	LR chi2(2) = 34.59	0.000
Labour market conditions	chi2(2) = 46.19	0.000	LR chi2(2) = 48.07	0.000

The summary of test results from the two test procedures unequivocally entails us that all analytical groups and/or sub-groups of factors are significant determinants of land farm

households' choice to off-farm engagements except the human capital variables. For example, factors that we analytically outlined and grouped under farm household characteristics are jointly significant determinants of households' choice to off-farm engagement despite the fact that family size and number of children, among others, appeared insignificant separately.

More so, other analytical groups of factors including farm characteristics, risk characteristics, financial conditions, socio-political capital and labour market conditions are jointly significant in explaining farm households' choice to off-farm engagements. However, we failed to reject the null of no significant effect on farm households' choice to off-farm work (of human capital variables) based on both test procedures. Even though the empirical evidence regarding the impact of human capital on households' choice to off-farm engagements usually goes either way, estimation results appeared to contradict our expectations and the broader theoretical assertion of significant positive effect.

4.3.2 The Level of Off-farm Engagements by Farm Households

In this section, the aim of the analysis is to estimate the extent of farm households' engagement in off-farm activities. This is accomplished by estimating the days of off-farm work and earnings from off-farm engagements. As a prelude to the estimation, a detailed summary (exploration) of days of off-farm engagement and off-farm earnings are considered and it provide us with useful insights into the potential problems that may arise in estimating the parametric tobit model with a linear conditional mean function. One of the important insights is that the dependent variables – off-farm days and off-farm earnings – are heavily skewed and with a considerably non-normal kurtosis.

After an attempt is made as to whether the problem is because of skewed regressors, a lognormal transformation is considered appropriate to avoid the possibility of ending up with flawed estimates. Such exploration of data and distribution of variables is performed to all variables we considered in estimation.

4.3.2.1 Tobit Estimation of Off-farm Days and Earnings

It is noteworthy to reckon that the choice of an appropriate empirical specification and estimation depends heavily on the conceptualization and assumptions made about zero-valued observations. Methodologically, there are two general ways to treat the zeros in empirical specification and estimation: (1) to just assume that households have no opportunities to participate in the off-farm activities and that is actually why we observed zero off-farm earnings; (2) to assume that this zero is a decision variable reflecting that households had the chance and the opportunity to engage in off-farm activities to secure some earnings but decided not to engage by choice – implying a corner solution model.

In this study, the analysis totally relied on the tobit model specification by characterizing those zero-valued observations of off-farm days (labour supply) and off-farm earnings (income) as the corner solutions that are optimal from the households' perspective. This is made clear from the analytical framework while deriving the testable implications from the theoretical model. So, zero-valued outcomes are modelled as though they emerged from a self-truncating process. Under the tobit model assumptions, the same set of variables determine both the probability that land farm households choice to diversify into the off-farm economy – an observation will be censored; and the number of off-farm days and the amount of earning from such engagements.

More so, the tobit model imposes a structure that implies the same set of variables determining the probability of non-zero observations explain the level of positive observation with the same algebraic sign. Hence, the same list of socio-economic and political factors used to explain the probability of farm households' choice to off-farm activities are used to explain the intensity of land farm households' off-farm engagement in terms of annual days of off-farm work and earnings from such off-farm days.

The standard method to estimate such censored regression models in the literature is maximum likelihood tobit estimation (MLE) due to Tobin (1978). However, the departure of errors from assumptions of homoscedasticity and normality provided the underlying motivations to later methodological developments and what actually makes parametric tobit estimates less attractive compared to emerging alternatives. Estimates are inconsistent under the conditions of heteroscedasticity and non-normality. Assumptions of homoscedasticity and normality do not hold in most of the applications using survey data. Further developments provided semiparametric alternatives to parametric tobit analysis including the symmetrically censored least square and censored least absolute deviation estimators that are due to and based on Powell (1984, - 86). Both estimators are attractive for they are robust against departures of the errors from assumptions of homoscedasticity and normal distribution.

Because the presence of such alternative estimators calls for thorough specification evaluation to choose among them in practical research work, to make comparison otherwise, we considered several tests and estimators. In fact, one strand of the scholarly work informs us to use all the three alternative estimators to empirically estimate the censored regression model of interest. This is argued to informally compare the point

estimates of alternative estimators if the difference between them is large in terms of economic implications of the difference. The other approach entails us to perform formal specification testing based on tobit estimates if there are departures from assumptions of normality and homoscedasticity (of errors).

More so, the Hausman (1978) test approach is argued to detect misspecification that are quiet serious in causing large point estimate differences. Hausman (1978) test evaluates if the difference between the point estimates (if assumptions of homoscedasticity and normality are not met) is statistically important. However, we ignored the Hausman test as small sample experiments suggest reliance on conditional moment tests and an informal comparison of point estimates for specification evaluation (Wilhelm, 2010).

In accordance with the literature and the methodological developments, we estimate off-farm days and off-farm earnings with the standard tobit specification first which is presented below {Table 4.5 and Table 4.6, respectively}. Then, several specification tests based on conditional moments (conditional moment test) and generalized residuals of the censored tobit regression (Lagrange multiplier test) are performed and presented seeking for consistent tobit estimates. Based on the implications of the specification tests, we then employed Powell's censored least absolute deviation and symmetrically censored least square estimators. This is primarily sought to address non-normality and heteroskedasticity of errors implied from specification tests implemented after the estimation of the parametric tobit model. Table 4.5 and Table 4.6 present the MLE of parametric tobit model for off-farm days and earnings, respectively.

Table 4.5: Off-farm Days – Estimation Results of the Standard Tobit Model

Off-farm days	Marginal effects			
	(1)	(2)	(3)	(4)
	E{y* | x}	**E{y | x}**	**E{y | x, y > 0}**	**Pr{y > 0 | x}**
Dummy for socio-political capital	1.3228***	0.9554***	0.6820***	0.2289***
	(0.3717)	(0.2564)	(0.1803)	(0.0691)
Sex of the household head	- 3.3120***	- 2.8855***	- 2.3226***	- 0.3284[a]
	(0.9578)	(0.6607)	(0.4644)	(0.1779)
Average age of earning members in years^	- 19.0814[a]	- 13.1626[a]	- 9.2528[a]	- 3.5447[a]
	(11.0410)	(7.6163)	(5.3539)	(2.0511)
Squared average age of earning members^	9.8471[a]	6.7927[a]	4.7749[a]	1.8293[a]
	(5.5124)	(3.8025)	(2.6730)	(1.0240)
Household size in adult equivalence	0.2620	0.1807	0.1270	0.0487
	(0.2546)	(0.1756)	(0.1235)	(0.0473)
Number of children members	0.1203	0.0830	0.0583	0.0223
	(0.1941)	(0.1339)	(0.0941)	(0.0361)
Farm experience in years^	- 0.2580	- 0.1780	- 0.1251	- 0.0479
	(0.4567)	(0.3151)	(0.2215)	(0.0848)
Literacy status of the household head	0.7364	0.5071	0.3575	0.1361
	(0.4481)	(0.3091)	(0.2173)	(0.0832)
Average years of schooling-earning members	0.0328	0.0226	0.0159	0.0061
	(0.0979)	(0.0675)	(0.0475)	(0.0182)
Farm size in hectares^	1.4205	0.9799	0.6888	0.2639
	(1.0836)	(0.7475)	(0.5255)	(0.2013)
On-farm productivity indicator^	- 0.1852	- 0.1277	- 0.0898	- 0.0344
	(0.4752)	(0.3278)	(0.2304)	(0.0883)
Livestock wealth in tropical livestock unit	- 0.0066	- 0.0046	- 0.0032	- 0.0012
	(0.0447)	(0.0309)	(0.0217)	(0.0083)
Farm debt at the beginning of 2012 in ETB	0.0005***	0.0004***	0.0002***	0.0001***
	(0.0001)	(0.00008)	(0.00005)	(0.00002)
Dummy for high level of intensification	- 1.2961*	- 0.7721*	- 0.5479*	- 0.2593*
	(0.5816)	(0.4012)	(0.2820)	(0.1081)
Dummy for low level of intensification	- 0.1405	- 0.0969	- 0.0681	- 0.0261
	(0.1499)	(0.1034)	(0.0727)	(0.0279)
Weighted average quality of land (risk1)	0.5846	0.4033	0.2835	0.1086
	(0.4433)	(0.3058)	(0.2149)	(0.0823)
Number of crops cultivated (risk2)	- 0.3569*	- 0.2462*	- 0.1730*	- 0.0662*
	(0.1526)	(0.1052)	(0.0740)	(0.0283)
Non-labour income n ETB	- 0.0015***	- 0.0010***	- 0.0007***	- 0.0003***
	(0.0002)	(0.0002)	(0.0001)	(0.00004)
Computed debt-asset ratio^	- 0.0918	- 0.0633	- 0.0445	- 0.0171
	(0.7126)	(0.4915)	(0.3455)	(0.1324)
Distance to the nearest town in kilometers	0.0856*	0.0591*	0.0415*	0.0159*
	(0.0422)	(0.0291)	(0.0204)	(0.0078)
Number of reported job opportunities	1.2685***	0.8750***	0.6151***	0.2356***
	(0.1518)	(0.1047)	(0.0736)	(0.0282)
Constant	0.6358	0.4386	0.3083	0.1181
	(5.0463)	(3.4810)	(2.4470)	(0.9374)
Log Likelihood	- 237.556	-	-	-
Chi Square	192.560	-	-	-

No of obs. =184; Marginal effects; Standard errors in parentheses; (dy/dx) are for discrete change from 0 to 1for dummy variables; ^ Logarithmic transformation applied; [a] $p < 0.09$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.5 (above) and 4.6 (below) presented estimation results relating off-farm days and off-farm earnings by farm households to several factors that determine the level of off-farm days and off-farm earnings based on the parametric tobit model. As it is already discussed in the preceding sections, the results are obtained under a strong, for that matter unknown, distributional assumptions of normality and homoscedasticity. To ensure the reliability (consistency and efficiency) of the tobit estimates and to make meaningful inference thereby, several specification tests are performed. In the first place, we specifically evaluate the underlying assumptions of normality and homoscedasticity to ensure correct specification of the model and hence consistent tobit estimates. Then, a general test of the parametric tobit specification is considered to ensure its adequacy.

Practically, the Lagrange Multiplier (score) test of heteroscedasticity and non-normality is found appealing as it only requires the estimation of a model under the hypothesis of normality and homoscedasticity. Accordingly, the Lagrange Multiplier test is performed after the tobit estimation besides the usual conditional moment test. The test statistic for the Lagrange Multiplier test is a quadratic form calculated, among others, using auxiliary regression and is developed with the generalized residuals of the censored regression – in this case the parametric tobit estimation of the off-farm days and earnings. A similar approach is used to perform a conditional moment test that is due to Pagan and Vella (1989). Following Skeels and Vella (1999), who built on the work of Newey (1985) and Tauchen (1985), we implemented the conditional moment test for the null hypothesis that the disturbances in a tobit model have a normal distribution. Parametric bootstrapping is applied and bootstrap critical values are used to correct size distortion of the test as it has reasonable power for large samples with bootstrap critical values Drukker (2002).

Table 4.6: Off-farm Earnings – Estimation Results of the Standard Tobit Model

Off-farm Earnings:	Marginal effects			
	(1)	(2)	(3)	(4)
	E{y* | x}	**E{y | x}**	**E{y | x, y > 0}**	**Pr{y > 0 | x}**
Dummy for socio-political capital	2.6966***	1.9512***	1.3940***	0.2331***
	(0.7406)	(0.5115)	(0.3596)	(0.0689)
Sex of the household head	- 6.6780***	- 5.8278***	- 4.7004***	- 0.3286a
	(1.9023)	(1.3139)	(0.9237)	(0.1769)
Average age of earning members in years^	- 37.1633a	- 25.6679	- 18.0455	- 3.4563
	(22.0096)	(15.2016)	(10.6873)	(2.0469)
Squared average age of earning members^	19.2494a	13.2952 a	9.3470 a	1.7902 a
	(10.9860)	(7.5878)	(5.3345)	(1.0217)
Household size in adult equivalence	0.5951	0.4110	0.2890	0.0553
	(0.5063)	(0.3497)	(0.2459)	(0.0471)
Number of children members	0.2466	0.1703	0.1197	0.0229
	(0.3869)	(0.2672)	(0.1879)	(0.0360)
Farm experience in years^	- 0.4386	- 0.3029	- 0.2130	- 0.0408
	(0.9160)	(0.6327)	(0.4448)	(0.0852)
Literacy status of the household head	1.5294a	1.0545 a	0.7435 a	0.1415 a
	(0.8916)	(0.6158)	(0.4329)	(0.0829)
Average years of schooling-earning members	0.0253	0.0175	0.0123	0.0024
	(0.1949)	(0.1346)	(0.0946)	(0.0181)
Farm size in hectares^	2.8975	2.0012	1.4069	0.2695
	(2.1579)	(1.4904)	(1.0478)	(0.2007)
On-farm productivity indicator^	- 0.5148	- 0.3556	- 0.2500	- 0.0479
	(0.9442)	(0.6522)	(0.4585)	(0.0878)
Livestock wealth in tropical livestock unit	0.0116	0.0080	0.0057	0.0011
	(0.0880)	(0.0608)	(0.0427)	(0.0082)
Farm debt at the beginning of 2012 in ETB	0.001***	0.0007***	0.0005***	0.0001***
	(0.0002)	(0.0002)	(0.0001)	(0.00002)
Dummy for high level of intensification	- 2.6664*	- 1.5826*	- 1.1241*	- 0.2674*
	(1.1591)	(0.8006)	(0.5628)	(0.1078)
Dummy for low level of intensification	- 0.2813	- 0.1943	- 0.1366	- 0.0262
	(0.2985)	(0.2062)	(0.1449)	(0.0278)
Weighted average quality of land (risk1)	1.0288	0.7106	0.4996	0.0957
	(0.8808)	(0.6083)	(0.4277)	(0.0819)
Number of crops cultivated (risk2)	- 0.7738*	- 0.5344*	- 0.3757*	- 0.0720*
	(0.3043)	(0.2102)	(0.1477)	(0.0283)
Non-labour income n ETB	- 0.0029***	- 0.0020***	- 0.0014***	- 0.0003***
	(0.0005)	(0.0004)	(0.0003)	(0.00004)
Computed debt-asset ratio^	- 0.4348	- 0.3003	- 0.2111	- 0.0404
	(1.4455)	(0.9984)	(0.7019)	(0.1344)
Distance to the nearest town in kilometers	0.1647*	0.1138*	0.0800*	0.0153*
	(0.0839)	(0.0579)	(0.0407)	(0.0078)
Number of reported job opportunities	2.4024***	1.6593***	1.1665***	0.2234***
	(0.3014)	(0.2082)	(0.1464)	(0.0280)
Constant	2.3335	1.6117	1.1331	0.2170
	(10.0668)	(6.9529)	(4.8889)	(0.9362)
Log likelihood	- 305.1649	-	-	-
chi2	188.9249	-	-	-

No of obs. =184; Marginal effects; Standard errors in parentheses; (dy/dx) are for discrete change from 0 to 1for dummy variables; ^ Logarithmic transformation applied; a ***p*** < 0.10, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.7 presents a summary of test results and reference is made in subsequent discussions. Both the Lagrange Multiplier and Conditional Moment tests are first implemented to test the null hypothesis of normal distribution for model errors. The conditional moment test returns a conditional moment value of 70.074 and 70.413, respectively, for the off-farm days and off-farm earnings models which is significant at 5 percent bootstrap critical value and suggests the rejection of the null hypothesis. Similarly, the Lagrange Multiplier test returns a test statistic of 70.074 and 70.413, respectively, for off-farm days and earnings which is significant at 5 percent bootstrap critical value and reaffirms the rejection of the null – errors are not normally distributed.

Table 4.7: Summary of Specification Tests

Off-farm days	CM/LM Test			
	Bootstrap Critical Values			
	CM/LM *	10%	5%	1%
CM test against the Null of Normal Errors	70.074	16.073	21.836	39.978
LM test of Tobit Specification	144.130	4.244	6.463	14.113
	LM Test			
	NR^2		P > Chi2	
LM test against the Null of Normal Errors	70.074		0.029	
LM test against the Null of Homoscedastic Errors	78.069		0.000	

Off-farm earnings	CM/LM Test			
	Bootstrap Critical Values			
	CM/LM *	10%	5%	1%
CM test against the Null of Normal Errors	70.413	17.075	23.874	36.424
LM test of Tobit Specification	148.07	4.353	6.482	13.743
	LM Test			
	NR^2		P > Chi2	
LM test against the Null of Normal Errors	70.413		0.025	
LM test against the Null of Homoscedastic Errors	83.764		0.000	

Note: CM – conditional moment; LM – Lagrange multiplier; N-sample size; R^2 – uncentered r-square. NR^2– from the uncentered regression has chi-squared distribution; P– p-value; * – test statistic

Then, the Lagrange Multiplier test is implemented against the null hypothesis of homoscedastic errors. It returns a test statistic of 78.069 and 83.764, respectively, for off-farm days and earnings which is significant at 1 percent bootstrap critical value. The result suggests a strong rejection of the null of homoscedastic errors in that model errors are not homoscedastic in their distribution.

Having these test results on the distribution of disturbances, we stepped into testing if the parametric tobit specification is adequate to estimate off-farm days and off-farm earnings in which we lend much from Vincent and Packard (2010). We implemented the Lagrange Multiplier (LM) test of the tobit specification that computes a Lagrange Multiplier statistic for testing the parametric tobit specification against the alternative of a model that is non-linear in the regressors and contains an error term that can be heteroscedastic and non-normally distributed. The test is carried out by taking a Box-Cox transformation of the dependent variable $\left\{\frac{Y^{(\lambda)-1}}{\lambda}\right\}$ and testing whether the parameter $\lambda = 1$.

A rejection of the null suggests that the parametric tobit specification is unsuitable as an alternative value for λ would be required to return the linearity, homosckedasticity and normality assumptions that are necessary for consistent estimates. Critical values are obtained via the parametric bootstrap where the regressors are assumed to be stochastic. The LM test of the tobit specification returns a test statistic of 144.13 and 148.07 respectively for off-farm days and off-farm earnings which is significant at 1 percent bootstrap critical value. It suggests a rejection of the null with the conclusion that the parametric tobit specification is unsuitable to estimate the off-farm days and earnings.[12]

[12] Note that estimation is performed presuming exogenous regressors. This has to do with the empirical strategy we implied. We specified a reduced-form equation in which exogeneity can be fairly thought.

4.3.2.2 Semi-parametric Estimates of Off-farm Days and Earnings

The inconsistency problem that the standard maximum likelihood estimator for tobit model suffered due to non-normal and heteroscedastic errors, on the one hand, and the rejection of the parametric tobit specification to adequately model off-farm days and earnings, on the other hand, gave ways to the semiparametric censored regression estimators – symmetrically censored least square (SCLS) and censored least absolute deviation estimators (CLAD). Following suggestions of Powell (1986), censored dependent variable model can be estimated by iteratively trimming the dependent variable around the regression function with a view to arrive at the final re-censored dependent variable that is symmetrically distributed around the estimated regression function. The estimators thus obtained will be consistent and symmetrically normal for a wide group of symmetric errors suffering from heteroscedasticity of an unknown form. Similarly, the CLAD estimator is an alternative to maximum likelihood estimator in providing estimators that are robust to heteroscedasticity and non-normality.

At this conjecture, the intensity of off-farm engagements as operationalized by the off-farm days and off-farm earnings is estimated using CLAD and SCLS estimation. The estimation results of off-farm days and off-farm earnings, respectively, obtained from these estimators are presented along with the results from the ML estimator (parametric tobit) separately in subsequent tables (Table 4.8 and Table 4.9). Partly, the aim is to make comparisons from among the alternative estimators seeking for an adequate model specification. Basically, this helps to address possible cases in which the maximum likelihood estimates of the parametric tobit model becomes more efficient than semiparametric estimates despite the non-robustness to normality and heteroscedasticity.

And, semiparametric estimates may appear less efficient than parametric maximum likelihood estimates while they are robust to non-normality and/or heteroscedasticity.

Estimation Results for the Off-farm Days Model: Estimation results for the off-farm days model, below in Table 4.8, reveals that estimates are considerably different from among the alternative parametric MLE and semi-parametric estimators. Specifically, estimates of the semi-parametric SCLS and CLAD estimation appeared quite different from results of the MLE. Coefficient estimates diverge considerably among the three estimators while they have mostly the same algebraic sign. For instance, MLE coefficient estimates for 'reported number of job opportunities' is about 1.25, which is nearly twice as large as the CLAD coefficient estimate (0.75) while having the same sign.

More importantly, the estimated standard errors appeared to be much larger for the semi-parametric estimators when compared to the MLE. The important implication for estimation is that the true distribution of off-farm days is considerably asymmetric and heteroscedastic. This is apparent from the reported used number of observation in SCLS and CLAD estimation (139 and 127, respectively) after the required trimming reduced the full sample observation of 184 land farm households into the respective sub-samples. What is equally important in here is that the semi-parametric estimators poorly perform to a considerable degree in that the produced standard errors are much larger with a consequent huge loss in efficiency. Here is the cross-road, then. The ML parametric tobit estimates are already tested for the mis-specification problems of heteroscedasticity and non-normality which led us to the rejection of both homoscedasticity and normality. At the same time, these estimates appeared to be more efficient than the semi-parametric estimates (see Table 4.8). However, semi-parametric estimates are robust to mis-

specification problems of heteroscedasticity and non-normality. Because SCLS estimator appeared to perform the poorest; adhering to the estimator robust to problems of heteroscedasticity and non-normality; and compromising efficiency for robustness and consistency, interpretation is made based on estimates of the CLAD estimator.

The first result of the off-farm days model (Table 4.8) entails that land farm households with considerable socio-political capital, on average, allocates more days of their household labour to the off-farm economy in either of the income earning activities. The estimated coefficient suggests that possession of socio-political capital has a significant positive effect (at 5%) on the annual days of off-farm work for sample land farm households. This result supports our expectation that social capital and authority help land farm households access important information on financial and labour market conditions especially under circumstances of incomplete rural markets and less transparent local governance. In effect, farm households with such socio-political capital enjoy broader off-farm opportunities and more annual off-farm days under circumstances of fluctuating and unreliable farm income (production).

From among the household characteristics we considered, none of the variables appear to significantly influence the annual off-farm days of land farm households except the age variable (yet at 10% level of significance). The negative effect of average age of earning members on the annual days of off-farm work by land farm households does not however support our expectation. Nor does the positive effect of squared average age of earning members support our expectation of a humped-shaped effect on the annual off-farm days. Possible explanations will be offered in the ensuing section of the analysis.

Table 4.8: Parametric and Semi-parametric Estimators (off-farm days)

Off-farm days:	(1) Tobit	(2) CLAD	(3) SCLS
Dummy for socio-political capital	1.3229***	1.5461**	0.7968
	(0.3718)	(0.4929)	(0.5361)
Sex of the household head	- 3.3120***	-	- 1.7745
	(0.9578)		(4.1194)
Average age of earning members in years^	- 19.0814[a]	460.3021[a]	- 12.9730
	(11.0411)	(289.9679)	(23.2700)
Squared average age of earning members^	9.8471[a]	- 224.5113[a]	6.5493
	(5.5124)	(141.8938)	(10.6648)
Household size in adult equivalence	0.2620	0.3829	0.2339
	(0.2546)	(0.3290)	(0.3343)
Number of children members	0.1203	0.2552	0.0599
	(0.1941)	(0.2268)	(0.2094)
Farm experience in years^	- 0.2580	- 0.4792	- 0.2471
	(0.4567)	(0.9540)	(1.5655)
Literacy status of the household head	0.7364[a]	1.2319*	0.6342
	(0.4481)	(0.5677)	(0.6158)
Average years of schooling-earning members	0.0328	0.0509	0.0002
	(0.0979)	(0.0987)	(0.1072)
Farm size in hectares^	1.4205	1.0890	0.9973
	(1.0836)	(1.2194)	(1.0325)
On-farm productivity indicator^	- 0.1852	- 0.8604	- 0.3671
	(0.4752)	(0.6589)	(0.6591)
Livestock wealth in tropical livestock unit	- 0.0066	- 0.0157	0.0086
	(0.0447)	(0.0622)	(0.0532)
Farm debt at the beginning of 2012 in ETB	0.0005***	0.0004*	0.0004*
	(0.0001)	(0.0002)	(0.0002)
Dummy for high level of intensification	- 1.2961*	- 0.9785	- 0.5457
	(0.5816)	(0.8352)	(0.7929)
Dummy for low level of intensification	- 0.1405	- 0.2206	- 0.0846
	(0.1499)	(0.1687)	(0.1500)
Weighted average quality of land (risk1)	0.5846	0.7214	0.5002
	(0.4433)	(0.9808)	(0.4588)
Number of crops cultivated (risk2)	- 0.3569*	- 0.5466*	- 0.3053
	(0.1526)	(0.2271)	(0.2704)
Non-labour income n ETB	- 0.0015***	- 0.0012***	- 0.0013
	(0.0003)	(0.0009)	(0.0011)
Computed debt-asset ratio^	- 0.0918	- 0.9303	0.0497
	(0.7126)	(1.3664)	(0.6735)
Distance to the nearest town in kilometers	0.0856*	0.0106	0.0444
	(0.0422)	(0.0780)	(0.0561)
Number of reported job opportunities	1.2685***	0.7540*	0.8307*
	(0.1518)	(0.3121)	(0.3231)
Constant	0.6358	- 44.1288	4.8544
	(5.0463)	(31.1939)	(11.3955)
Log likelihood	- 237.56	-	-
Observations	184	127	139

Estimated coefficients; Standard errors in parentheses; (dy/dx) are for discrete change from 0 to 1for dummy variables; ^ Logarithmic transformation applied; [a] $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Parameter estimates associated with human capital variables are equally important in here. Estimation results suggest a statistically significant positive relationship between the literacy status of the household head and the annual days of off-farm engagements in either or all forms of off-farm activities. Land farm households with a literate decision making member (head) appeared to allocate more annual days of labour to the off-farm economy which supports our expectations. However, the average years of schooling for earning members does not significantly explain the annual days of off-farm engagements.

Results regarding the farm characteristics and wealth indicators show that none of the variables significantly explain farm households' annual days of off-farm engagements as we have expected except farm debt which appeared to have a significantly positive influence on the annual days of off-farm activities (at 5% level of significance). Thus, the results suggest that land farm households with an accumulating (high) level of farm debt allocates more days of household labour to the off-farm economy in either or all of the off-farm activities. This result has tremendous implications to the farm economy and state-sponsored programs which we discuss in the ensuing part of the analysis.

Similarly, the second risk indicator we used – number of crops cultivated – has a significantly negative effect on the annual days of off-farm engagements (at 5% level of significance) while the first indicator – weighted average quality of land – does not have such a significant effect. As such, the result suggests that land farm households with high risk behaviour allocates more days of the household labour to off-farm engagements as we have expected. To put it differently, the significant negative relationship between number of crops cultivated and households' annual days of off-farm work suggests that the propensity of high risk behaviour households to allocate more days of labour to the

off-farm economy becomes low as the number of crops cultivated increase which in effect reduces the risk of farm households.

More so, non-labour income and household indebtedness are included in the off-farm days model to capture the influence of financial conditions on annual days of off-farm work. The results suggest that non-labour income has a significant negative impact on the annual days of off-farm work by land farm households (1% level of significance) while the indebtedness index does not. The significant negative effect of non-labour income on annual days of off-farm work suggests that land farm households prefer to allocate less days of household labour to the off-farm economy as amount of non-labour income they enjoyed increase as expected.

Distance to the nearest market and self-reported number of job opportunities are the last set of factors included in the off-farm days model to capture labour market conditions as determinants of the annual days of off-farm engagement by land farm households. Estimation results suggest a significant positive relationship between the self-reported numbers of job opportunities and the annual days of off-farm engagements by land farm households while distance to the nearest market does not have any relationship. Based on the results and as we have expected, the annual days of off-farm work by land farm households significantly increases with an increasing number of job opportunities created and made available in the rural economy. This result has important implication to discuss which is included as part of the next section.

Estimation Results for the Off-farm Earnings Model: Estimation results for the off-farm earnings model, below in Table 4.9, shows that estimates considerably vary across the alternatives of parametric maximum likelihood estimator (MLE) and semi-parametric estimators. Specifically, estimates of the semi-parametric estimations appeared significantly different from among themselves (CLAD and SCLS) and from results of the MLE. The magnitude of coefficient estimates still diverges considerably across the three estimators used while they have mostly the same algebraic sign except for few continuous variables. For instance, the coefficient estimate for 'reported number of job opportunities' using MLE is about 2.4 while it is 2.0 using CLAD with positive sign.

What is more important in here is that the standard errors produced by the semi-parametric estimators, specifically SCLS, appeared to be much larger when compared to the remaining estimators. However, standard errors produced from CLAD seemed inconclusive in the sense that they go either way when compared to MLE. In some cases, CLAD estimates appeared to have lower standard errors than MLE. Yet, one important implication of these comparisons is that the true distribution of off-farm earnings is considerably asymmetric and heteroscedastic.

This can be further supported by the reported used number of observation in SCLS and CLAD estimation (141 and 128, respectively) after the trimming process reduced the full sample observation of 184 land farm households into the respective sub-samples. What is equally important in here is that SCLS perform extremely poor in that the produced standard errors are much larger with an almost complete loss of efficiency.

Table 4.7: Parametric and Semi-parametric Estimators (Off-farm earnings)

Off-farm earnings:	(1) Tobit	(2) CLAD	(3) SCLS
Dummy for socio-political capital	2.6966***	2.7454***	1.6396
	(0.7406)	(1.0452)	(1.1350)
Sex of the household head	- 6.678***	-	- 3.4968
	(1.9023)		(8.5566)
Average age of earning members in years^	- 37.1633*a*	- 62.8275	- 24.3986
	(22.0096)	(359.9523)	(47.5173)
Squared average age of earning members^	19.2494*a*	31.5430	12.3552
	(10.9860)	(176.0942)	(21.7693)
Household size in adult equivalence	0.5951	0.2570	0.5369
	(0.5063)	(0.5438)	(0.7322)
Number of children members	0.2466	- 0.5738*a*	0.1191
	(0.3869)	(0.3435)	(0.4569)
Farm experience in years^	- 0.4386	2.3914*a*	- 0.4190
	(0.9160)	(1.3718)	(3.2195)
Literacy status of the household head	1.5294*a*	1.7666*a*	1.2789
	(0.8916)	(0.9300)	(1.2596)
Average years of schooling-earning members	0.0253	0.2401	- 0.0495
	(0.1949)	(0.1796)	(0.2238)
Farm size in hectares^	2.8975	0.6888	2.0367
	(2.1579)	(1.7237)	(2.1316)
On-farm productivity indicator^	- 0.5148	3.5932**	- 0.8578
	(0.9442)	(1.0630)	(1.2896)
Livestock wealth in tropical livestock unit	0.0116	0.2795*	0.0398
	(0.0880)	(0.1192)	(0.1645)
Farm debt at the beginning of 2012 in ETB	0.001***	0.0011***	0.0008*a*
	(0.0002)	(0.0004)	(0.0004)
Dummy for high level of intensification	- 2.6664*	- 0.2297	-1.2256
	(1.1591)	(1.6560)	(1.7417)
Dummy for low level of intensification	- 0.2813	- 0.1287	- 0.1928
	(0.2985)	(0.2413)	(0.2989)
Weighted average quality of land (risk1)	1.0288	0.9018	0.8373
	(0.8808)	(1.3866)	(0.9975)
Number of crops cultivated (risk2)	- 0.7738*	- 1.6416***	- 0.6923
	(0.3043)	(0.3042)	(0.5687)
Non-labour income n ETB	- 0.0029***	- 0.0043***	- 0.0025
	(0.0005)	(0.0016)	(0.0024)
Computed debt-asset ratio^	- 0.4348	- 1.0258	- 0.3108
	(1.4455)	(1.7531)	(1.4751)
Distance to the nearest town in kilometers	0.1647*	0.2081*a*	0.0833
	(0.0839)	(0.1175)	(0.1106)
Number of reported job opportunities	2.4024***	1.9969***	1.5293*
	(0.3014)	(0.5667)	(0.7019)
Constant	2.3335	48.5885	10.9052
	(10.0668)	(45.6677)	(23.2033)
Log likelihood	- 305.1649	-	-
Observations	184	128	141

Estimated coefficients; Standard errors in parentheses; (dy/dx) are for discrete change from 0 to 1for dummy variables; ^ Logarithmic transformation applied; *a* ***p*** < 0.10, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Generally, the CLAD estimates of the off-farm earnings model can be safely considered for two reasons. One, the estimates embrace some considerable level of efficiency comparable to the MLE. Two, because the SCLS estimator appeared to perform the poorest and seeking for the estimator robust to problems of heteroscedasticity and non-normality while still compromising the efficiency of robust estimates, CLAD estimates appeared reasonable to use.

Therefore, the parameter estimate associated with the first variable indicates that farm households' socio-political capital has a highly significant positive influence on their off-farm earnings from either of and/or all alternative forms of engagements off the farm. The positive significant effect of socio-political capital suggests that land farm households possessing such capital realize more annual off-farm earnings from one or more off-farm engagements. Such a significant positive relationship between farm households' socio-political capital and their annual off-farm earnings further strengthened the result obtained for annual off-farm days.

Likewise, estimation results for the second set of variables considered shows that none of the household characteristics has a significant effect on farm households' off-farm earnings under the presumed standard level of significance with a 95% confidence level. However, parameter estimates shows that the number of children has a negative influence on farm households' annual off-farm earnings at 10% significance level. The negative influence of the number of children suggests that land farm households having more child members realize less annual off-farm earnings under normal conditions as we have expected. More so, households' farm experience appeared to have a positive effect on their annual off-farm earnings at 10% significance level. Suggesting that households

with more years of experience in the farm industry realize more annual off-farm earnings, this result has important implication for livelihood diversification and the farm – off-farm nexus in so far as transforming the rural economy is put at the centre stage.

From among the human capital variables included in the model, average years of schooling for earning members does not significantly explain households' annual off-farm earnings which indeed consolidate the no relationship result for off-farm days model. Parameter estimates associated with the literacy status of the decision making member (head) however indicate a positive relationship with households' annual off-farm earnings, but at 10% significance level. The result suggests that land farm households managed by a literate head realized more annual off-farm earnings by diversifying into the off-farm economy.

Estimation results related to the farm characteristic variables indicates a significant positive relationship between the on-farm productivity index and farm households' off-farm earnings. The significant positive effect of on-farm productivity, unlike our expectation, suggests that land farm households realize more annual off-farm earnings by diversifying into the off-farm economy when their on-farm productivity improves. In the same vein, parameter estimates associated with farm debt show a significant positive relationship between farm debt and households' off-farm earnings. So, this significant positive influence of farm debt suggests that land farm households may realize more annual off-farm earnings as the magnitude of their farm debt mounts in tandem with expanding/intensifying farm operations. Similar result is obtained in the off-farm days model in which a significant positive relationship is found between the level of farm debt and the annual days of off-farm earnings.

The other equally important variable in the model is livestock wealth included to capture the possible effect of wealth on farm households' labour market behaviour. Parameter estimates entails a significant positive relationship between farm households' livestock wealth and their off-farm earnings at 5% significance level. As such, the result suggests that land farm households may realize more annual off-farm earning by diversifying into the off-farm economy as their livestock wealth increases in number/value.

Parameter estimates associated with the risk indicators in the off-farm earnings model entails a highly significant positive relationship between the risk behaviour of farm households and their off-farm earnings. So, the results suggest that land farm households may realize less annual off-farm earnings as their high-risk behaviour induce multiple cropping which in effect reduces the risk of farm income shortfall. The significant negative relationship between the number of crops cultivated and the annual off-farm earnings by land farm households in deed supports the analysis just outlined.

The last set of variables included in the off-farm earning model captures the financial and labour market condition in which farm households' make their choices. Estimation results associated with indicators of the financial condition entails a significant negative relationship between farm households' non-labour income and off-farm earnings. As such, the result suggests that land farm households may realize less annual off-farm earnings as the amount of their non-labour income increases in size. On the other hand, the parameter estimate of household indebtedness suggests no significant relationship while a significant positive relationship is obtained in the off-farm days model. Finally, estimation results suggest a significant positive relationship between the number of job opportunities created and annual off-farm earnings by land farm households.

4.4 Discussion of Results and Implications for Transformation

The simplified economic model of farm households (Figure: 2.1) presents a holistic relationship amongst the set of economic choices that farm households undertake in which the economic well-being of farm households happened to depend: (1) households' characteristics, their resources, production and employment; and (2) the ability of their income to meet consumption, savings and other household needs. From among the set of choices, one involves the allocation of time (endowment) to income-earning activities and home time in which households' labour time is further allocated mainly into on-farm production and off-farm engagements. As such, off-farm engagements, conceptualized as employment off households' own farm, occupied a significant place in the economic process of a nation and the history of nations' development and structural transformation.

Contemporary theoretical and empirical analysis of off-farm engagements offered important policy implications on, at least, two fronts. Under circumstances of weak farm economy to create and deliver sustainable livelihood for the farm families, promoting the efficiency of rural markets and off-farm engagements can be an alternative course of policy action to materialize a steadily growing rural income to address overwhelming youth unemployment, food insecurity and poverty in its all possible forms. More so, promoting the development of the off-farm economy, thereby off-farm employment and income opportunities, serves as an important leap-forward in the process of economic transformation. By economic transformation, we are basically referring to the structural change in production, employment and income at all levels from the individual unit of analysis to sectoral and the macro-economy as a whole.

In Ethiopia, for instance, evidence of increasing proportion of farm families with off-farm employment and a growing share of off-farm income in households' balance sheet clearly entails a process of change taking place in the rural economy. Accordingly, a twin-track development approach becomes commendable in which investment and pricing policy measures are considered to promote household income both through improved farm productivity and opportunities to off-farm employment and income.

Under circumstances of no strategic interest of economic growth and transformation, such economic process of diversifying into the off-farm economy to realize a steadily growing rural income and transformation of the rural economy may naturally evolve in response to and as a copping strategy to the pervasive unpredictable farm income shocks. The microeconomic choice of households and the working of rural markets are the crux in such a process despite the nature of the shock – policy and/or normal income shock.

However, experimented development policies historically resemble to increasing farm income and reducing its variability with limited policy attention to promote inclusive off-farm employment and income opportunities. As a matter of fact, household income is more indicative of economic well-being than income from farming. So, understanding farm households' choice to diversify into and the intensity of off-farm engagements has long remained a missing link between policy making and implementation.

To this end, this thesis analysed farm households' off-farm engagements to draw implications for the undergoing, desired otherwise, economic transformation. The analysis is performed assuming that the importance of off-farm engagements and the microeconomic choice of farm households, on one hand; and the nature and distribution

of factors explaining such a choice, on the other hand, arguably varies across regions, time and households. As an integral element of the analysis, we estimated farm households' choice to and the intensity of off-farm engagements, the results of which are presented and described in **Section 4.3**, above. Henceforth, this section is devoted to a vivid discussion of results and comprehensive summary of implications for which we will be referring descriptive and estimation results.

We have now come a reasonably long way in our attempt to understand and explain the microeconomic choices of labour allocation and some distinguishing features that play a vital role in shaping the capabilities of and choices undertaken. Generally, land farm households' participation in the off-farm economy is found significant. According to the results, farm households' diversification into the off-farm economy is no longer in line with the long-held view of temporary pursuit aimed to dampen unfavourably negative farm income shocks.

The temporal observation (in a year) of sample land farm households' off-farm engagement revealed a positive mean days of off-farm work across the two analytical peak and lean seasons in a year. Off-farm engagements are thus considerably part of the microeconomic choice of labour allocation by farm households in their attempt to optimally combine farm and off-farm income sources. However, the extent of off-farm engagements significantly swing between the analytical seasons mentioned. This is in fact a reflection of the structural specificities in which farm households' choices are embedded. A typical specificity, for instance, is the supply side factor of limited availability of farm wage work and income opportunities during the lean season as farm production mainly hinges on nature – rainfall.

The overall analysis that attempted to explain farm households' choice to off-farm engagements and the intensity of these engagements provide important results on several factors we included to model off-farm engagements by farm households. The significant positive influence of socio-political capital on off-farm engagements is the first empirical evidence we paid a special interest for the literature does not bring it to policy attention so far. The results from the off-farm choice, off-farm days and off-farm earnings models entail a significant difference in choice to and intensity of off-farm engagements between farm households who possess such socio-political capital and who do not possess.

Specifically, the result suggests that holding and exercising power at the local administrative unit may help have better information on several public development programs (employment creation schemes, enterprise development, asset building and livelihood diversification programs) and available wage and entrepreneurial self-employment opportunities. More so, such political and social capital can be a solid basis to materialize potential entrepreneurial characteristics of the farm household.

The idea is that one who holds power in local governance and/or members of his household may easily start farm and non-farm businesses by appropriating the array of socio-political capital to mobilize resources and related institutional setups. Apparently, the system is open to local influence. Therefore, any of these channels imply broader opportunities to off-farm engagement, higher likelihood of diversifying into the off-farm economy, and more off-farm engagements – in terms of annual off-farm days and earnings – for land farm households rich in socio-political capital.

The possible implication for economic transformation rests on the importance of knowledge about labour market opportunities and financial resources that can be appropriated by farm households in the rural economy. This call forth, according to the results, an institutional arrangement that deals with market information in planned and integrated platform so that farm households will make informed choices about where to allocate the extra days of labour. Such institutional arrangement can be managed by research institutes in collaboration with other stakeholders in a more innovative manner.

The results associated with the set of household characteristics indicates somewhat a different story in the sense that some factors influence farm households' choice to off-farm engagement while it does not influence off-farm days and earnings at all and vice-versa. Sex of the decision making member, squared age of earning members, and farm experience of the household significantly explain the choice to off-farm engagements while only age and squared age of earning members significantly (at 10%) influence off-farm days. The number of children members, which significantly explain off-farm earnings (at 10%), is not significant both in the off-farm choice and off-farm days model. Similarly, some of the households' characteristics influence both the choice and intensity of off-farm engagements but differently.

The results suggest a significant negative relationship (at 5%) between farm experience and the choice to off-farm engagements while a significant positive relationship is implied between farm experience and off-farm earnings (10%). Generally, the results of the study suggest that the set of farm household' characteristics are jointly a significant determinants of the choice to off-farm engagements. Yet, it does not explain the level of off-farm engagements as much as it does the choice to off-farm engagements.

Partly, such results are not totally unexpected since the parameter estimates for the off-farm choice model are obtained separately under the assumptions of the Probit model corrected for heteroscedasticity. Parameter estimates for the off-farm days and earning models are obtained under tobit model assumptions corrected for heteroscedasticity and non-normality with CLAD estimator following suggestions by Huffman (2004).

The other equally important set of variables in the analysis is related to human capital. The results of the study suggest no significant relationship between farm households' choice to off-farm engagements and those human capital variables – literacy of the decision making member and average years of schooling for earning members. On the other hand, the results suggest a significant positive (10%) relationship between the literacy statuses and both annual off-farm days and earnings while no significant relationship with the average years of schooling for earning members. Unlike the long-held explanation/interpretation for results related to household (capacity) characteristics and human capital variables, we forward an alternative explanation in that such almost no significant relationship can be fairly viewed from the wage and non-wage factors angel.

Many of these variables are considered relevant to off-farm wages from the outset when we fix the ideas and set the context within which the analysis is made. So, the absence of significant relationships in support of the expectations made based on the theoretical underpinnings and empirical evidence from earlier studies suggests simply, but indirectly, the less importance of wage factors in farm households' choice to off-farm engagement. Then, it sincerely put non-wage factors into the attention of policy contrary to the predictions of the classical theory which emphasises on the comparison of wages offered in the off-farm economy and productivities in the farm economy.

Beyond the simple account of off-farm engagements, the results of the analysis suggest almost no significant relationship between human capital variables and off-farm days and/or off-farm earnings with the conclusion that human capital variables has little to do with the choice to and intensity of off-farm engagements. Thus, one important implication for the undergoing, desired otherwise, economic transformation is to re-orient rural development policies from "getting wages right" to "getting institutions work". This will make possible an interim expansion of off-farm employment and income opportunities paving the way for structural changes in production, employment and income in the rural economy.

As part of the theoretical and empirical expositions made to frame this particular study, farm productivity, wealth indicators and farm characteristics of the household have emerged as one class of factors in modelling and explaining off-farm engagements. The results of the analysis suggest a significant positive relationship between farm households' choice to off-farm engagements and farm size and farm debt but negative relationship with agricultural intensification. However, only farm debt has a significant positive impact on off-farm days while a significant positive relationship is obtained between off-farm earnings and on-farm productivity, livestock wealth and farm debt.

From among the results, the significant positive relationship between farm debt and both the choice and intensity of off-farm engagements is perhaps striking with tremendous implications. We already learned from the descriptive analyses that a significant proportion of sample farm households reported positive farm expenses related to inputs and farm technologies. Similarly, a significant proportion of sample farm households reported positive farm debt as defined in the methodological chapter. Putting these

together, farm debt significantly explains farm households' choice to off-farm pursuits and the level of such engagements through its increasing pressure on the balance sheet of farm households. This, in turn, may be attributed to the insufficient farm income either to cover farm expenses from the outset or to fully repay borrowings of different kind but related specifically to farm operation.

On the surface, a rather misleading implication of this particular result is to suggest keeping farm debt increasing for it compels a farm household choose to engage and allocate more annual off-farm days. The correct message is however an apparent low return from the farm business and, mismanagement of borrowings otherwise. Above all, it suggests the failure of government which comes into the rural economy to get the market work through arranged credit for livestock (oxen) and intensification technologies (fertilizer, improved seeds …). Farm households shall be free to choose the type of farming systems, the type and quantity of farm intensification technologies. So, the rather most important implication for transformation is to safeguard the market institutions and ensure robust demand-driven services with regard to inputs and farm technologies.

The significant positive relationship between off-farm earnings and on-farm productivity and livestock wealth strengthens the synergic farm – off-farm nexus in the sense that one would rather have expected less off-farm engagements and earnings when on-farm productivity and livestock wealth are significantly increased. The significant positive effect of farm size on households' choice to off-farm engagements can be argued in a similar way. Large farm size may, through the productivity channel, promote non-farm businesses and self-employment.

One of the theoretical arguments to the observed choice of off-farm engagements is the risk associated with farm operation and farm households' behavioural response to it. In the empirical analysis, we controlled for risk characteristics using what we propounded is a possible reflection (indicator) of risk behaviour. The result suggests a significant positive relationship between the risk behaviour of farm households and their choice to off-farm engagements and the intensity – annual off-farm days and earnings.

The possible message of this result is that farm households may allocate positive off-farm days without a commensurate return if the extra day of labour is allocated on their own farm. As this implies sub-optimal outcome and perhaps with interesting implication for economic transformation, the results call forth an institutional arrangement that takes care of and insures the farm business. For instance, small-scale crop insurance schemes may significantly influence the risk behaviour and expectation formation of households.

Another equally important factor in analysing the propensity to and level of off-farm engagements we considered is financial conditions which we controlled for it by including non-labour income and farm households' indebtedness in the estimation. On average, farm households reported a positive and considerably large household debt which is at least much enough to cause financial stress. Similarly, sample farm households' mean annual estimated non-labour income appeared significantly positive. Results of the study indicate a significant relationship between financial conditions – non-labour income (negative) and indebtedness (positive) – and farm households' choice to the off-farm engagements while only non-labour income significantly explain annual off-farm days and earnings (negative).

These results suggest that farm households with financial stress (highly indebted) and no non-labour income, small enough to consider otherwise, choose to trade off leisure for additional income by supplying labour into the off-farm economy. For diversifying farm households, the results suggest more off-farm days and subsequent increased off-farm earnings when farm households are subject to financial obligations coupled with no non-labour income. Once more, important insights for transformation can be derived.

The sale of livestock units, several forms of remittances and hand out of money as part of a long-standing safety net program constituted the lion's share of positively reported non-labour income. Similarly, borrowings from diverse sources including relatives, peers, rural financial institutions and government arrangements for asset building are considered irrespective of the purpose they are essential meant to serve. Now, the observed significant positive relationship between farm households' choice to off-farm engagements and indebtedness entails the rather constrained choice to supply positive labour days into the off-farm economy as highly indebted farm households have to settle their financial obligations.

The government arranged credit program for asset building and wealth creation is repeatedly reported counterproductive for it has led farm households highly indebted. In effect, households are observed to deplete their assets and choosing to positive off-farm days which is sub-optimal. This calls forth robust institutional arrangements so that demand-driven credit services will be made available for farm households to choose unconstrained by the consequent increasing indebtedness. A similar arrangement can be implied for non-labour income dampens off-farm engagements by increasing the marginal value of off-farm days.

Indicators of the labour market conditions are the last set of factors we included in modelling and analysing the propensity to and level of off-farm engagements. From among the indicators, a significant positive relationship is obtained between self-reported number of job opportunities and the choice to and level of off-farm engagement. This result suggests that the choice to and intensity of off-farm engagements does significantly vary with the availability and size of labour market opportunities in the off-farm economy. This clearly shows the overriding importance of supply-side factors of labour market opportunities and enterprise development specifically job creation in the rural economy. For a robust economic transformation to flourish and sustain, results suggest more emphasis on getting institutions right to shape the incentive structure in the rural economy for that leads several enterprises flourish and more job opportunities created.

In a nutshell, the analysis of off-farm engagements we made in view of driving implications for an undergoing/desired economic transformation appeared to offer important insights into and support for the ideas raised from the outset. Off-farm engagements as a permanent pursuit are implied from the analysis of farm households' distinguishing features and behavioural choices (labour market) in the rural economy. The two-tire analysis of households' off-farm engagements, estimation of the propensity to engage and the level of such engagements, suggest unequivocally that the structural specificities of the rural economy do matter for a robust economic process of change to flourish and sustain. Thus, the continued policy bias to sustained growth in rural income notwithstanding the tremendous and dynamic element of off-farm engagements may be counterproductive to materialize meaningful transformation.

CHAPTER FIVE

5. SUMMARY, CONCLUSION AND SUGGESTIONS

5.1 Summary of Major Findings and Conclusion

Off-farm engagements and earnings from such engagements, as conceptualized in this particular study, occupied a significant place in the economic process of a nation and the history of nations' economic development and structural transformation. From among the winning arguments for off-farm engagements and income, in the context of low income countries for which Ethiopia is no exception, is its contribution to materialize a steadily growing rural income. The other equally important case in point is the huge potential of the off-farm economy, off-farm employment and income opportunities by implication, to realize the desired/undergoing economic transformation.

The evidence of increasing proportion of households observed with off-farm employment and a considerably growing share of off-farm income in households' balance sheet captures a blue-print of an economic process in which off-farm engagements do matter to the extent that is not possible otherwise (in Ethiopia). As experimented development policies historically bias to increasing farm income and reducing its variability; as household income is more indicative of economic well-being than farm income when viewed from a perspective of a pragmatic development; as there is no (limited otherwise) policy attention to inclusive off-farm opportunities; understanding farm households' choice to diversify into and the intensity of off-farm engagements is argued a missing link between policy making and implementation in Ethiopia. We thus analysed off-farm engagements to understand how households respond to economic incentives for it helps drive possible implications to the desired/undergoing economic transformation.

A cross sectional research design is implemented to generate the data we used in the analysis as farm households' choice to and the importance of off-farm engagements, on one hand; and the nature and distribution of factors explaining such a choice, on the other hand, arguably vary across space, time and households. Random sample (multi-stage) of 200 land farm households in Libo Kemkem Woreda are surveyed by administering of standard and structured questionnaire during March-April, 2013. Making use of the data, we first described important features of sample farm households to understand structural specificities we attempted to adequately capture while theoretically modelling their optimizing behaviour. Applying micro-econometric models and tools of analysis, we estimated households' propensity to diversify (allocate labour) into the off-farm economy and the intensity of such engagements to understand the relationship between socio-economic and institutional factors and the households' choice to off-farm engagements.

The main results of the overall analysis can be analytically summarized as in what follows. Generally, land farm households' participation in the off-farm economy is found significant. The results suggest that farm households' diversification into the off-farm economy is no longer in line with the long-held view of temporary pursuit aimed to dampen unfavourably negative farm income shocks. Off-farm engagements are thus part of the behavioural choice of labour allocation by farm households in their attempt to optimally combine farm and off-farm income sources. More so, the analysis that attempted to model farm households' choice to off-farm engagements and the intensity of these engagements provide important results.

We found a significant positive influence of socio-political capital on off-farm engagements by land farm households. The result from the estimated models to off-farm

choice, off-farm days and off-farm earnings entails a significant difference in the choice to and the extent of off-farm engagements between farm households who possess such socio-political capital and who do not possess. One possible explanation is the idea that one who holds power in local governance and/or members of his household may access better information on available labour market and entrepreneurial self-employment opportunities; easily mobilize resources and manoeuvre institutional procedures to start any businesses by appropriating the array of socio-political capital, otherwise. The local governance is apparently open to local influences.

The results associated with households' characteristics indicates somewhat a different story in the sense that some factors influence farm households' choice to off-farm engagement while it does not influence the intensity – off-farm days and earnings – and vice-versa. However, the results generally suggest that the characteristics of farm household' considered [age, sex, number of children, farm experience, household size ...] are jointly significant determinants of the propensity to off-farm engagements. Yet, it does not explain the level of off-farm engagements as much as it does the propensity.

In relation to these results, the results of the analysis suggest no significant relationship between farm households' propensity to and extent of off-farm engagements and human capital variables – literacy of the decision making member and average years of schooling for earning members. It is noteworthy to reckon how these two groups of factors are significant in modelling and explaining off-farm wage (determination). Under this perspective, such almost no significant relationship can be fairly attributed to the less importance of wage factors to model and explain the propensity to and intensity of households' off-farm engagement.

As part of the theoretical and empirical expositions made to frame this particular study, farm productivity, wealth indicators and farm characteristics of the household were analytically considered as one class of factors in modelling and explaining off-farm engagements. The results of the study suggest a significant positive relationship between farm households' choice to off-farm engagements and farm size and farm debt but negative relationship with agricultural intensification. On the other hand, only farm debt has a significant positive impact on annual off-farm days while a significant positive relationship is obtained between off-farm earnings and on-farm productivity, livestock wealth and farm debt. From among others, farm debt significantly explains farm households' propensity to off-farm pursuits and the level of such engagements through its increasing pressure on the balance sheet of farm households. This may be attributed to the insufficient farm income either to cover farm expenses from the outset or to fully repay borrowings of different kind but related specifically to farm operation.

The risk associated with farm operation and farm households' behavioural response to it is one of the theoretical arguments to expect positive off-farm engagements. In the empirical analysis, we controlled for risk characteristics using what we propounded is a possible reflection of risk behaviour. Results suggest a significant positive relationship between risk behaviour of households and the propensity to and intensity of off-farm engagements. It is thus possible to observe off-farm days for which the return may not be commensurate to returns if the extra day of labour is allocated on households' own farm.

In analysing the propensity to and the level of off-farm engagements, we considered financial conditions by including non-labour income and farm households' indebtedness in estimation. A significant relationship between financial conditions – non-labour

income (negative) and indebtedness (positive) – and households' propensity to off-farm engagements is found in the analysis. These results suggest that households with financial stress (indebted) and no non-labour income choose to trade off leisure for additional income by supplying labour into the off-farm economy. For diversifying households, the results suggest more off-farm days and increased off-farm earnings when households are subject to financial obligations coupled with no non-labour income.

From among the analytical group of factors considered to model and explain off-farm engagements, a significant positive relationship is obtained between reported number of job opportunities and the choice to and level of off-farm engagements. Results suggests that the choice to and intensity of off-farm engagements does significantly vary with the availability and size of employment opportunities in the off-farm economy. This clearly shows the overriding importance of supply-side factors and enterprise development for job creation in the rural economy to the extent it would matter otherwise.

Therefore, off-farm engagements as a permanent pursuit are implied from the analysis of farm households' off-farm engagements in this study. The analysis of households' off-farm engagements, estimation of the propensity to engage and the level of such engagements, unequivocally suggest that the structural specificities of the rural economy do matter for a robust economic process of change to flourish and sustain. Non-wage factors appeared to be an integral element of the incentive structure shaping households' choice and important instrument of policy thereof. Above all, the results do not support the long-standing policy bias to farm productivity and income as off-farm employment and income opportunities have substantial implications to a growing and sustained rural income required to materialize meaningful economic process of transformation.

5.2 Policy Suggestions

The analysis of off-farm engagements is reckoned to offer important implications to the desired/undergoing economic transformation and to draw policy suggestions accordingly. Based on the mounting theoretical arguments and supporting empirical evidence on the promises of off-farm engagements to realize a steadily growing rural income and robust economic transformation, on one hand; and the results of this particular study on farm households' propensity to and intensity of off-farm engagements, on the other hand; suggestions can now be made by triangulating farm households' choice, the contemporary policy platform and desired/undergoing economic transformation.

First, the results of the study reinforce the renewed interest in the off-farm engagements (economy) for a successful and dynamic economic process to prevail and sustain in the rural economy. By economic process, we apparently imply a robust nexus between the farm and off-farm sectors from which farm households mainly drive their livelihood in the rural economy. It is thus recommended to pay considerable policy attention to the off-farm economy, at least, as much as what is being paid to the farm economy. For instance, public investment and pricing policies can be design and put in place in a way that enhance both farm income and increased off-farm employment and income opportunities through a balanced policy attention both to the farm and off-farm economy.

The results of the study suggest a significant relationship between farm households' off-farm engagements and the socio-political capital, farm characteristics, risk, financial and labour market conditions. Thus, it is equally recommended to devise a clear and functional institutional arrangement to enable the farm household exercise informed

choices for their incentive structure is shaped by one or more of the aspects outlined already. Information problems shall be addressed first.

With regard to the implementation of specific policy instruments, it is fairly recommended to re-orient the policy paradigm to a more robust demand – driven and market – based delivery than forcing farm households to take it up. Neither the long-practiced package approach is recommended. Many of the policy implementation schemes (rural finance, infrastructure, farm inputs ...), for instance, appeared counter-productive by creating a vicious-circle of indebtedness with a consequent financial stress induced sub-optimal allocation of labour.

5.3 Suggestions for Further Study

In an econometric analysis of a censored/truncated dependent variable, it is made clear that the choice of an appropriate empirical model depends heavily on both the conceptualization and assumptions made about the zero-valued outcomes/observations. In this particular study, the analysis totally relied on the tobit model specification by implicitly characterizing those zero-valued observations of off-farm days (labour supply) and off-farm earnings (income) as corner solutions that are optimal from the households' perspective. As a result, zero-valued outcomes are modelled as though they emerged from a self-truncating process.

However, there may be cases where farm households forgo positive days of off-farm activity not only in situations of high opportunity cost to positive days of off-farm engagement but also in situations of huge market imperfections. Thus, households have

no opportunities to diversify into the off-farm economy which is actually why we observed zero off-farm days and/or off-farm earnings. Specifically, this is a case in point when farmers who would allocate positive labour days to the off-farm economy are additionally constrained by poorly performing markets characterised typically by limited employment opportunities and huge transaction costs of different type. Besides, there are cases in which we may observe zero off-farm earnings while observing positive days of off-farm work that cannot be attributed to non-positive days of off-farm work. This implies an additional process with a substantial implication for empirical estimation.

So, this study may serve as a prelude to and suggests to further the analysis of off-farm engagements by reframing the underlying assumption we made to empirically specify and estimate farm households' propensity to off-farm engagements and the level of such engagements - the days of off-farm engagement and earnings from off-farm activities.

References

Abdulai, A. and Delgado, C. (1999). Determinants of non-farm earnings of farm-based husbands and wives in Northern Ghana. *American Journal of Agricultural Economics*. 81(1):117-130.

Adelman Irma (1984). Beyond Export-led Growth. *World Development*. 12: 937-49

Ahearn, M.C., and J.E. Lee, (1991). *Multiple Job-Holding among Farm Operator Households in the United States*. M.C. Hallberg, J.L. Findeis, and D.A. Lass (eds.), Iowa State University Press.

Ahearn, M.C., J.E. Perry, and H.S. El-Osta (1993). The Economic Well-Being of Farm Operator Households, 1988-90. U.S. *Department of Agriculture, Economic Research Service*, AER-666

Alderman, H., Chiappori, P., Haddad, L., Hoddinott, J., and Kanbur, R. (1995). Unitary versus Collective Models of the Household: Is It Time to Shift the Burden of Proof? *World Bank Research Observer*. 10(1): 1-19.

Benjamin, C. & Guyomard, H. (1994). Off-farm work decisions of French agricultural households. In Caillavet F, Guromard H & Litran R (eds). *Agricultural household modelling and family economics*. Amsterdam: Elsevier. 65-85.

Barrett, C., Reardon, T. and Webb, P. (2001). Non-farm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics, and Policy Implications'. Mimeo.

Becker, G. (1965). A Theory of the Allocation of Time. *The Economic Journal*. 75: 493-517.

Beyene, AD (2008). Determinants of off-farm participation decision of farm households in Ethiopia. *Agrekon*. 47-1: 140-161

Bezabih, M., Zenebe G., Liyousew G., and Köhlin G. (2010). Participation in Off-Farm Employment, Rainfall Patterns, and Rate of Time Preference: The Case of Ethiopia. *Environment for Development*, Discussion Paper

Block, S. and P. Webb (2001). The Dynamics of Livelihood Diversification in Post-Famine Ethiopia. *Food Policy* 26(4): 333-350.

Cameron, A. Colin and Pravin K. Trivedi (2006). *Microeconometrics: Methods and Applications*. Cambridge University Press.

Chikwama, C. (2004). Rural Off-Farm Employment and Farm Investment: An Analytical Framework and Evidence from Zimbabwe. Discussion Paper 2004/03. Edinburgh, Scotland: *Centre for Economic Reform and Transformation*. Heriot-Watt University.

CSA (Central Statistic Agency) (2007). Household Income, Consumption and Expenditure Survey 2004/5: Volume I - Analytical Report. Statistical Bulletin 394. Addis Ababa, Ethiopia: *Federal Democratic Republic of Ethiopia.*

Davis, J. R. (2003). The Rural Non-Farm Economy, Livelihoods, and Their Diversification: Issues and Options. Report prepared for Natural Resources Institute, *Department for International Development*, and World Bank. Chatham Maritime, Kent, UK: NRI.

De Janvry, A. and Sadoulet, E. (2001). Income strategies among rural households in Mexico: the role of off-farm activities. *World Development*. 29(3): 467-480.

De Janvry, A., Fafchamps, M, and Sadoulet, E. (1991). Peasant Household Behaviour with Missing Markets: Some Paradoxes Explained. *The Economic Journal*. 101: 1400-1417.

Diao, X. , Taffesse. A. S., Dorosh, P., Thurlow, J., Pratt, A. N and Yu, B (2007). Agricultural Growth Linkages in Ethiopia: Estimates using Fixed and Flexible Price Models‖. IFPRI Discussion Paper No. 00695. Washington DC: *International Food Policy Research Institute*

Drukker, D. M. (2002). Bootstrapping a conditional moments test for normality after tobit estimation. *The Stata Journal*. 2(2): 125-139.

Ekstrom, L. Brenda, Arlen G. Leholm, Harvey G. Vreugdenhil and F. Larry Leistritz (1986). Effect of Farm Financial Stress on Off-Farm Work Behavior of Farm Operators and Spouses in North Dakota. *North Central Journal of Agricultural Economics*. 8-2: 268-282

Ellis, Frank. (2000). *Rural Livelihoods and Diversity in Developing Countries*. Oxford University Press, New York.

EPA (Environmental Protection Authority) (2012). National Report of Ethiopia, the United Nations Conference on Sustainable Development (Rio+20). Federal Democratic Republic of Ethiopia, Addis Ababa

ERHS (Ethiopia Rural Household Survey Dataset), 1989-2009 (2011). Washington, D.C. International Food Policy Research Institute (IFPRI) (datasets).

(http://www.ifpri.org/dataset/ethiopian-rural-household-surveys-erhs)

Fafchamps, M. & Quisumbing, A. R (1999). Human capital, productivity, and labour allocation in rural Pakistan. *Journal of Human Resource*. 34(2): 369-406

Fuguitt, G. V. (1959). Part-Time Farming and the Push-Pull Hypothesis. *The American Journal of Sociology*. 64:375-379.

Goodwin, K. Barry and Holt, T. Mathew (2002). Parametric and Semi-parametric Modelling of the Off-farm Labour Supply of Agrarian Households in Transition Bulgaria. *American Journal of Agricultural Economics*. 84(1):184-209

Gould, W. Brain., and W.E. Saupe (1989). Off-Farm Labour Market Entry and Exit. *American Journal of Agricultural Economics*. 71-1:960-969

Green, W. E. (2003). *Econometric Analysis*, 5th ed. Engle wood Cliffs, NJ: Prentice Hall.

Gunter, Lewell., and K.T. McNamara (1990). The Impact of Local Labour Market Conditions on the Off-farm Earnings. *Southern Journal of Agricultural Economics*. 22(1): 155-165

Haggblade, S., P.B.R. Hazell and T. Reardon (2009). Transforming the Rural Non-Farm Economy: Opportunity and Threats in the Developing World. IFPRI Issue Brief No. 58. Washington DC. *International Food Policy Research Institute.*

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*. 46: 1251–1271.

Hazell, Peter, and Steven Haggblade (1993). Farm-Non-farm Growth Linkages and the Welfare of the Poor. In Lipton M. and Jacques V. D G (eds). *Including the Poor*. Washington: W Bank.

Heckman, J. (1979). Sample Selection Bias as a specification Error. *Econometrica*. 47:153-61.

Heckman, J. J. (1974). Shadow prices, market wages and labour supply. *Econometrica*. 42(4):679-94

Hopkins, W. Jeffrey, Hisham S. El-Osta, Mitchell J. Morehart, James D. Johnson, and Ashok K. Mishra (2002). Farm Sector Performance and Well-Being Branch, Resource Economics Division, Economic Research Service. *U.S. Department of Agriculture*. Report No. 812.

Huffman, W. E (1991). Agricultural Household Models: Survey and Critique. In *Multiple Job-holding Among Farm Families*. J. L. Findeis, M. C. Hallberg, and D. L. Lass, (eds). Ames IA, Iowa State University Press.

Huffman, W.E. (1980). Farm and Off-Farm Work Decisions: the Role of Human Capital. *Review of Economics and Statistics*. 62: 14-23.

Huffman, Wallace E. (2004). Discussion: Off-Farm Employment, Government Policy, and the Structure of Agriculture: An International Perspective. *American Journal of Agricultural Economics*. 86-3: 737-739

Huffman, Wallace E. (1977). Allocative Efficiency: The Role of Human Capital. *Quarterly Journal of Economics*. 91(1): 59-79.

Jacoby, H. G. (1993). Shadow Wages and Peasant Family Labour Supply: An Econometric Application to the Peruvian Sierra. *The Review of Economic Studies*. 60 (4): 903-921.

John K. Mduma and Peter Wobst (2005). Determinants of Rural Labour Market Participation in Tanzania. *African Studies Quarterly*. 8(2)

Kerachsky, Stuart H. (1977). Labour Supply Decisions of Farm Families. *American Journal of Agricultural Economics*. 59(5): 869-873

Kimhi, A. (1994). Participation of Farm Owners in Farm and Off-farm Work Including the Option of Full time Off-farm Work. *Journal of Agricultural Economics*. 45(2): 232-239

Kimhi, A. (2004). Family Composition and Off-Farm Participation Decisions in Israeli Farm Households. *American Journal of Agricultural Economics*. 86: 502-512.

Lanjouw, P. and Shariff, A. (2004). Rural Non-Farm Employment in India: Access, Incomes and Poverty Impact. *Economic and Political Weekly*. 39 (40): 4429-4446.

Lanjouw, Peter (1999). Rural Non-agricultural Employment and Poverty in Ecuador. *Economic Development and Cultural Change*. Series 48, 1(9): 1-22.

Lemi, A. (2006). The Dynamics of Income Diversification in Ethiopia: Evidence from Panel Data. Working Papers 3. *University of Massachusetts*, Boston.

Lopez, R. E. (1986). Structural Models of Farm Household that Allows for Interdependent Utility and Profit Maximisation Decision. In I. Singh, L. Squire, and J. Strauss (eds.). *Agricultural Household Models: Extensions, Applications, and Policy*. Baltimore: The Johns Hopkins University Press, 306-26.

Maddala, G. S. (1083)*: Limited Dependent and Qualitative Variables in Econometrics.* Cambridge, MA: Cambridge University Press.

McDonald, F. John., and R. A. Moffitt (1980). The Uses of Tobit Analysis. *The Review of Economics and Statistics.* 62 (2): 318-321.

McNamara, Kevine T. and Weiss, Christoph (2005). Farm Household Income and on- and off-farm Diversification. *Journal of Agricultural and Applied Economics*. 37 (1): 37-48.

Mellor W. John (1986). Agriculture on the Road to Industrialization. In John P. Lewis and Valeriana Kallab (1986) (eds.), *Development Strategies Reconsidered*. Washington, D.C.

Mishra, Ashok K. and Paudel, Krishna P. (2008). Policy Reform and Off-farm Labour Supply by Operators in the Delta Region: A. Annual Meeting, February 2-6, 2008, Dallas, Texas 6725. *Southern Agricultural Economics Association.*

Mishra, A. K (1996). Farm Income Variability and the Off-Farm Labour Supply of Farmers and Their Spouses. Department of Economics, North Carolina State University, Raleigh, NC

Mishra, A.K., and B.K. Goodwin (1997). Farm Income Variability and the Supply of Off-Farm Labour. *American Journal of Agricultural Economics* 79: 880-887.

Mishra, A.K., and C.L. Sandretto (2002). Stability of Farm Income and the Role of Nonfarm Income in U.S. Agriculture. *Review of Agricultural Economics*. 24 (1): 208-221.

Mishra, A.K., and M.J. Morehart (2001). Off-Farm Investment of Farm Households: A Logit Analysis. *Agricultural Finance Review.* 61 (1): 87-101.

MoFED (Ministry of Finance and Economic Development) (2010). Growth and Transformation Plan (GTP) 2010/11-14/15 (2010). *Federal Democratic Republic of Ethiopia*, Addis Ababa.

MoFED (Ministry of Finance and Economic Development) (2012a). Ethiopia's Progress towards Eradicating Poverty: An Interim Report on Poverty Analysis Study (2010/11). *Federal Democratic Republic of Ethiopia*, Addis Ababa.

MoFED (Ministry of Finance and Economic Development) (2012b). Annual Progress Report for F.Y. 2011/12 Growth and Transformation Plan (GTP) 2010/11-14/15 (2010). *Federal Democratic Republic of Ethiopia*, Addis Ababa.

MOLSA (1997). Agricultural wage employment and rural non-farm employment in Ethiopia: survey results Addis Ababa*: Ministry of Labour and Social Affairs*.

Mulat D., Guta F. and Tadele F. (2006). Towards a more employment-intensive and pro-poor economic growth in Ethiopia: Issues and policies. *ILO*

Nakajima, Chihiro (1986). *Subjective Equilibrium Theory of the Farm Household.* Elsvier. NY.

Newey, W. (1985). Maximum likelihood specification testing and conditional moment tests. *Econometrica*. 53: 1047-1073.

OECD (Organization for Economic Cooperation and Development) (n.d.). What are equivalence scales? Retrieved on 8th of October 2012 [http://www.oecd.org/dataoecd/61/52/35411111.pdf]

Olapade and Guenther (2007). The Non-farm Economy in Rural Ethiopia 1995-2005: Characteristics and Dynamics. Background paper for the Ethiopia Rural Investment Climate Assessment. Washington DC: *The World Bank.*

Olfert, M. Rose., J.S. Taylor and J.C. Stabler (1993). Non-farm Labour Market Participation of Farm Women. *Canadian Journal of Agricultural Economics*. 41:81-95

Powell, J. (1994). Estimation of Semiparametric Models. In Engle, R. and McFadden, D. (eds.) *Handbook of Econometrics*. Vol. 4 (North Holland), Sec. 1.1, 1.2.

Powell, J. (1986). Symmetrically Trimmed Least Squares Estimation for Tobit Models. *Econometrica* 54(6): 1435-1460.

Powell, J. (1984). Least Absolute Deviations Estimation for the Censored Regression Model. *Journal of Econometrics*. 25(3): 303-325.

Pagan, A. and Vella, F. (1989). Diagnostic Tests for Models Based on Individual Data: A Survey. *Journal of Applied Econometrics*. 4: 29-59.

Reardon, T., J. Berdegué, C.B. Barrett and Stamoulis K. (2006). Household Income Diversification into Rural Nonfarm Activities. In S. Haggblade, P. Hazell and T. Reardon (eds.), *Transforming the Rural Non-Farm Economy:* p1-33. Baltimore: J. Hopkins University Press.

Reardon (2001). Rural non-farm incomes in Nicaragua. *World Development*. 29(3): 427-441.

Reardon, T. (1997). Using Evidence of Household Income Diversification to Inform Study of the Rural Non-farm Labour Market in Africa. *World Development*. 25(50): 735-747.

Reardon, T., and Stamoulis, K., Cruz, M.E., Balisacan, A., Berdegue, J., Savadogo, K. (1998). Diversification of Household Incomes into Nonfarm Sources: Patterns, Determinants, and Effects. Paper no. 4, Prepared for IFPRI Conference on Strategies for Stimulating Growth of the Rural Non-farm Economy in Developing Countries, 17-21 May 1998 at Virginia.

Robinson, Chris., P. McMahon and J. Quggin (1982). Labour supply and Off-farm Work by Farmers: Theory & Estimation. *Australian Journal of Agricultural Economics.* 26 (1): 23-38.

Russell (2003). Fertilizer Use, Risk, and Off-Farm Labour Markets in the Semi-Arid Tropics of India. *American Journal of Agricultural Economics*. 85 (2): 359-371

Sadoulet, E., and De Janvry, A. (1995). *Quantitative Development Policy Analysis*. Baltimore: Johns Hopkins University Press.

Simpson, Wayne., and M. Kapitany (1983). The Off-farm Work Behaviour of Farm Operators. *American Journal of Agricultural Economics*. 65: 801-805

Singh, I., Squire, L., and Strauss, J. (1986). *Agricultural Household Models: Extensions, Applications, and Policy* (eds.). Baltimore: The Johns Hopkins University Press.

Skeels, C. L., and F. Vella. (1999). A Monte Carlo investigation of the sampling behaviour of conditional moment tests in tobit and probit models. *Journal of Econometrics*. 92: 275-294.

Steven, C. Kyle (1993). The Relation between Farm Production Risk and Off-Farm Income. *Agricultural and Resource Economics Review.*

Sumner, A. Daniel (1982). The Off-farm Labour Supply of Farmers. *American Journal of Agricultural Economics*. 64: 499-510

Tauchen, G. (1985). Diagnostic testing and evaluation of maximum likelihood models. *Journal of Econometrics*. 30: 415-443.

Taylor, J. Edward and Irma Adelman (2003). Agricultural Household Models: Genesis, Evolution, and Extensions. *Review of Economics of the Household*. 1: 33-58

TGE (Transitional Government of Ethiopia) (1991). Ethiopia's Economic Policy during the Transitional Period. Addis Ababa, Ethiopia.

Thomas, R. W (1977). A Review of Income Concepts Used in Economic Analysis. Report prepared by Abt Associates for the Office of the Assistant Secretary for Planning and Evaluation, Department of Health, Education, and Welfare.

Thorbecke, Erik. (1993). Impact of State and Civil Institutions on the Operation of Rural Markets and Nonmarket Configurations. *World Development*. 21(4): 591-605.

Tobin, James (1958). Estimation of Relationships for Limited Dependent Variables. *Econometrica.* 26: 263–85.

Tokle, J.G., and W.E. Huffman (1991). Local Economic Conditions and Wage Labour Decisions of Farm and Non-farm Couples. *American Journal of Agricultural Economics*. 73 (3): 652-670

Verbeek, Marno (2004). *A Guide to Modern Econometrics*. John Wiley & Sons Ltd, England. 2nd ed. Weersink, Alfons., C. Nicholson and J. Weerahewa (1998). Multiple Job-holding among Diary Farm Families in New York and Ontario. *Agricultural Economics*. 18 (2): 127-143.

Wilhelm, M.O. (2010). Practical Considerations for Choosing Between Tobit and SCLS or CLAD Estimators for Censored Regression Models with an Application to Charitable Giving. *Oxford Bulletin of Economics and Statistics*. 70(4), 559-582.

Woldehanna, T. (2000). Economic analysis and policy implications of farm and off-farm employment, a case study in Tigray Region of Ethiopia. Wageningen University, Netherlands.

Woldehanna, T. (2002). Rural farm/non-Farm Income Linkages in Northern Ethiopia. In B. Davis, T. Reardon, K. Stamoulis and P. Winters (eds) pp. 121-144. Rome: FAO.

Woldehanna, T. and A. Oskam (2001). Income Diversification and Entry Barriers: Evidence from the Tigray Region of Northern Ethiopia. *Food Policy*. 26: 351-365.

World Bank (2008a). Ethiopia: Climate Factsheet. Washington DC: World Bank, Accessed May 2013. http://siteresources.worldbank.org/INTAFRICA/Resources/Ethiopia_Country_Note.pdf.

World Bank (2009). Towards the Competitive Frontier: Strategies for Improving Ethiopia's Investment Climate. Finance and Private Sector Development Unit, Africa Region. Washington.

Appendices

Annex – 1: Sampling Frame (List of Kebeles and Distribution of Land Farm Households)

No.	Kebele	No. Land household heads
1.	Agela	1125
2.	Agid kirgna	1617
3.	Agita	1005
4.	Ameno	1042
5.	Angot	1405
6.	Yifag Akababi	1270
7.	Asta Mariam	1507
8.	Banbiko	1325
9.	Bilbuha	1211
10.	Bira	1328
11.	Birkute	1792
12.	Bura	1502
13.	Derita	957
14.	Estifanos	1505
15.	Ginaza ena silkisa	1347
16.	Gendewa	1173
17.	Kab	1322
18.	Libo	1939
19.	Martadios	1109
20.	Mendere Mariam	1245
21.	Michael Debir	2170
22.	Mitad	1019
23.	Shamo	1340
24.	Shhoch Tehara	1347
25.	Shina Tsion	1313
26.	Tara Gedam	1279
27.	Teza Amba	1044
28.	Tibaga	1204
29.	Whusha Tiris	941
	Total	39, 283

Source: Environmental Protection, Land Administration and Use office, Libo Kemkem Woreda (EPLAUO, 2012)

Annex – 2: Questionnaire

Annex – 3: Conversion Factors (Livestock and Household members)

No.	Livestock Type	TLU (Tropical Livestock Unit)
1.	Calf	0.20
2.	Weane	0.34
3.	Dcalf	0.75
4.	Heifer	1.00
5.	Cow/Oxen	1.10
6.	Horse/Mule	0.70
7.	Donkey	0.13
8.	Sheep/Goat	1.25

Source: Storck et al. (1991) and Fekadu Nigussie (2008)

The OECD Equivalence Scale:

The equivalence scale suggested by OECD for countries which have not established their own scale was used to calculate the household size in adult equivalent. This equivalence scale called "OECD equivalence scale" or Oxford scale" assigns a value of 1 to the household head, value of 0.7 to each additional adult and of 0.5 to each child. And it is given by the formula AE = (1+0.7(a-1) +0.5(c), where 'a' is total number of adults and 'c' is total number of children with in the household.

No.	Household Members	AES (Adult Equivalence Factor)
1.	Household Head	1.0
2.	Adult Members (a)	0.7
3.	Child Members (c)	0.5
	AES	(1+0.7(a-1) +0.5(c)

Source: OECD [Organization for Economic Cooperation and Development] (n.d.)

Annex – 4: Results of Some Descriptives Used in the Analysis

* Livestock wealth brought to marriage (Husband Vs Spouse by off-farm engagement)

```
------------------------------------------------------------------------------------------
Variable |      Obs       Mean    Std. Dev.       Min        Max
------------------------------------------------------------------------------------------
tluvbtmh |      184    1.339837    .7891058         0        5.5
tluvbtms |      184    1.370543    .9010369         0        5.5
------------------------------------------------------------------------------------------
```

- Two-sample t test with unequal variances:

```
------------------------------------------------------------------------------------------
  Variable |     Obs       Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
------------------------------------------------------------------------------------------
 tluvbtmh |     184    1.339837   .0581737    .7891058    1.22506    1.454614
 tluvbtms |     184    1.370543   .0664253    .9010369    1.239486   1.501601
------------------------------------------------------------------------------------------
combined |     368     1.35519    .044096    .8459076    1.268478   1.441903
------------------------------------------------------------------------------------------
    diff |           -.0307065   .0882978               -.2043512    .1429381
------------------------------------------------------------------------------------------
     diff = mean(tluvbtmh) - mean(tluvbtms)                        t =  -0.3478
     Ho: diff = 0                     Satterthwaite's degrees of freedom = 359.744
     Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
     Pr(T < t) = 0.3641         Pr(|T| > |t|) = 0.7282          Pr(T > t) = 0.6359
```

Off-farm = 1

```
------------------------------------------------------------------------------------------
Variable |      Obs       Mean    Std. Dev.       Min        Max
------------------------------------------------------------------------------------------
tluvbtms |       97    1.308041    .8395567         0        4.6
------------------------------------------------------------------------------------------
```

Off-farm = 2

```
------------------------------------------------------------------------------------------
Variable |      Obs       Mean    Std. Dev.       Min        Max
------------------------------------------------------------------------------------------
tluvbtms |       87     1.44023    .9651135         0        5.5
------------------------------------------------------------------------------------------
```

- Two-sample t test with equal variances (Off-farm)

```
------------------------------------------------------------------------------------------
   Group |     Obs       Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
------------------------------------------------------------------------------------------
       1 |      97    1.308041   .0852441    .8395567    1.138833   1.477249
       2 |      87     1.44023    .103471    .9651135    1.234536   1.645924
------------------------------------------------------------------------------------------
combined |     184    1.370543   .0664253    .9010369    1.239486   1.501601
------------------------------------------------------------------------------------------
    diff |           -.1321887    .133052               -.3947114    .1303341
------------------------------------------------------------------------------------------
     diff = mean(1) - mean(2)                                      t =  -0.9935
     Ho: diff = 0                     degrees of freedom =  182
     Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
     Pr(T < t) = 0.1609         Pr(|T| > |t|) = 0.3218          Pr(T > t) = 0.8391
```

Off-farm = 1

Variable	Obs	Mean	Std. Dev.	Min	Max
tluvbtmh	97	1.291031	.7232457	0	4.7

Off-farm = 2

Variable	Obs	Mean	Std. Dev.	Min	Max
tluvbtmh	87	1.394253	.8575732	0	5.5

- Two-sample t test with equal variances (Off-farm)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
1	97	1.291031	.0734345	.7232457	1.145265	1.436797
2	87	1.394253	.0919415	.8575732	1.211479	1.577027
combined	184	1.339837	.0581737	.7891058	1.22506	1.454614
diff		-.1032219	.1165884		-.3332606	.1268167

diff = mean(1) - mean(2) t = -0.8854
Ho: diff = 0 degrees of freedom = 182
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.1886 Pr(|T| > |t|) = 0.3771 Pr(T > t) = 0.8114

* Off-farm Engagement by farm households

Off-farm	Freq.	Percent	Cum.
1	97	52.72	52.72
2	87	47.28	100.00
Total	184	100.00	

- Summary of off-farm engagements by type

Variable	Obs	Mean	Std. Dev.	Min	Max
dfw1	184	308.4565	169.6368	0	2105
dfw2	184	18.30435	16.67382	0	180
dofww1	184	11.27717	24.14945	0	180
dofww2	184	0	0	0	0
donfww1	184	2.445652	13.39796	0	135
donfww2	184	14.75543	23.45371	0	135
dosew1	184	4.23913	17.50776	0	140
dosew2	184	11.1413	25.93185	0	170

* Seasonal difference of off-farm engagements by farm households

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
dfw1	184	308.4565	12.50579	169.6368	283.7824	333.1306
dfw2	184	18.30435	1.22921	16.67382	15.8791	20.72959
combined	368	163.3804	9.834524	188.6589	144.0413	182.7195
diff		290.1522	12.56606		265.3623	314.942

diff = mean(dfw1) - mean(dfw2) t = 23.0902
Ho: diff = 0 Satterthwaite's degrees of freedom = 186.536
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
dofww1	97	21.39175	3.034331	29.88469	15.36865	27.41485
dofww2	97	0	0	0	0	0
combined	194	10.69588	1.697828	23.64801	7.347196	14.04456
diff		21.39175	3.034331		15.36865	27.41485

diff = mean(dofww1) - mean(dofww2) t = 7.0499
Ho: diff = 0 Satterthwaite's degrees of freedom = 96
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
donfww1	97	4.639175	1.849769	18.21811	.9674123	8.310938
dofww2	97	0	0	0	0	0
combined	194	2.319588	.937474	13.0575	.4705779	4.168597
diff		4.639175	1.849769		.9674123	8.310938

diff = mean(donfww1) - mean(dofww2) t = 2.5080
Ho: diff = 0 Satterthwaite's degrees of freedom = 96
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9931 Pr(|T| > |t|) = 0.0138 Pr(T > t) = 0.0069

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
dosew1	97	8.041237	2.388579	23.52477	3.299946	12.78253
dosew2	97	21.13402	3.318943	32.6878	14.54597	27.72207
combined	194	14.58763	2.092979	29.15183	10.45958	18.71568
diff		-13.09278	4.089094		-21.16326	-5.022306

diff = mean(dosew1) - mean(dosew2) t = -3.2019
Ho: diff = 0 Satterthwaite's degrees of freedom = 174.41
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0008 Pr(|T| > |t|) = 0.0016 Pr(T > t) = 0.9992

* Farm - off-farm engagements (peak season)

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
dfw1	97	281.8041	10.99222	108.2608	259.9847	303.6235
dofww1	97	21.39175	3.034331	29.88469	15.36865	27.41485
combined	194	151.5979	10.96282	152.6944	129.9756	173.2202
diff		260.4124	11.40334		237.8149	283.0099

diff = mean(dfw1) - mean(dofww1) t = 22.8365
Ho: diff = 0 Satterthwaite's degrees of freedom = 110.546
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
dfw1	97	281.8041	10.99222	108.2608	259.9847	303.6235
donfww1	97	4.639175	1.849769	18.21811	.9674123	8.310938
combined	194	143.2216	11.41972	159.0583	120.6982	165.7451
diff		277.1649	11.14678		255.0539	299.276

diff = mean(dfw1) - mean(donfww1) t = 24.8650
Ho: diff = 0 Satterthwaite's degrees of freedom = 101.433
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
dfw1	97	281.8041	10.99222	108.2608	259.9847	303.6235
dosew1	97	8.041237	2.388579	23.52477	3.299946	12.78253
combined	194	144.9227	11.33799	157.92	122.5604	167.285
diff		273.7629	11.24875		251.4588	296.067

diff = mean(dfw1) - mean(dosew1) t = 24.3372
Ho: diff = 0 Satterthwaite's degrees of freedom = 105.046
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

* Farm - off-farm engagements (lean season)

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
dfw2	97	12.90722	1.006538	9.913251	10.90925	14.90518
dofww2	97	0	0	0	0	0
combined	194	6.453608	.683934	9.526098	5.104664	7.802553
diff		12.90722	1.006538		10.90925	14.90518

diff = mean(dfw2) - mean(dofww2) t = 12.8234
Ho: diff = 0 Satterthwaite's degrees of freedom = 96
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
dfw2	97	12.90722	1.006538	9.913251	10.90925	14.90518
donfww2	97	27.98969	2.636582	25.96733	22.75612	33.22327
combined	194	20.44845	1.508482	21.01073	17.47323	23.42368
diff		-15.08247	2.822178		-20.66862	-9.496327

diff = mean(dfw2) - mean(donfww2) t = -5.3443
Ho: diff = 0 Satterthwaite's degrees of freedom = 123.4
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 1.0000

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
dfw2	97	12.90722	1.006538	9.913251	10.90925	14.90518
dosew2	97	21.13402	3.318943	32.6878	14.54597	27.72207
combined	194	17.02062	1.754769	24.4411	13.55963	20.4816
diff		-8.226804	3.468213		-15.09763	-1.355983

diff = mean(dfw2) - mean(dosew2) t = -2.3721
Ho: diff = 0 Satterthwaite's degrees of freedom = 113.511
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0097 Pr(|T| > |t|) = 0.0194 Pr(T > t) = 0.9903

* Off-farm Earnings by farm households

Variable	Obs	Mean	Std. Dev.	Min	Max
yfww	97	1131.959	1440.959	0	5200
ynfww	97	1597.423	1520.423	0	7400
ysew	97	1802.577	3048.278	0	12500

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
yfww	97	1131.959	146.3073	1440.959	841.5412	1422.376
ynfww	97	1597.423	154.3756	1520.423	1290.99	1903.856
combined	194	1364.691	107.3846	1495.694	1152.893	1576.489
diff		-465.4639	212.6914		-884.9833	-45.94452

diff = mean(yfww) - mean(ynfww) t = -2.1884
Ho: diff = 0 Satterthwaite's degrees of freedom = 191.449
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0149 Pr(|T| > |t|) = 0.0298 Pr(T > t) = 0.9851

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
yfww	97	1131.959	146.3073	1440.959	841.5412	1422.376
ysew	97	1802.577	309.5057	3048.278	1188.213	2416.941
combined	194	1467.268	172.4258	2401.613	1127.187	1807.349
diff		-670.6186	342.3443		-1347.587	6.349747

diff = mean(yfww) - mean(ysew) t = -1.9589
Ho: diff = 0 Satterthwaite's degrees of freedom = 136.863
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0261 Pr(|T| > |t|) = 0.0522 Pr(T > t) = 0.9739

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
ynfww	97	1597.423	154.3756	1520.423	1290.99	1903.856
ysew	97	1802.577	309.5057	3048.278	1188.213	2416.941
combined	194	1700	172.644	2404.653	1359.489	2040.511
diff		-205.1546	345.8694		-888.9154	478.6061

diff = mean(ynfww) - mean(ysew) t = -0.5932
Ho: diff = 0 Satterthwaite's degrees of freedom = 140.982
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.2770 Pr(|T| > |t|) = 0.5540 Pr(T > t) = 0.7230

* Off-farm job Opportunities

Reported number of local private job offers

Nlpj	Freq.	Percent	Cum.
0	174	94.57	94.57
1	9	4.89	99.46
2	1	0.54	100.00
Total	184	100.00	

Reported number of paid rural development job

nprdj	Freq.	Percent	Cum.
0	127	69.02	69.02
1	40	21.74	90.76
2	14	7.61	98.37
3	3	1.63	100.00
Total	184	100.00	

Reported number of opportunities for self-employment

nsej	Freq.	Percent	Cum.
0	75	40.76	40.76
1	53	28.80	69.57
2	44	23.91	93.48
3	9	4.89	98.37
4	3	1.63	100.00
Total	184	100.00	

- Two-sample t test with equal variances

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       1 |      97    .1134021    .0355259    .3498895    .0428837    .1839204
       2 |      87           0           0           0           0           0
---------+--------------------------------------------------------------------
combined |     184    .0597826    .0191454    .2597013    .0220084    .0975568
---------+--------------------------------------------------------------------
    diff |            .1134021    .0375227               .0393666    .1874375
------------------------------------------------------------------------------
    diff = mean(1) - mean(2)                                      t =   3.0222
    Ho: diff = 0                     degrees of freedom =      182
    Ha: diff < 0                 Ha: diff != 0                 Ha: diff  > 0
    Pr(T < t) = 0.9986         Pr(|T| > |t|) = 0.0029          Pr(T > t) = 0.0014
```

- Two-sample t test with equal variances

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       1 |      97    .1134021    .0355259    .3498895    .0428837    .1839204
       2 |      87           0           0           0           0           0
---------+--------------------------------------------------------------------
combined |     184    .0597826    .0191454    .2597013    .0220084    .0975568
---------+--------------------------------------------------------------------
    diff |            .1134021    .0375227               .0393666    .1874375
------------------------------------------------------------------------------
    diff = mean(1) - mean(2)                                      t =   3.0222
    Ho: diff = 0                     degrees of freedom =      182
    Ha: diff < 0                 Ha: diff != 0                 Ha: diff  > 0
    Pr(T < t) = 0.9986         Pr(|T| > |t|) = 0.0029          Pr(T > t) = 0.0014
```

- Two-sample t test with equal variances

```
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       1 |      97    1.319588    .0740727    .7295317    1.172554    1.466621
       2 |      87    .5977011    .1195418    1.115011     .36006    .8353423
---------+--------------------------------------------------------------------
combined |     184    .9782609    .0735017    .9970258    .8332411    1.123281
---------+--------------------------------------------------------------------
    diff |            .7218865    .1375857               .4504184    .9933546
------------------------------------------------------------------------------
    diff = mean(1) - mean(2)                                      t =   5.2468
    Ho: diff = 0                     degrees of freedom =      182
    Ha: diff < 0                 Ha: diff != 0                 Ha: diff  > 0
    Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

* Land brought to marriage (Husband Vs Spouse)

Variable	Obs	Mean	Std. Dev.	Min	Max
lbtmh	184	4.108696	3.405597	0	18
lbtms	184	1.319293	1.458542	0	6

- Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
lbtmh	184	4.108696	.251064	3.405597	3.613343	4.604048
lbtms	184	1.319293	.1075251	1.458542	1.107145	1.531442
combined	368	2.713995	.1545902	2.965554	2.410001	3.017988
diff		2.789402	.2731204		2.25147	3.327334

diff = mean(lbtmh) - mean(lbtms) t = 10.2131
Ho: diff = 0 Satterthwaite's degrees of freedom = 247.947
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

- Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
1	97	3.68299	.2695461	2.654721	3.147945	4.218035
2	87	4.583333	.433912	4.047262	3.720745	5.445922
combined	184	4.108696	.251064	3.405597	3.613343	4.604048
diff		-.9003436	.4998149		-1.88652	.0858331

diff = mean(1) - mean(2) t = -1.8014
Ho: diff = 0 degrees of freedom = 182
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0367 Pr(|T| > |t|) = 0.0733 Pr(T > t) = 0.9633

- Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
1	97	1.18299	.143335	1.411686	.8984719	1.467508
2	87	1.471264	.1610984	1.502626	1.151011	1.791517
combined	184	1.319293	.1075251	1.458542	1.107145	1.531442
diff		-.2882747	.2148997		-.7122898	.1357404

diff = mean(1) - mean(2) t = -1.3414
Ho: diff = 0 degrees of freedom = 182
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0907 Pr(|T| > |t|) = 0.1814 Pr(T > t) = 0.9093

* Household Debt and Off-farm Engagements

Variable	Obs	Mean	Std. Dev.	Min	Max
Outstanding loan	184	1412.499	1990.951	0	7000
Borrowing 2012	184	918.1184	1426.525	0	8000

- Paired t test

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
outstn~n	184	1412.499	146.7749	1990.951	1122.91	1702.088
brr~2012	184	918.1184	105.1648	1426.525	710.627	1125.61
diff	184	494.3805	146.1793	1982.872	205.967	782.7939

mean(diff) = mean(outstndgloan - brrwng2012) t = 3.3820
Ho: mean(diff) = 0 degrees of freedom = 183
Ha: mean(diff) < 0 Ha: mean(diff) != 0 Ha: mean(diff) > 0
Pr(T < t) = 0.9996 Pr(|T| > |t|) = 0.0009 Pr(T > t) = 0.0004

- Two-sample t test with equal variances (Outstanding loan)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
1	97	1994.858	215.1286	2118.771	1567.831	2421.885
2	87	763.2023	173.3572	1616.968	418.5796	1107.825
combined	184	1412.499	146.7749	1990.951	1122.91	1702.088
diff		1231.655	280.2973		678.6052	1784.706

diff = mean(1) - mean(2) t = 4.3941
Ho: diff = 0 degrees of freedom = 182
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

- Two-sample t test with equal variances (Borrowings 2012)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
1	97	1035.741	160.3926	1579.684	717.3642	1354.118
2	87	786.9761	131.8161	1229.498	524.9344	1049.018
combined	184	918.1184	105.1648	1426.525	710.627	1125.61
diff		248.7648	210.4124		-166.3965	663.9261

diff = mean(1) - mean(2) t = 1.1823
Ho: diff = 0 degrees of freedom = 182
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.8807 Pr(|T| > |t|) = 0.2386 Pr(T > t) = 0.1193

* Primary Occupation

Primary occupation of the Husband and spouse

	Freq.	Percent	Cum.
Other than farming	2	1.09	1.09
Farming	182	98.91	100.00
Total	184	100.00	

* Access to farm credits (By off-farm engagement)

Access to Credit … Livestock [2012]

	Freq.	Percent	Cum.
have access	79	42.93	42.93
no access	105	57.07	100.00
Total	184	100.00	

Access to Credit … Farm Implements [2012]

	Freq.	Percent	Cum.
have access	24	13.04	13.04
no access	160	86.96	100.00
Total	184	100.00	

Off-farm = 1

Access to Credit … Livestock [2012]

	Freq.	Percent	Cum.
have access	47	48.45	48.45
no access	50	51.55	100.00
Total	97	100.00	

Off-farm = 2

Access to Credit … Livestock [2012]

	Freq.	Percent	Cum.
have access	32	36.78	36.78
no access	55	63.22	100.00
Total	87	100.00	

Access to Credit … Livestock [2012] and off-farm engagements

Credit	Off-farm 1	Off-farm 2	Total
have access	47	32	79
no access	50	55	105
Total	97	87	184

Pearson chi2(1) = 2.5503 Pr = 0.110

Off-farm = 1

Access to Credit … Farm Implements [2012]

	Freq.	Percent	Cum.
have access	14	14.43	14.43
no access	83	85.57	100.00
Total	97	100.00	

Off-farm = 2

Access to Credit … Farm Implements [2012]

	Freq.	Percent	Cum.
have access	10	11.49	11.49
no access	77	88.51	100.00
Total	87	100.00	

Access to Credit … Farm Implements [2012]

	Freq.	Percent	Cum.
have access	14	10	24
no access	83	77	160
Total	97	87	184

Pearson chi2(1) = 0.3492 Pr = 0.555

* Crop production expense and the nearest market

expense	Freq.	Percent	Cum.
yes	158	85.87	85.87
no	26	14.13	100.00
Total	184	100.00	

- Summary

Variable	Obs	Mean	Std. Dev.	Min	Max
expense	184	1055.984	836.3019	0	4000
distance	184	8.440217	5.329494	1	19

* Crop failure, intertemporal movement in yield, Decision making and migration

- Crop failure in the year in 2011

	Freq.	Percent	Cum.
yes	129	70.11	70.11
no	55	29.89	100.00
Total	184	100.00	

- Yield/farm income in 2012 compared to 2011 or so

	Freq.	Percent	Cum.
Increase	35	19.02	19.02
Decrease	125	67.93	86.96
No change	24	13.04	100.00
Total	184	100.00	

- Household Decision Making … Major Income and Expenditures

	Freq.	Percent	Cum
Household head	59	32.07	32.07
Husband and spouse	124	67.39	99.46
All members collectively	1	0.54	100.00
Total	184	100.00	

- Household Decision Making … Miscellaneous nor Income and Expenditures

	Freq.	Percent	Cum.
Household head	12	6.52	6.52
Husband and spouse	171	92.93	99.46
All members collectively	1	0.54	100.00
Total	184	100.00	

- Migration to … considered as an option?

	Freq.	Percent	Cum.
yes	22	11.955	11.955
no	162	88.045	100.00
Total	184	100.00	

- Crop failure and off-farm engagement

	Off-farm engagement		
Crop failure (2011)	1	2	Total
1	67	62	129
2	30	25	55
Total	97	87	184

Pearson chi2(1) = 0.1052 Pr = 0.746

- Yield and off-farm engagement

	Off-farm engagement		
Yild/farm income (2012)	1	2	Total
1	17	18	35
2	70	55	125
3	10	14	24
Total	97	87	184

Pearson chi2(2) = 1.9575 Pr = 0.376

- Migration plan and off-farm engagement

	Off-farm engagement		
Migration plan	1	2	Total
1	15	6	21
2	81	80	161
Total	97	87	184

Pearson chi2(2) = 3.3297 Pr = 0.189

Declaration

I, the undersigned, declare that this thesis is my own original work and has not been presented for a degree in any other university, and that all sources used for the thesis work have been duly acknowledged.

Declared by:

Name: _____

Signature: _____

Date: _____

Confirmed by:

Name: _____

Signature: _____

Date: _____

Place and Date of Submission: _____