Prospects of Transforming Subsistence Agriculture into Sustainable Livelihoods: A case-study of the Ribb sub-Catchment, Ethiopia

Yodit Balcha

Uppsala University, Department of Earth Sciences
Master Thesis E, in Sustainable Development, 30 credits
Printed at Department of Earth Sciences, Geotryckeriet, Uppsala University, Uppsala, 2013.
Prospects of Transforming Subsistence Agriculture into Sustainable Livelihoods: A case-study of the Ribb sub-Catchment, Ethiopia

Yodit Balcha

Supervisor: Louise Karlberg
Evaluator: Atakilti Beyene
Contents

List of Tables .......................................................................................................................... ii
Table of Figures ....................................................................................................................... iii
Abbreviation ............................................................................................................................ vi

1. Introduction .............................................................................................................................. 1
   1.1. Gap analysis .................................................................................................................. 2
   1.2. Objective ....................................................................................................................... 3

2. Background .......................................................................................................................... 4
   2.1. Sustainable rural livelihood ......................................................................................... 4
   2.2. Rural livelihood development ..................................................................................... 5
   2.3. Subsistence agriculture in transition .......................................................................... 6
   2.4. Progression in agricultural commercialization ........................................................... 6

3. Methods .................................................................................................................................. 8
   3.1. Description of the study area ....................................................................................... 8
   3.2. Sampling technique and Data collection ...................................................................... 9
       3.2.1. Sampling technique ......................................................................................... 9
       3.2.2. Data collection ............................................................................................... 9
   3.3. Data analysis ................................................................................................................ 10
       3.3.1. Descriptive analysis approach ........................................................................ 10
       3.3.2. Econometric analysis approach ....................................................................... 10
   3.4. Definition of variables ............................................................................................... 12
       3.4.1. Dependent variable ......................................................................................... 12
       3.4.2. Explanatory variables .................................................................................... 13

4. Results .................................................................................................................................. 15
   4.1. Descriptive results ........................................................................................................ 15
       4.1.1. Natural capital ................................................................................................. 15
       4.1.2. Social and human capital ................................................................................. 17
       4.1.3. Economic characteristics and financial capital ............................................. 18
       4.1.4. Institutional characteristics .......................................................................... 19
   4.2. Econometric results ...................................................................................................... 19
   4.3. Difference in farm income across farm typologies .................................................... 21

5. Discussion ........................................................................................................................... 23
   5.1. Enabling factors for agricultural transformation ......................................................... 23
   5.2. Constraints factors for agricultural transformation .................................................... 24
   5.3. Implications for policy ............................................................................................... 25

6. Conclusion ............................................................................................................................ 26

7. Acknowledgment ................................................................................................................ 27

8. Reference ............................................................................................................................ 28

Appendix .................................................................................................................................... 31
List of Tables

Table 1. Major Farm typologies in Ribb sub-catchment ................................................................. 12
Table 2. Percentage of interviewed household’s farm typology by farm land topography .......... 15
Table 3. Land fertility in plot erosion (%) .................................................................................. 16
Table 4. Percentage of farm land fragmentation for the sampled households ....................... 16
Table 5. Respondents access to irrigation (%) .......................................................................... 17
Table 6. Demographic characteristics of the interviewed respondent in each farm typology ...... 17
Table 7. Education status of household head (%) .................................................................... 18
Table 8. Major livelihood strategy used by the respondents (%) .............................................. 18
Table 9. Market infrastructure in the study area ....................................................................... 19
Table 10. Major cooperatives sampled households are a member to (in number) .................... 19
Table 11. Results from Ordered Logit Regression (dependent variable: Farming typology) .... 20
Table of Figures

**Figure 1.** The Sustainable Livelihood Framework (Scoones 1998) ................................................................. 5
**Figure 2.** Map of Ethiopia and location of the study area ..................................................................................... 8
**Figure 3.** Difference in farm income across farm typology (ETB/yr) ................................................................. 21
**Figure 4.** Farm income range in each farm typology (ETB) ............................................................................. 22
Prospects of Transforming Subsistence Agriculture into Sustainable Livelihoods; A case-study of the Ribb sub-Catchment, Ethiopia.

Yodit Balcha


Abstract: This study assesses the importance of agricultural transformation in achieving sustainable livelihood in rural Ethiopia. By focusing on the different agricultural transformation components, the study analyse different farming typologies at household level. Through the process of smallholder commercialization, households can transform into more desired farm typology which can assist them to achieve food security and reduce poverty. Based on households production objective, the result suggests that households in the study area belong to four major farm typology i.e., below-subsistence, subsistence, constant improving and commercial level farm typologies. By applying an ordered logit regression model, the variables having high significance level and determine households to transform from lower farm typology (below-subsistence level) to higher (commercial level) are topography, livestock holdings and irrigation. Farm land size, land fragmentation and non-farm income are also determining factors in smallholder agricultural transformation. In addition, the result show that weak institutions, poor access to markets and credit, inadequate infrastructure, poor soil fertility and land degradation have constrained households to transform to smallholder commercialization.

Keyword: Sustainable development; sustainable rural livelihood; farm typology; subsistence agriculture; smallholder commercialization; agricultural transformation; ordered logit regression

Yodit Balcha, Department of Earth Sciences, Uppsala University, Villavägen 16, SE- 752 36 Uppsala, Sweden
Prospects of Transforming Subsistence Agriculture into Sustainable Livelihoods; A case-study of the Ribb sub-Catchment, Ethiopia.

Yodit Balcha


**Summary:** Agriculture is the main source of livelihood for the majority of Ethiopian rural people and back bone of the country’s economy. Ethiopian agricultural system faces livelihood resource competition due to high population increase, climate change and variability, natural resource degradation and decline of agricultural production. To meet food security targets it is a necessity to transform smallholder subsistence agricultural system, into high yielding, intensive farming systems, which at the same time is sustainable.

By assessing the importance of smallholder agricultural transformation to achieve sustainable livelihood, this study specifically looks at the different agricultural typology; livelihood strategies; the enabling socio-economic and bio-physical conditions; and the difference in farm income across farm typology. The analysis is based on household level data collected from 102 randomly selected farm households from 7 Peasant Associations of the Ribb sub-Catchment in Fogera Woreda of the Amhara region in Ethiopia. An ordered logit model was applied to analysis the enabling socio-economic and bio-physical variables in smallholder agricultural transformation.

Based on households production objective, 31.4% of the households from the sampled cases belongs to below-subsistence level farm typology whereas only 19.6% are commercial farmers. Land fertility plays a crucial role in agricultural transformation, where 61.9% of below-subistence level farm households are located on severely eroded farm land, while 55% of commercial households are located on productive lands. Irrigation was found to be a determining factor for commercialization. Out of the total sampled households, 42% are irrigation users from which 50% are commercial farmers and 38.1% are below-subsistence level farm households. Water availability for irrigation enabled the farmers to have an additional crop per season, which resulted in higher farm incomes. The study also identified the farm income range for all indentified farm typologies in the study area. The study concludes that to ensure food security and reduce poverty; the ongoing smallholder farm transformation is both sustainable and feasible, in terms of long term yields and environmental impacts. Furthermore, there is a need for assessments on smallholder agricultural transformation and its consequences on downstream water resources, as well as estimations of future agricultural water and energy requirements.

**Keyword:** Sustainable development; sustainable rural livelihood; farm typology; subsistence agriculture; smallholder commercialization; agricultural transformation; ordered logit regression

Yodit Balcha, *Department of Earth Sciences, Uppsala University, Villavägen 16, SE- 752 36 Uppsala, Sweden*
Abbreviation

ADLI Agricultural Development-Led Industrialization
ARARI Amhara Region Agricultural Research Institute
BoARD Bureau of Agriculture and Rural Development
BoWRD Bureau of Water Resources Development
CSA Central Statistical Agency of Ethiopia
DA Development Agent
DID Department of International Development
EIA Ethiopian Investment Authority
EMIS Education Management Information System
FAO Food and Agricultural Organization
GDP Gross Domestic Product
GTP Growth and Transformation Plan
IDS Institute for Development Studies
IFAD International Fund for Agricultural Development
ILCA International Livestock Center for Africa
MDGs Millennium Development Goals
MoA Ministry of Agriculture
MoFED Ministry of Finance and Economic Development
MoWE Ministry of Water and Energy
NGO Non Governmental Organization
PA Peasant Association
PASDEP Plan for Accelerated and Sustained Development to End Poverty
PRS Poverty Reduction Strategy
SAPRP Sustainable Development and Poverty Reduction Programme
SARD Sustainable Agriculture and Rural Development
SSA Sub-Saharan Africa
UNCED United Nations Conference on Environment and Development
UNDP United Nations Development Programme
WCED World Commission on Environment and Development
1. Introduction

Sub-Saharan Africa (SSA) is categorised as an agrarian economy where 32% and 65% of the region’s total gross domestic product (GDP) and total labour respectively depends on (World Bank, 2007; Bach & Per, 2008). The region’s agricultural production depends on diverse agro-ecological and farming systems where farmers grow a wide range of crops and keep different types of livestock for their livelihood strategies. SSA is highly challenged in terms of poverty and hunger as well as ensuring environmental sustainability (Reynolds et al., 2007; Rockstrom et al., 2007). The major challenges the agricultural sector in SSA faces include high population growth (which results in livelihood resources competition), increasing climate variability, declining levels of agricultural productivity, natural resource degradation and food insecurity (Biggs et al., 2004; Beintema & Stads, 2006). In order to enhance the agricultural productivity of the region, a special attention needs to be given to the smallholder1 farmers. Most of SSA smallholder farmers use small-scale rain-fed agricultural system categorizing them as; “the poorest, least educated, poorly linked to markets, most vulnerable to non-conducive policies and surrender more severely to unfavourable environmental conditions such as draught” (World Bank, 2007).

Like many of sub-Saharan African countries, the major driving vehicle for the economic growth and in fighting poverty and hunger in Ethiopia is agriculture. As the main source of livelihood and backbone of the country’s economy; for the year 2008/2009 agriculture sector contributed 43% for GDP, 86% for foreign currency earnings (EIA, 2010) and 85% for rural employment (MoA, 2011). Through institutional and policy reforms, Ethiopia has achieved strong and promising economic growth in the past decade (MoFED, 2007). The witnessed economic growth is believed to be the result of the Poverty Reduction Strategy (PRS)2 designed by the Ethiopian government with subsequent policy eras of Sustainable Development and Poverty Reduction Programme (SDPRP) for year 2002-2004/05; Plan for Accelerated and Sustained Development to End Poverty (PASDEP) for year 2005/06-2009/10 and Growth and Transformation Plan (GTP) for 2010/11-2014/15. To date SDPRP and PASDEP have been formulated with major emphasis given to Agricultural Development-Led Industrialization (ADLI) since agriculture sector is the source of the country’s livelihood (MoFED, 2003). Even if Ethiopia recorded highest performing economies in sub-Saharan Africa, 29% of the population still lives below the national poverty line (IFAD, 2009). In 2011, World Bank reported that 83% of Ethiopian population resides in the rural part of the country where poverty is significantly severe and livelihood strategy is dependent on small scale farming or livestock herding. With 1.8% annual rural population growth in Ethiopia (World Bank, 2011), promoting Sustainable Agriculture and Rural Development (SARD) in order to satisfy the demands of the increasing population for food and other agricultural commodities is important.

“The major objective of SARD is to increase food production in a sustainable way and enhance food security ...” (UNCED, 1992). There is growing realisation that there is no single solution to achieving SARD and that income generation off the farm importantly contributes to enhancing the quality of rural life.” (FAO, 2001).

The primary focus of ADLI (the agricultural policy and strategy designed by the Ethiopian government) is on the expansion of large scale commercial farms and smallholder productivity improvement in order to accelerate agricultural production and development at all level (MoFED, 2003). Although ensuring agricultural productivity and food security is the primary objective, there should be a parallel goal that maintains and/or enhances the agro-ecosystem services to achieve sustainable development and rural livelihood (see Folke et al., 2002; Sayer & Cambell, 2004; Swinton et al., 2007). Evidence from Ghana shows that strong agricultural performance by strongly emphasising on smallholder and subsistence farmer’s investment can be a key tool in poverty eradication (Beintema & Stads, 2006). Ethiopia’s development and poverty reduction strategy also recognizes the need in “market oriented” agricultural system in order to promote “sustainable development”. The five year plan PASDEP that was put in action for the years 2005/06-2009/10 gave particular emphasis on commercialization of agriculture, private sector development and the scaling up of resources for a faster development (MoFED, 2007). With this strategy, Ethiopia is heading in the right path in

---

1 Smallholder farmers are often characterized as farmers with limited land and capital, high exposure to risk, low input technologies, and low market orientation (World Bank, 2003).

2 Poverty reduction strategy is a strategy that describes and evaluates the country’s macroeconomic, structural, and social policies and programmes that will promote growth and reduce poverty (MoFED, 2003).

3 In order to sustain agro-ecosystem services, this study included the different social endeavors shaped by human values such as market development and policy decisions (see Robertson & Swinton 2005). Through this, we can specifically study the social-ecological linkage of the agricultural system that can help us to meet the challenges of sustainable development (see Folke et al., 2002; Sayer & Cambell, 2004).
eradicating extreme poverty and hunger and ensuring environmental sustainability (MDGs 1 and 7) by giving priority to the development of rural livelihood where vast number of the country’s population resides.

Different agricultural policies have been adopted by many agrarian countries in SSA, where implementation of those policies with special focus in smallholder agricultural transformation. The study made by Salami et al., (2010) in four East African countries including Ethiopia commented on the significant agricultural potential the countries posses though achieving food security seems to be a challenge. By giving special attention in smallholder agricultural infrastructural development (through access to water and irrigation), enhancing access to markets, access to finance (by providing credits to facilitate investments and inputs purchase), adaptation of technology which increases crop varieties and policy re-orientation that secure land tenure system food security and rural development can be achieved (FAO, 2008; IFAD, 2009; Moti et al., 2009; Salami et al., 2010). Therefore, this study fully investigates the multiple components the Ribb sub-Catchment has in smallholder agricultural transformation. Since the region is “endowed and blessed with a high potential of irrigable land area, sizeable surface water diversion for small-scale agricultural system from four major river basins and underground water” (BoWRD, 2005), a focused study of households using irrigation in smallholder agricultural transformation is included.

1.1. Gap analysis

This study tries to address the different aspects smallholder farmers apply that helps them to transform their agricultural system. Currently, intensive development intervention is underway through irrigation and infrastructure in Amhara region (BoWRD, 2005). Modern irrigation schemes to successfully transform smallholder agriculture require investment in improved technologies (improved seeds, high value crops, constant supply of inputs and agronomic packages) and knowledge that integrate production and marketing (Salami et al., 2010). Agricultural transformation mainly is seen as the linkage farm households have with market at a given point of time. Different characteristics and parameters are used by different authors and researchers to describe what agricultural transformation is (see Moti et al., 2009). This study uses a combination of change in production objective (from subsistence to marketing where changes in the proportion of marketed agricultural outputs is the key aspect) and change in harvested crops (from traditional to commercial crops) as indicators of transformation. The parameter “change in harvested crops” is used due to the recent witnessed change where farmers in the study area started producing marketable/ cash crops (mainly rice). Even though the region has great potential in transforming small-scale farmers to achieve food security through irrigation and other agricultural water management technologies. Lack of investment capital, limited access to credit and market infrastructure (roads, physical market structures, market information and contacts) is reported to be an obstacle in smallholder transformation in the region. Due to the lack of these factors result small-scale farmers to stay trapped within subsistence agriculture system with minimal orientation towards commercializing and increasing agricultural productivity. By addressing these factors in a proper and contextual manner, households in the region can achieve sustainable rural livelihood strategy and food security.

The Amhara region is the second most populous region in Ethiopia with a total population of 18,529,000 (CSA, 2012). The region have a long history of famine and drought where an estimated 18-20% of the population is chronically food insecure (BoARD, 2003). The Bureau of Agriculture and Rural Development (BoARD) listed “erratic and unreliable rainfall, degraded natural resource base, high population density and low productivity caused by poor agricultural management practices” as major factors for the witnessed famine and food insecurity in the region. As reported by MoFED (2010), one of the major challenge encountered while implementing PASDEP in the past five years were the delayed on-set of rain which has made increasing agricultural productivity very difficult. In some areas of the country mal-distribution of rain were the major challenge mentioned with regards to smallholder commercialization which is helpful way in increasing agricultural productivity and reducing the level of household’s food insecurity. It is therefore very important to study how food security can be achieved through agricultural commercialization for sustainable rural livelihood.

---

4 Ethiopia is divided in to 11 regions (which replaced the older system of provinces). From those 11 regions, 9 are ethnically based administrative regions (named: Afar, Amhara, Benishangul-Gumuz, Gambela, Harari, Oromiya, Somali, Southern Nations and Nationalities People (SNNP) and Tigray) and Two city Administrative regions (Addis Ababa and Dire Dawa) are autonomous cities (CSA, 2012).

5 The household is taken as the unit of reference because it is the primary level of aggregation through which people organizes production, share income and consumption (Guido et al., 2012).
1.2. Objective

This study assesses the importance of smallholder agricultural transformation to achieve sustainable livelihood in the Ribb sub-Catchment of the Amhara region in Ethiopia. With specific objectives of answering the following research questions:

- What are the different agriculture typologies and rural livelihood strategies conducted in the area?
- What are the enabling socio-economic and bio-physical conditions for the transformation of subsistence smallholder farming systems to a level of better welfare status?
- What is the difference in farm income across farm typologies?
2. Background

This section is composed to include the different literature reviews done on the topic of sustainable rural livelihood as well as smallholder commercialization. Definitions of different terms are also included in order to give a clear image by linking smallholder agriculture commercialization to achieve sustainable livelihood thus defining the scope of the study.

2.1. Sustainable rural livelihood

With 83% of Ethiopia’s population residing in rural areas, the government adopted a focused intervention through strengthening rural development for accelerated and sustained economic growth (MOFED, 2003). In order to eradicate poverty and achieve economic development, the 1987 Brundtland report proposes a development path that is sustainable which involves a progressive transformation of economy and society for both developing and developed countries. As per the Brundtland report:

“Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987).

In order to achieve sustainable development by a nation, the development strategy should focus on the available resource and assets. For Ethiopia, agriculture and rural livelihood development can be a great way to eradicate poverty and achieve sustainable development. A livelihood may be defined as “the sum of ways in which households obtain the things necessary for life, both in good and bad years” (FAO, 2008). Scoones (1998) in his paper discussed about the different livelihood approaches rural people uses and which strategy would yield a sustainable livelihood outcome. It is very important to define what sustainable livelihood means and how realistic it is. Krantz (2001) has made a detailed analysis about the different definition and terminologies used by different scholars and research organizations by referring the early definition of sustainable livelihood found in Brundtland report of 1987. In her paper, Krantz believes the definition the Institute for Development Studies (IDS) team used is more realistic and appropriate in cases of studying specific livelihood strategies. Thus, the definition of sustainable livelihood in this paper uses the IDS teams’ definition of:

“A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base” (Chambers & Conway, 1992).

In order to investigate and provide a solution (way forward) to achieve sustainable rural livelihood, the IDS team has developed a Sustainable Rural Livelihoods framework (fig.1.). Derived from a combination of different livelihood strategies a community or an individual can reach sustainable livelihood based on their access to different livelihood resources and the way they pertain those resources. The framework provides a more logical and integrated approach in realizing how to lessen poverty by addressing policy, institutional, development and resource management factors. Department of International Development (DFID) in 1999 has acknowledged the framework’s attractiveness since it provides “a simple but well-developed way of thinking about a complex issue and can be applied as a broad conceptual framework or as a practical tool for designing programmes and evaluation strategies”. The framework is also a holistic approach in understanding poverty and how to alleviate it (DFID, 1999).

---

6 1987 Brundtland report was organized by the World Commission on Environment and Development (WCED) following the first conference on the Human and Environment held in Stockholm in 1972. The WCED’s aim while publishing the report is in “creating a united international community with shared sustainability goals by identifying sustainability problems worldwide, raising awareness about them, and suggesting the implementation of solutions” (WCED, 1987).

7 These necessities include food, water, shelter, clothing and health care (with education often included too) (FAO,2008)

8 Livelihood strategies imply agricultural intensification or extensification, livelihood diversification and migration.

9 Livelihood resource includes natural, economic, human and social capitals.
The livelihood effects generated could take both positive and negative depending on the available resources people have and the pressure exerted on those resources. The different components of the sustainable livelihood outcomes (fig. 1.) have a linkage between one another where; the employment generated through a specific livelihood strategy adopted by household will lead to poverty reduction and improving household’s well-being and capability. By achieving those outcomes a resilient livelihood adaptation and natural resource sustainability can be enhanced. This in turn will be a starting point in any policy and development project in achieving sustainable development by the rural community and the country in general. Since the framework helps in identifying the necessary linkages in rural people’s living strategy in an economically, ecologically, and socially sustainable manner (Krantz, 2001; Timmer, 2003; Bryceson, 2005; Guido et al., 2012) a country can incorporate a policy to achieve sustainable development.

2.2. Rural livelihood development

SSA is home to more than 690 million people (UNDP, 2006) from which 62% of the population resides in the rural area (FAO, 2008). Since the rural part of the SSA population’s livelihood depends on agriculture, decreases in rural household’s farm size and resource competition has become a common phenomenon for the region. With more than half of SSA population residing in the rural part, it is very important to increases the levels of productivity per unit area of land in order to reduce rural poverty and generate employment for their growing population. Referring back to the sustainable livelihood framework (fig. 1.), agricultural intensification will be a key way to improve rural livelihood.

Why agricultural intensification? Since many rural households in SSA have land holding of less than 1 ha (FAO, 2008), a livelihood strategy of agricultural intensification which is characterized by “more output per unit area through capital investment or increases in labour inputs” (Scoones, 1998) will be suitable.

It is necessary to use different livelihood strategies in order for the households to be able to resist shock or to avert risk. From past experience applying a specific type of livelihood strategy of agricultural investments (such as investments in natural and physical assets) in challenging conditions (land degradation, soil fertility and rainfall variability) has limited smallholder farmer’s livelihood development (World Bank, 2003; Brown and Lall, 2006). Even though the livelihoods of rural household especially in SSA is predominantly characterized as subsistence farming, households supplement their livelihood strategy with several other activities (non- 11 and off-farm 12 income, migration income, remittance, food transfer) for food and income earning (FAO, 2008). Since different livelihood options are available to people depending on where they live (the agro-ecological context) and the resources to which they have access (land, infrastructure,

---

10 Scoones (1998) by referring various literatures, have an elaborated discussion about each component in his paper.

11 Non-farm income includes income generated from employment, petty trading, handicraft, sales of wood, renting out land, etc…

12 Income gained from working on others farm either through cash or food (share of production)
assets, financial resources, labour, social network, etc.), it is necessary to map out and identify homogenous conditions where households share similar livelihood patterns and have relatively similar entitlements (Guido et al., 2012). By considering the biophysical and socio-economic determinants of rural households, rural livelihood development resolutions can be sketched.

2.3. Subsistence agriculture in transition

Subsistence agricultural system is widely practiced by smallholder farmers in developing economies usually characterised by ‘low production and economic return’ which may not be a viable activity in ensuring sustainable livelihood and food security (Pingali et al., 2005). In order to sustain smallholder farmer’s production, there is a need to transform the process they practice to more desirable and economically viable solution. Moti et al. (2009) talked about the importance of agricultural commercialization for a country’s economic growth and development through smallholder commercialization. In order to lay concrete foundation in attaining MDGs by 2015, strategy documents in many SSA countries tend to highlight in transforming smallholder agriculture to high growth path shift through diversification and commercialization (MOFED, 2006; World Bank, 2007). In Ethiopia in 2010, for example, the average annual per capita income growth rate was 8.4% due to the emphasis given by PASDEP to commercialization and diversification of smallholder agriculture (MOFED, 2010).

Several researches including Pingali et al. (2005), FAO (2008) and Moti et al. (2009) has shown the impacts of the transition from subsistence to commercialized agricultural system in income generation, nutritional change, other social and economic dimension development, and production specialization both at regional and household level as well as production diversification at national level. Though subsistence farmers usually transform to commercial farming due to surplus crop production while producing staple foods; smallholder commercialization will lead to increased diversity of market oriented commodities at national level (Thorpe et al. 2000; Pingali et al., 2005). For example; experiences from Kenya in 2000 suggested that agricultural products from rural smallholder farmers contributed export items (60% of horticultural export, 62% of black tea and 80% of dairy output) that generated income and employment opportunity (Thorpe et al., 2000).

2.4. Progression in agricultural commercialization

The agricultural strategy the Ethiopian government aims, as in the PASDEP report outlined is to pursue a parallel shift in commercialization (MOFED, 2006). This shift has improved people’s livelihood; infrastructure development and expansion of social services; involvement of private investors and a remarkable real GDP growth of 8.4% (MOFED, 2010). Box 1 describes the public investment and services the PASDEP strategy outlined to facilitate and help jump-start the process of agricultural commercialization.

### Box 1. Accelerating market based agricultural development under PASDEP

In order to encourage smallholder farmers to transform in to market based agricultural system which will lead to economic growth and food security, the instruments used under PASDEP by the Ethiopian government includes:

- Constructing farm to market roads,
- Development of agricultural credit markets,
- Specialized extension services for differentiated agricultural zones and types of commercial agriculture,
- The development of national business plans and tailored packages for specialized export crops (such as spices, cut flowers, fruits and vegetables),
- Supporting small-scale irrigation and area irrigation through multi-purpose dams,
- Measures to improve land tenure security, and to make land available where feasible for large-scale commercial farming,
- Reforms to improve the availability of fertilizer and seeds and,
- Better-functioning agricultural markets for both inputs and outputs, and institutions, including improved value chains, information flows, quality and standards support, and cooperatives that strengthen the position of farmers in the market.

Source: MOFED, 2006
Although such national level progress has been witnessed by implementing the market based agricultural development initiative, most smallholder farmers still exercise subsistence agriculture (MOFED, 2010). An agricultural transformation process in which individual farms shift from a subsistence-oriented production towards more specialized with marketable surplus production can be characterized as agricultural commercialization (Moti et al., 2009).

Depending up on the different resources available to the households, agricultural transformation from subsistence to commercial production takes a longer process (Pingali and Rosegrant, 1995). This transformation process through which farmer’s pass is explained in different categories of farming typologies. The identification and categorization of rural population’s typology is a crucial aspect in the sustainable rural livelihood analysis. These typologies have different characteristics, constraints, priorities and attitudes for which different individual’s practice (in this case transforming to smallholder agricultural commercialization) which can impact differently on their livelihoods (Guido et al., 2012). In different literatures different definitions of farm typologies existed based on the specific characteristics each author used. Box 2 shows some examples of farm typology definitions.

**Box 2. Defining farm typology**

Pingali and Rosegrant (1995) and Moti et al., (2009) defined farm typology based on the comparative advantage the produced product have in the market as well as the major production objective and decision the household used. Based on those characteristics three levels of farm typologies were formed named subsistence, semi-commercial and commercial farming system. The specific characteristics the authors used in order to classify farming households in different farm typologies includes input and output markets, degree of specialization in production and dependence on markets for income and/or consumption the household uses.

<table>
<thead>
<tr>
<th>Farm typology</th>
<th>Farmers objective</th>
<th>Source of input</th>
<th>Product mix</th>
<th>Household income source</th>
<th>Human nutrition</th>
<th>Soil fertility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsistence system</td>
<td>Food self-sufficiency</td>
<td>Household generated (non traded)</td>
<td>Wide range</td>
<td>Pre-dominantly agriculture</td>
<td>Predominantly home produced</td>
<td>Farm yard manure (FYM)</td>
</tr>
<tr>
<td>Semi-commercial system</td>
<td>Surplus generation</td>
<td>Mix of traded and non-traded inputs</td>
<td>Moderately specialized</td>
<td>Agricultural and non agricultural</td>
<td>Home produced and purchased</td>
<td>FYM and chemical fertilizer</td>
</tr>
<tr>
<td>Commercial system</td>
<td>Profit maximization</td>
<td>Predominantly traded inputs</td>
<td>Highly specialized</td>
<td>Pre-dominantly non-agricultural</td>
<td>Predominantly purchased</td>
<td>Chemical fertilizer</td>
</tr>
</tbody>
</table>


On the other hand Guido et al. (2012) identified five main farming typologies based on livelihood analysis context as:

**Highly vulnerable people:**
This category consists of people having no or very limited access to livelihood assets and resources. They are often widows, families affected by HIV/AIDS or other diseases, etc.

**Landless:**
These are farmers who do not possess any land, depends on other’s land for cultivation by providing their labour

**Traditional smallholder farmers:**
These farmers produce mainly staple food (both crop and livestock) for household consumption and have relatively marginal connections to markets. The aim at stabilizing production and reduce risks of production failures.

**Emerging market-oriented smallholder farmers:**
These farmers may partially subsist from their own production but whose principal objective is to produce a marketable surplus.

**Commercial farmers:**
These are large or small-scale commercial farmers and enterprises that are fully oriented towards internal and export markets.
3. Methods

This study constitutes part of a large research project on Blue Nile/ Lake Tana Nexus project in Ethiopia undertaken under the auspices of Stockholm Environment Institute (SEI), aimed at studying the food, energy and water nexus issues in the region. This study is based on a survey conducted during April and May 2012, in the Ribb Sub-Catchment area of the Fogera woreda\textsuperscript{13}, which is part of the South Gonder Zone of the Amhara Regional State. This section is organized to include the descriptions of the study area, data sampling and collection procedure and the theoretical and empirical methodology of data analysis.

3.1. Description of the study area

Ribb River is found in Libo Kemkem and Fogera woredas and is one of the contributing Rivers of Lake Tana\textsuperscript{14}. The specific study area of the Ribb River sub-Catchment is located in the Fogera woreda of South Gonder zone. The Fogera woreda is bordered by Libo Kemkem woreda in the north, Dera woreda in the south, Lake Tana in the west and Farta woreda in the east (fig.2). Woreta is the capital of Fogera woreda and is located 625 km from Addis Ababa and 55 km north of the regional capital, Bahir Dar city. It is located at 11°44'-12°03'N latitude and 37°25'-37°58'E longitude (BoWRD, 2005).

\textbf{Figure.2.} Map of Ethiopia and location of the study area

Fogera woreda consists of plain or flat lands that account for 76% mountains, 11% hills and 13% valley bottoms classified locally as highland, midland and lowland topography levels. The total land area of the woreda is 117,405 ha with land holding ranging from 0.5 to 3.0 ha (BoARD, 2003). According to the Central Statistical Authority (CSA) the total population size of Fogera woreda in 2008 was 251,714 from which 129,093 are male and 122,621 are female. High

\textsuperscript{13} Woreda (which is an equivalent to a district) in Ethiopia is the third-level administrative division that is managed by a local government.

\textsuperscript{14} Lake Tana is Ethiopia's largest lake and it is the gateway to the Blue Nile Falls, river and the Zeghe Peninsula. It measures 68 km by 73 km and is famous for the churches and monasteries on 20 of the lake's 37 islands (BoARD, 2003).
population density of 233 people per km$^2$ was recorded for the woreda exerting severe pressure on natural resources of the area. The agro-ecology of Fogera plain is classified as Woina Dega (sub-humid), with average annual rainfall of about 1296 mm during the main rainy season (June to September). Agriculture in the area is characterized by small-scale subsistence mixed farming-system, with livestock production as an integral part. Hot-pepper appears to be the major crop cultivated during the rainy season where as Maize, Teff, Sorghum and Chickpea are also grown in smaller amount. Traditionally finger millet and fenugreek are cultivated as cash crops and since 1999 rice has also become one of the best cash crop grown in the lower catchment through flood based farming mechanism (ARARI, 2009), transforming the livelihood strategy of households in the lower catchment to market oriented strategy.

Generally the Amhara region has been under intensive economic and infrastructural development over the past 20 years. The region has an estimated density of 121.9 persons per km$^2$ making the region the second most densely populated region in Ethiopia. The economy of the Amhara region is highly dependent on irrigated agriculture, agro-industry, hydropower generation, tourism and other rural-urban development schemes. Some 18-20% of the region’s population is critically food insecure. The region is greatly endowed with a potential of irrigable land area of 0.6 million hectare, from which only about 76 thousand hectare is currently being irrigated (BoWRD, 2005). In order to maximize the total number of hectare being irrigated and to increase agricultural productivity, the Federal Government of Ethiopia is currently implementing irrigation and drainage projects funded by the World Bank. The region has also undergone through an intensive development interventions in large scale hydropower plants and infrastructure construction. Infrastructural development includes construction of asphalt roads from and to the major cities of the region. There are also all weathered roads within the woredas of the region. The availability of road has provided easily access to transportation where farmers could benefit from easily accessing of market. Other interventions by the Government include the establishment of health posts and primary schools in rural villages.

3.2. Sampling technique and Data collection

3.2.1. Sampling technique

The Fogera woreda was selected purposely to include the new irrigation development scheme in the Ribb River. This study used both qualitative and quantitative methods of data collection from both natural and social characteristics of the rural livelihoods system. A combination of primary and secondary data collection is used to identify the different variables that are considered to be key thresholds for farmer’s livelihood strategy. This approach has been chosen specifically for this study in order to capture the necessary interactions between the socio-economic and bio-physical components of the rural livelihood typologies.

3.2.2. Data collection

a) Primary data collection

The procedure of collecting household level data from selected participants was done in two phases. The first phase includes qualitative studies that involved key informant interviews and individual farmer’s interviews. This process has helped in identifying the key farm typologies definition used by the woreda Agriculture Office and was helpful in guiding the development of the formal questioners. Based on this informal survey, a representative seven Peasant Associations (PA), which is the smallest administrative unit, were purposely selected since those areas are part of an irrigation project conducted by the woreda Agricultural Office funded by the World Bank. From the chosen seven peasant associations (i.e., Weji, Alember, Addis Betekrstian, Wetenb, Avua Kokit, Zenge and Nabega), 15 farmers were randomly selected, making a total number of 102 households interviewed. The randomly selected households are categorized as those that use irrigation and those with out in order to evaluate the impact of irrigation access in agricultural system transformation.

The second phase of data collection included the individual interview conducted with the selected 102 households from the seven PA’s. These randomly selected households were individually interviewed using a semi-structured questionnaire (e.g Brenner et al., 1985; Bernard, 1994; Weiss, 1994) and ranking questions (e.g Mikkelsen 1995). An estimated 1.30 – 2.00 hours were spent in interviewing the informants. The interviews and discussions were held in Amharic, which is the main language spoken in the area. Both female headed and male headed households were selected and interviewed. In order to generate an honest answer and data from the respondents, the questioner is designed to include consistent information. The questions included in the final survey has covered household and farm characteristics of physical, socio-cultural/economic and institutional aspects (see Appendix 1).
b) Secondary data collection

Secondary data was collected through different literateur studies. Those include investment and policy briefs, laws, reports, articles, atlases etc; that are relevant to the study area and in addressing rural livelihood strategies have been included and analyzed.

3.3. Data analysis

The methods of data analysis used in the study include a descriptive statistics and econometric regression modelling. The data analyzing methods described briefly in this section are selected because it provides the quantifiable results in explaining to which farm typology each household belongs and the impact of smallholder agricultural transformation. Based on the sustainable rural livelihood framework (fig.1.), linkage between livelihood resources available for farmers and the outcome generated was analyzed.

3.3.1. Descriptive analysis approach

This part mainly focuses in analyzing the descriptive statistics of the data collected from the field survey. The analysis approach summarizes the data on household demographic and socio-economic characteristics, livelihood assets, strategies and outcomes, access to market, agricultural extension programme, soil quality, gender related issues and similar quantitative data generated by the survey.

3.3.2. Econometric analysis approach

I used an ordered logit regression to identify the enabling socio-economic and bio-physical factors for household to transform from below-subsistence farm typology to commercial farm typology. Ordered logit model creates successive iterations in order to fit the full model at sufficiently small log likelihood. The econometric model used to examine the factors that condition smallholder farming system to belong in different farm typologies of the study area is the ordered logit model. The advantage of ordered logit is its ability to analyze a dependent variable that has more than two categories where the value between each category has meaningful unobserved sequential order (Green, 2008; Wooldridge, 2002). This regression assumes the relationship between each pair of outcome group is the same, that in the case the coefficients that describe the relationship between the lowest (below-subsistence level farm typology) versus all the other categories of farm typology are the same as those that describe the relationship between the next lowest category (subsistence farm typology) and all higher category.

To describe the ordered logit model, let \( Y \) denote a random variable (farm typology in this case) taking on a positive integer values of 1, 2...\( j \). And let \( x \) denote a set of conditioning variables (household attributes, farm income, institutional framework, access to irrigation, soil fertility, topography and so forth). In order to answer how all other things held constant, changes in the elements of \( x \) affect the response probabilities \( P(y = j / x) \), \( j = 1, 2 ... j \) (where the probabilities will be summed to unity, \( P(y = j / x) \) after determining the probabilities for \( j = 2, ... j \) (Green et al., 2008).

In case of ordered logit we introduce a latent variable \( (y^*) \) which is not observed variable; however the properties of the variable are useful and intuitive.

- The latent variable takes a low value if household’s farm typology is below subsistence (\( y=1 \))
- Intermediate 1 value if household’s farm typology is subsistence (\( y=2 \))
- Intermediate 2 value if household’s farm typology is constant improving (\( y=3 \))
- High value if household’s farm typology is commercial (\( y=4 \))

Thus, the latent continuous variable model specification (including the logistic error term) is described as:

\[ y^*_j = \beta_1 + \beta_2 x_{2i} + \beta_3 x_{3i} + \ldots + \beta_n x_{ni} + \epsilon_i \]

Whereas the observed ordered categorical variable \( (y_j) \) model specification is described as:

\[ \frac{Pr(y_j > j)}{Pr(y_j \leq j)} = \exp \left[ -\gamma_j + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \ldots + \beta_n x_{ni} \right] \]

The ordered logit model compared to the ordered probit model which is also used in ordered choice model is widely used based on mathematical convenience and because of its ready revelation of “odds ratios” (see Berkson, 1951).
Where:  
\( y_i \) is farm typology  
\( x_i \) is the vector of other socio economic variables  
\( \beta_1, \ldots, \beta_n \) is the slopes of the equation in the model (the coefficients to be estimated)  
\( \beta_0 \) is the intercept  
\( \epsilon_i \) is the disturbance (error) term

However, the difference between the categories is unknown though the variables are inherently ordered resulting in low, intermediate 1, intermediate 2 and high values. By introducing threshold variables of \( y_{1}, y_{2}, \) and \( y_{3} \) we will be able to formulate the formal relationship between the latent (\( y_i^* \)) and observed (\( y_i \)) model specification is:

\[
y_i = \begin{cases} 
1 & \text{if } y_{i}^* \leq 0 \\
2 & \text{if } 0 \leq y_{i}^* \leq y_{2} \\
3 & \text{if } y_{2} \leq y_{i}^* \leq y_{3} \\
4 & \text{if } y_{3} \leq y_{i}^* 
\end{cases}
\]

The implied probabilities are obtained as:

\[
P(y_{i} = 1) = P(y_{i}^* \leq y_{1}) = P(X, \beta + \epsilon_i \leq y_{1}) = \Phi(y_{1} - X, \beta) \\
P(y_{i} = 2) = P(y_{1} < y_{i}^* \leq y_{2}) = P(X, \beta + \epsilon_i > y_{1}, \beta) = \Phi(y_{2} - X, \beta) - \Phi(y_{1} - X, \beta) \\
P(y_{i} = 3) = P(y_{2} < y_{i}^* \leq y_{3}) = P(X, \beta + \epsilon_i > y_{2}, \beta) = \Phi(y_{3} - X, \beta) - \Phi(y_{2} - X, \beta) \\
P(y_{i} = 4) = P(y_{i}^* > y_{3}) = P(X, \beta + \epsilon_i > y_{3}, \beta) = 1 - \Phi(y_{3} - X, \beta)
\]

Where \( \gamma \) is an unknown parameter that is estimated jointly with \( \beta \). We enter the above probabilities in a likelihood function and estimate them based on maximum likelihood method.
3.4. Definition of variables

Below is the definition of the variables used in the ordered logit econometric model. The model is useful in generating linkage between factors that determine smallholder farming system and smallholder agricultural transformation (commercialization). The variables are entered in to Stata statistical package which performs most general statistical analyses (such as: regression, logistic regression, ANOVA, factor analysis, and some multivariate analysis).

### 3.4.1. Dependent variable

**Farm typology:** is the dependent variable and four major types of farm typology were identified for the Ribb sub-catchment based on the local context of farmer’s production objective, consumption behaviour, input use and agricultural diversification and the market share of the produced farm output (Table 1). The variable takes a continuous positive integer value of:

1 if the household is in the farm typology of below-subsistence;
2 if the household is in the farm typology of subsistence;
3 if the household farm typology of constant improving and
4 if the household farm typology is commercial.

<table>
<thead>
<tr>
<th>Farm Typology</th>
<th>Consumption behaviour</th>
<th>Production objective</th>
<th>Input use</th>
<th>Market share</th>
<th>Overall characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below-subsistence</td>
<td>They under consume</td>
<td>They require</td>
<td>Homemade fertilizers and require</td>
<td>No market share</td>
<td>Households production isn’t sufficient enough to feed their family year long</td>
</tr>
<tr>
<td></td>
<td></td>
<td>production loan for consumption</td>
<td>seed loan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsistence</td>
<td>They struggle to feed their family from self production</td>
<td>Self sufficiency production objective</td>
<td>Uses seed and fertilizer from their home</td>
<td>No/minimal market share, if they sell product from their production it is in order to gain cash to buy other non-staple items for household consumption</td>
<td>Could barely feed their households all year along and they use traditional farming technique and they have to sell what they have in order to purchase other necessities through what they have produced</td>
</tr>
<tr>
<td>Constant improving</td>
<td>They consume from their production and maintain to have surplus production to improve their farming system</td>
<td>Produce surplus or marketable goods to get loan</td>
<td>Agricultural diversification is to minimal</td>
<td>Through surplus production sale</td>
<td>They will try to use some degree of technological innovations in their farming; where there will be surplus production after consumed by the household and will be marketed to generate additional income</td>
</tr>
<tr>
<td>Commercial</td>
<td>They consume both from self and purchased production</td>
<td>Market targeted production objective</td>
<td>Apply improved seeds and fertilizer for better production</td>
<td>Through sales of profit maximizing products</td>
<td>The cultivated products mostly are aimed for market and they also apply different technological innovations to improve their production</td>
</tr>
</tbody>
</table>

Table 1. Major Farm typologies in Ribb sub-catchment

Source: Authors interview with the Forgera woreda agricultural expert, 2012
3.4.2. Explanatory variables

Taking the measures and incentives made available by the government under the PASDEP strategy (refer Box 1), transformation of agricultural production into different farm typologies relies on a set of basic livelihood resources (natural, human, social, economic/financial capital). In order for a household’s farming system to go through agricultural transformation the following explanatory variables were hypothesized to affect the dependent variable.

A) Natural Capital

**Topography:** this variable is helpful in identifying the agricultural land use for farming and its characteristics for development. As per the definition given in MoWE (2010), the variable in the analysis is classified as:
- 0: Highland (characterized by very steep slopes in an intensively used, eroded and degraded landscape where production yield from these farms are minimal).
- 1: Middle section Ribb (characterized as the River is often incised and receives water flow from different tributes; have a relative resistance to land degradation and with a proper land and water management, sufficient production can be achieved).
- 2: Lowland (characterized by flooded plain, sediment deposition and river channel change where farmers practice flood based farming for high production output).

**Land holding:** the average size of agricultural land a household holds is hypothesized to benefit the households economically through production of agricultural products. In the analysis farm land size takes a numeric value to indicate the total land the household constitutes.

**Soil fertility:** this variable is important in understanding farmer’s farm land capability for agricultural development. By identifying the fertility status of soil, farmers apply different soil management that would enhance the fertility and yield higher output. In the Ribb sub-catchment soil fertility is identified based on soil color and texture since those criteria’s are helpful in identifying the soils water holding capacity, workability and fertilizer requirement (the level of soil nutrient). Therefore the values the variable use are categorized as:
- 0: Severely eroded (poor fertility)
- 1: Moderately fertile
- 2: Productive

**Irrigation:** to see the impact of access to irrigation in agricultural transformation, this variable uses a dummy value of 0 for households that do not have access to irrigation and therefore do not use and 1 for those that have access and are irrigation users.

**Farm land holding fragmentation:** this variable indicates the ratio of number of parcels owned by the household and the average parcel in the community. High farm land holding fragmentation occurs in the Eastern Amhara region (CSA, 2012), it is important to see the effect of fragmented land holding have in agricultural commercialization since the more fragmented the land holding is the more time it takes for the farmers to manage each land and with potential consequence in productivity.

B) Social and human capital

**Labour holding:** this variable is continues numeric variable. It is the number of adults in the household that can be used as labour holding for the agricultural system.

**Gender of the household head:** this variable takes a dummy value 0 if the household head sex is female and 1 if it is male.

**Household Head Age:** this variable takes an integer value in order to describe the association of age and agricultural transformation.

**Education level of Household head:** this variable takes a value of continues integer value based on the structure of Ethiopian education system (EMIS, 2010).
- 0: Illiterate

---

16 Farm land holding fragmentation is when household’s farm land constitutes with a number of separate farm plot that are located in different places.
1: Adult education (this is implies the household head can read and write)
2: 1st cycle education level (if the heads educational status ranges from 1-4)
3: 2nd cycle education level (if the heads educational status ranges from 5-8)
4: General secondary education level (if the heads educational status is 9 &10)
5: Preparatory level (if the heads educational status ranges between grade 11&12)
6: Technical and vocational education and training (TVET) the educational status for the household head is certificate.

C) Economic/financial capital

Livestock holding (TLU): livestock in Ethiopia is a major source of income, draught power for farming, asset, and nutritional source and as a means for transportation (ILCA, 1980). Different livestock species in the household have different value to the household depending up on the livestock work for their livelihood. In order to quantify household’s livestock asset as a single figure we use the tropical livestock unit (TLU) conversion factor. The specific value for most common livestock species that are commonly owned by the Ethiopian rural households for their livelihoods is described in Appendix 2. The TLU conversion factor uses “exchange ratio” where different species with different size can be compared and described to a common one unit (FAO, 1986).

Non-farm income: this variable describes the total amount of cash gained by the household from other nonfarm activities. This variable will help us identify if external income is a determining factor in transforming households farming system from one farm typology to the other (to most favorable one).

D) Institutional composition

Market infrastructure: having a good rural-urban market linkage is important in smallholder agricultural transformation in order for households to sell their marketable product in a good price. The variable takes a numeric value which describes the total time a household have to travel to get to the nearest market in minute. The total time travelled to the market indicates if the household have good access to market infrastructure (the availability of road and transportation)

Agricultural extension services: this variable takes a Yes or No value to identify if farmers get agricultural extension services or not. The agricultural extension service plays a vital role in creating awareness and educating people through promoting their participation in the supply of services, improving resource allocation and by making sure public services provided for the farmers are delivered effectively.

Cooperative membership: if the household is a member of any cooperative the variable takes a value of 1(Yes) or 0 (No) if otherwise. Cooperatives play a great role for households since they provide different kinds of services (sales of output, supplying improved seeds and fertilizer, etc...).
4. Results

This chapter presents the descriptive and econometrics results of the study based on the different agricultural typologies and rural livelihood strategies conducted by the sampled households. The results also identify the difference in farm income across farm typology. The enabling socio-economic and bio-physical conditions in transforming subsistence smallholder farming systems to a level of higher farm income status (smallholder commercialization) are analyzed and interpreted.

4.1. Descriptive results

This section discusses the descriptive statistics of the socio-economic and demographic characteristics of the sampled households. The result generated in this section answers the specific objectives by identifying the different farming typologies and rural livelihood strategies exercised by the sampled households in the study area. By applying descriptive statistics such as mean, frequency and percentage, the results compare sampled households with the available livelihood resources to draw important implications.

4.1.1. Natural capital

Based on data obtained from 102 households, I generated 12 different groups paired by farm typologies and topography as shown in Table 2. Most of the households (31.4%) are found to be at the subsistence level followed by those who are in constant improvement (28.4%), while the remaining 20.6% and 19.6% are below-subistence level and commercial households respectively. Looking at the different farm typologies of the different farm land topography, in highlands 37.9% out of the total 29 households are below-subistence level, whilst the majority (41.4%) are subsistence farmers, 17.2% are constant improving farm households and only 3.4% are found to be in the commercial farm typology.

Table 2. Percentage of interviewed household’s farm typology by farm land topography

<table>
<thead>
<tr>
<th>Farm typology</th>
<th>Highland (N=29)</th>
<th>Midland (N=33)</th>
<th>Lowland (N=40)</th>
<th>All cases (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below-Subsistence</td>
<td>37.9</td>
<td>21.2</td>
<td>7.5</td>
<td>20.6</td>
</tr>
<tr>
<td>Subsistence</td>
<td>41.4</td>
<td>30.3</td>
<td>25.0</td>
<td>31.4</td>
</tr>
<tr>
<td>Constant improving</td>
<td>17.2</td>
<td>30.3</td>
<td>35.0</td>
<td>28.4</td>
</tr>
<tr>
<td>Commercial</td>
<td>3.4</td>
<td>18.2</td>
<td>32.5</td>
<td>19.6</td>
</tr>
</tbody>
</table>

NB: N= the number of sampled households interviewed

For the midland of the study area, subsistence and constant improving farming households account for 30.3 percent of the households level identifying the households in this topography to have better chance in feeding their family members from their farm production and as well market their production in case of surplus. The value of 18.2% for commercial level farmers in the midland also indicates that when the farm land topography changes from upper (which is characterised by high degradation and poor soil fertility) to middle catchment, the number of farm households that are categorised in commercial farm typology increased. However, around 21.2% of the households from the midland are found to be below-subistence farm typology.

Higher percentage value was recorded for commercial farm typology in the lowland of 32.5% compared to the other farm typologies. About 35% of the sampled households in the lowland are in a constantly improving farm typology and only 7.5% are below-subistence level (Table 2). This indicates that farm land topography plays a great role in transforming agricultural households from below-subsistence level to commercial level. The result was consistent with the secondary data obtained from ARARI (2009), which indicates that households located at the lowland have been practicing flood based farming which transferred their livelihood to market oriented and targeted crop production (rice being the predominantly grown cash crop and then pepper).

The total area of land owned by the sample farmers was about 146.2 ha with the average of 1.4ha per household. The average land holding for below-subistence level farm typology is 0.5ha, 1.2ha for subsistence level, 1.7ha for constant improving farm typology and 2.5ha per person for commercial level agricultural households. This
The figure was consistent with secondary data obtained from BoARD (2003) which indicated that the average land holding for the total population of the local district ranges from 0.5 to 3.0 ha. The result indicates that landholdings of below-subsistence level households are smaller by about 80% than that of commercial level households. Moreover, it was found that the fertility of land in Ribb sub-catchment varies from productive plots to severely eroded plots. Only 25.5% of the total farm land is productive where as 36.3% and 38.2% are severely and moderately eroded respectively according to farmer’s judgment (Table 3). To avoid soil fertility losses, the farmers practice various soil and water conservation techniques like terracing, cut off drain and tree planting.

Table 3. Land fertility in plot erosion (%)

<table>
<thead>
<tr>
<th>Degree of soil fertility</th>
<th>Severely eroded</th>
<th>Moderately eroded</th>
<th>Productive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below-Subsistence (N=21)</td>
<td>61.9</td>
<td>38.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Subsistence (N=32)</td>
<td>62.5</td>
<td>21.9</td>
<td>15.6</td>
</tr>
<tr>
<td>Constant Improving (N=29)</td>
<td>10.3</td>
<td>55.2</td>
<td>34.5</td>
</tr>
<tr>
<td>Commercial (N=20)</td>
<td>5.0</td>
<td>40.0</td>
<td>55.0</td>
</tr>
<tr>
<td>All cases (N=102)</td>
<td>36.3</td>
<td>38.2</td>
<td>25.5</td>
</tr>
</tbody>
</table>

Another important farm characteristic in smallholder agricultural system is the distribution of farm land fragmentation. The ratio between the total plot owned by the household to the average parcel owned by the community is used to describe land fragmentation. A larger proportion of the households (28.57%) in below-sub-subsistence farm typology have land fragmentation ratio of 0.24, this implies the number of plot owned by the household is less for this farm typology. In contrast commercial farm households have higher (25%) land fragmentation of 1.44 and 0.96 indicating that more plot is owned in this farm typology. Most people responded to having a fragmented farm holding by renting it out rather than farming it themselves since it requires too much labour time as well as energy to manage each plot properly. From the result it was found that constant improving and commercial farm typology have larger farm land fragmentation which implies those farm households have large land holding either from renting in or owning. Having a larger land fragmentation and be able to stay in a higher welfare status of commercial or constant improving farm typology implies that, land fragmentation plays a great role in agricultural transformation. The main reason for this is since the parcels owned by the household are located in different agro-ecological conditions, it has helped households to produce different types of crops (diversify) and minimize disasters (such as crop failure, disease, pests and other environmental disaster).

Table 4. Percentage of farm land fragmentation for the sampled households

<table>
<thead>
<tr>
<th>Land fragmentation</th>
<th>Below-Subsistence (N=21)</th>
<th>Subsistence (N=32)</th>
<th>Constant Improving (N=29)</th>
<th>Commercial (N=20)</th>
<th>All (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.24</td>
<td>28.57</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5.88</td>
</tr>
<tr>
<td>0.48</td>
<td>23.81</td>
<td>6.25</td>
<td>7.41</td>
<td>5</td>
<td>9.80</td>
</tr>
<tr>
<td>0.72</td>
<td>19.05</td>
<td>21.88</td>
<td>25.93</td>
<td>10</td>
<td>19.61</td>
</tr>
<tr>
<td>0.96</td>
<td>23.81</td>
<td>37.50</td>
<td>18.52</td>
<td>25</td>
<td>26.47</td>
</tr>
<tr>
<td>1.2</td>
<td>4.76</td>
<td>18.75</td>
<td>14.81</td>
<td>20</td>
<td>14.71</td>
</tr>
<tr>
<td>1.44</td>
<td>0</td>
<td>6.25</td>
<td>22.22</td>
<td>25</td>
<td>12.75</td>
</tr>
<tr>
<td>1.67</td>
<td>0</td>
<td>9.38</td>
<td>3.70</td>
<td>10</td>
<td>7.84</td>
</tr>
<tr>
<td>1.91</td>
<td>0</td>
<td>0</td>
<td>7.41</td>
<td>5</td>
<td>2.94</td>
</tr>
</tbody>
</table>

Water is a perquisite in smallholder agricultural transformation. In the Ribb sub-Catchment, water supply is generally adequate in the rainy season though over the past several years erratic and uneven rainfall distribution has been witnessed. The Ethiopian government has launched irrigation and drainage projects in the region to increases agricultural productivity during dry seasons. According to the result from the survey 47.1% of the sampled households are irrigation users from which 37.5% of the households reside in the midland catchment, 33.3% are in the lowland catchment and the remaining 29.2% are in the highland catchment. From the data collected the majority of below-subsistence level (61.9%) and subsistence level households (53.1%) are non-users of irrigation (Table 5); whereas, for constant improving and commercial level households the majority are irrigation users with 51.7% and 50% respectively. The result clearly shows the importance of water availability in transformation and commercialization of smallholder agricultural system. For households in the highland of
the catchment, irrigation from rivers and springs act as a source of water for agricultural production. Whereas for
the low land catchment flooding during rainy season as well as irrigating rivers and ponds are used as a source of
water which contributed for households agriculture to transform to constant improving and commercial
agricultural typologies.

Table 5. Respondents access to irrigation (%)

<table>
<thead>
<tr>
<th></th>
<th>Irrigation users</th>
<th>Non-users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below-Subsistence (N=21)</td>
<td>38.1</td>
<td>61.9</td>
</tr>
<tr>
<td>Subsistence (N=32)</td>
<td>46.9</td>
<td>53.1</td>
</tr>
<tr>
<td>Constant improving (N=29)</td>
<td>51.7</td>
<td>48.3</td>
</tr>
<tr>
<td>Commercial (N=20)</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>All cases (N=102)</td>
<td>47.1</td>
<td>52.9</td>
</tr>
</tbody>
</table>

From the data, households in the study area also perform water harvesting techniques in addition to irrigating
their farm land. In order to store and stabilize water availability for their agricultural and day to day life activity,
the most common water harvesting technique used are constructing traditional ditches, raised boundary buds and
small wells constructed from stone/soil. In the highlands of the study area, 48.3% practices rain fed agricultural
harvesting; whereas the remaining 51.7% uses irrigation through cut-off drains or artificial water ways. In the
midland and lowland catchment areas, 27.3% and 27.5% respectively practice flood based agricultural
harvesting. In the midland 54.5% irrigate their lands while 18.2% still practices rain fed agricultural harvesting
system.

4.1.2. Social and human capital

Table 6 shows the demographic composition of sampled households. The majority (85.3%) of the interviewed
households are male headed (MHH), whereas female headed households (FHH) account for 14.7%. One of the
major reasons for higher number of MHHs in the study area is because FHHs tend to shift their livelihood
strategy from agriculture to small business due to social factors. Men inherit farm land from their family, whilst
women only get farm land if married to a person who owns land or in cases where there is no male sibling to
inherit the land. About 66.7% of FHHs that practice agriculture as their major livelihood strategy in the study
area are below-subsistence farmers and 6.7% lies in the commercial farm typology. In the case of MHH, the
majority (33.3%) of the households are constant improving farmers, while only a few of the MHHs (12.6%) are
below-subsistence level. Since the number of MHHs and FHHs are not relative it is hard to conclude if
household head’s sex has impact in smallholder agricultural transformation.

Table 6. Demographic characteristics of the interviewed respondent in each farm typology

<table>
<thead>
<tr>
<th></th>
<th>Sex of household head (%)</th>
<th>Average age of household</th>
<th>Average family size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>head</td>
</tr>
<tr>
<td>Below-Subsistence (N=21)</td>
<td>12.6</td>
<td>66.7</td>
<td>37.2</td>
</tr>
<tr>
<td>Subsistence (N=32)</td>
<td>32.2</td>
<td>26.7</td>
<td>42.8</td>
</tr>
<tr>
<td>Constant improving</td>
<td></td>
<td></td>
<td>41.7</td>
</tr>
<tr>
<td>(N=29)</td>
<td>33.3</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Commercial (N=20)</td>
<td>21.8</td>
<td>6.7</td>
<td>47.8</td>
</tr>
<tr>
<td>All cases (N=102)</td>
<td><strong>85.3</strong></td>
<td><strong>14.7</strong></td>
<td><strong>42.25</strong></td>
</tr>
</tbody>
</table>

The age structure for the total households shows an average of 42.25 years with the minimum and maximum age
of 20 and 76 years respectively. The average age for commercial farm households (47.8 years) is found to be
greater than for those below-subsistence farm households (37.2). The average household size in the study area
is 5.63 people, with a range of 1 to 10 people residing per household. Comparing the average household size for
each typology, Table 6 shows average family size increases as the farm typology improves. I calculated family
size in adult equivalent (AE) and the standard conversion factors used is given in Appendix 3. The major source
of agricultural labour is family labour which consists of the labour force of all adult people residing within the
household. The result shows that the average family size for below-subsistence farmers is 4.1 whereas it is 7.0
for commercial farming household. This implies that increases in average family size have a high impact in
transforming household’s agriculture.
As shown in Table 7, the education status indicates that about 35.3% of the households were illiterate, 31.4% attended adult education classes while around 17.6% have 1st cycle education level and only 4.9% have general secondary school level. Furthermore, 69.1% of below-subsistence level households are illiterate; 23.8% can read and write and the remaining 14.3% have 1st cycle education level. In contrast, about 25% of commercial level households were illiterate; 30% can read and write; 25% have first cycle educational level; 15% have second cycle educational level and about 5% have a general secondary educational level. The results indicate that percentage of illiterate household head decreases as the farm typology improves. Looking at the structure of the Ethiopian educational system listed by EMIS (2010), head of the sampled households have a maximum educational level of general secondary level (grade 9&10). The reason to why there are no household heads in the study area that have educational level greater than secondary schooling is mainly because their livelihood strategy changes from agriculture to other source of livelihood.

Table 7. Education status of household head (%)

<table>
<thead>
<tr>
<th>Education level</th>
<th>Illiterate</th>
<th>Adult Education (Read and write)</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; cycle (grade 1-4)</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; cycle (grade 5-8)</th>
<th>General secondary (grade 9&amp;10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below-Subsistence (N=21)</td>
<td>61.9</td>
<td>23.8</td>
<td>14.3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Subsistence (N=32)</td>
<td>31.3</td>
<td>40.6</td>
<td>12.5</td>
<td>12.5</td>
<td>3.1</td>
</tr>
<tr>
<td>Constant improving (N=29)</td>
<td>27.6</td>
<td>27.6</td>
<td>20.7</td>
<td>13.8</td>
<td>10.3</td>
</tr>
<tr>
<td>Commercial (N=20)</td>
<td>25.0</td>
<td>30</td>
<td>25.0</td>
<td>15.0</td>
<td>5</td>
</tr>
<tr>
<td>All cases (N=102)</td>
<td>35.3</td>
<td>31.4</td>
<td>17.6</td>
<td>10.8</td>
<td>4.9</td>
</tr>
</tbody>
</table>

### 4.1.3. Economic characteristics and financial capital

In general, the major livelihood strategy practiced in the study area is mixed-farming system where as extracting and selling sand along the river banks are also practiced by youth, landless and the poor. Off-farm employment is also another major livelihood strategy practiced in the study area. From the sampled households 60% of commercial farmers practice mixed crop production as their major livelihood strategy where as 25% of the households have livestock fattening incorporated (Table 8). Also 10% of the commercial farm typology households earn income through vegetable farming as their second most important activity for income generation where as 5% of the commercial farmers practice bee keeping as their second most important livelihood strategy. For below-subsistence level farmers, 52.4% practice mixed crop production as their primary income generator or livelihood strategy where as 38.1% integrates poultry farming with their crop production. The mean livestock size owned by the sample farmers is 4.5 TLU. Where comparison of the livestock ownership between each farm typology shows that below-subsistence farmers on average own 2.1 TLU, subsistence farmers on average own 3.8 TLU, constant improving farmers on average own 5.7 TLU, and commercial farmers on average own 6.6 TLU per household. This implies that livestock holding increases when households farming system improves and indicates the wealth status a household holds since livestock holding is considered as a measure of farm households wealth in the study area.

Table 8. Major livelihood strategy used by the respondents (%)

<table>
<thead>
<tr>
<th>Livelihood Strategy</th>
<th>Below-Subsistence (N=21)</th>
<th>Subsistence (N=32)</th>
<th>Constant Improving (N=29)</th>
<th>Commercial (N=20)</th>
<th>All cases (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed crop production</td>
<td>52.4</td>
<td>56.3</td>
<td>51.7</td>
<td>60.0</td>
<td>54.9</td>
</tr>
<tr>
<td>Crop production and Poultry farming</td>
<td>38.1</td>
<td>25.0</td>
<td>10.3</td>
<td>0.0</td>
<td>18.6</td>
</tr>
<tr>
<td>Crop production and Livestock fattening</td>
<td>4.8</td>
<td>6.3</td>
<td>20.7</td>
<td>25.0</td>
<td>13.7</td>
</tr>
<tr>
<td>Crop production and Vegetable farming</td>
<td>4.8</td>
<td>6.3</td>
<td>17.2</td>
<td>10.0</td>
<td>9.8</td>
</tr>
<tr>
<td>Crop production and Bee keeping</td>
<td>0.0</td>
<td>6.3</td>
<td>0.0</td>
<td>5.0</td>
<td>2.9</td>
</tr>
</tbody>
</table>
4.1.4. Institutional characteristics

Having access to different kinds of agricultural services is important in transforming smallholder agriculture. From the field research, households are part of existing institutions in the study area which have been helpful in promoting people’s participation in adopting new and improved agricultural production. Extension services, cooperatives, credit and market organizations, microfinance institutions and irrigation associations are some of the major institutions the sampled households are actively participating.

**Market infrastructure**, for households to transform to commercial agricultural system it is necessary to have a working market infrastructure through which households could easily deliver their products. Having good access to road, transportation and a working market linkage between urban and rural have a great influence in agricultural commercialization. On average households residing in the highlands of the catchment travel 2.3hrs to get to the nearest market, in the midland area the average time spent in travelling to the nearest market is 3.7 whereas for the lowland catchment travel 2.1hr on average (Table 9). This indicates that households residing in the lowland and highland area are closer to the nearby market compared to the households residing in the midland area.

Table 9. Market infrastructure in the study area

<table>
<thead>
<tr>
<th>Market distance</th>
<th>Highland</th>
<th>2.3hrs</th>
<th>Midland</th>
<th>3.7hrs</th>
<th>Lowland</th>
<th>2.1hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market information</td>
<td>Neighbors</td>
<td>85%</td>
<td>Radio</td>
<td>8%</td>
<td>Traders</td>
<td>7%</td>
</tr>
</tbody>
</table>

Households in the study area receive market information from neighbours, radio and traders (Table 9). The majority of households (85%) take their agricultural production to the market based on the price and other information they get from their neighbours. Farmers trust the information generated from their neighbours and act accordingly than they get from the radio and traders. This is mainly because in the Ribb sub-Catchment agricultural products are sold in the market through the involvement of brokers who act as price setters for that product. Brokers are not legal price makers but since they transport most of the received products to larger markets and cities they manipulate the pricing system.

**Cooperatives**: the major cooperatives households are member too in the study area is farmers cooperative with large number of households from each farm typology are a member too (Table 10). Due to the variety of service farmers cooperative provide to farming households it is common for households to be a member there. It was only 2 households from constant improving farm typology that uses microfinance institution to get credit to improve their agricultural system. Households from commercial (2) and constant improving (3) farm typology are also the ones that are a member in the fishery cooperative that existed in the area.

Table 10. Major cooperatives sampled households are a member to (in number)

<table>
<thead>
<tr>
<th></th>
<th>Below-Subsistence (N=21)</th>
<th>Subsistence (N=32)</th>
<th>Constant Improving (N=29)</th>
<th>Commercial (N=20)</th>
<th>All cases (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation cooperative</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td>Farmers cooperative</td>
<td>13</td>
<td>22</td>
<td>14</td>
<td>8</td>
<td>57</td>
</tr>
<tr>
<td>Fishing cooperative</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Extension service</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>Micro Finance</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

4.2. Econometric results

Based on the basic livelihood resources available to the households and general agricultural characteristics, the ordered logit regression analysis helped to identify the factors that determine household’s transformation between farming typology. Out of the thirteen variables included in the analysis, six variables were found to have significant effect in transforming households farming system from below-subsistence level to commercial
farming system (Table 11). Those variables are topography, land fragmentation; land size, livestock holding in terms of TLU, irrigation and non-farm income.

Table 11. Results from Ordered Logit Regression (dependent variable: Farming typology)

| Variables                              | Coefficient | Standard Error | z     | P>|z| |
|----------------------------------------|-------------|----------------|-------|------|
| Topography                             | -.0674246   | .02837         | -2.38 | 0.017** |
| Land holding                           | -.397656    | .02385         | -1.57 | 0.095*  |
| Soil fertility                         | .0198884    | .01694         | 1.17  | 0.240  |
| Irrigation                             | -.0728411   | .03522         | -2.07 | 0.039** |
| Farm land holding fragmentation        | -.0000263   | .00001         | -1.85 | 0.064*  |
| Labour holding                         | -.0067546   | .00874         | -0.77 | 0.439  |
| Gender of household head               | .594559     | .04861         | 1.22  | 0.221  |
| Household Head Age                     | -.0003881   | .00117         | -0.33 | 0.740  |
| Education level of Household head      | .0000194    | .00033         | 0.06  | 0.953  |
| Livestock holding                      | -.0203527   | .00755         | -2.69 | 0.007** |
| Non-farm income                        | -.210e-06   | .00000         | -1.68 | 0.092*  |
| Agricultural extension services        | -.0029519   | .00282         | -1.05 | 0.295  |
| Cooperative membership                 | .0039352    | .00341         | 1.16  | 0.248  |

Ordered logistic regression       Number of obs = 102
LR chi2(15) = 65.34
Prob > chi2 = 0.0000
Pseudo R2 = 0.2949
Log likelihood = -78.099167

Marginal effects after ologit

y = Pr(farmtypo== Below-subsistence level) (predict)
= .06699499

*statistical significant at 10% and ** statistical significant at 5%

The p-value 0.017 for topography indicates that as topography changes from highland to midland and from midland to lowland, the likelihood of the household being in commercial farm typology versus the other farm typology increases by factor of 2.38 given that all other variables in the model are held constant. Farming land size is also a determining factor in agricultural transformation where a one unit increases in the size of household’s farm land, the likelihood of farm typology shifts from lower to higher by a factor of 1.57. The estimated coefficient for irrigation 0.039 indicates that a unit increases in irrigation use by the household is more likely to change their farm typology from lower level to higher farm typology at a factor of 2.07. Increase in land fragmentation also increases the likelihood of smallholder agricultural transformation from lower farm typology to higher by 1.85 given all other variables in the model is held constant. As the livestock holding increases, the likelihood of farming system to transform from lowers farm typology to commercial increases by a factor of 2.59. Having non-farm income to supplement agricultural transformation have also a positive implication in transforming household’s farm typology from lower level to higher and more desired one by a factor of 1.68.

As it is further seen in Table 11, the coefficient estimates for the rest of the variables in the model such as soil fertility, market infrastructure, household labour holding and sex of the head are not statistically significant. Even though those variables had a positive impact and has been found to be the characteristics of commercial farm typology compared to the others in the descriptive analysis, the econometric analysis found them to be insignificant. This is mainly because those variables alone cannot have an impact in transforming households to better farm typology. For example, having market infrastructure alone cannot transform households to be commercial farmers since they would require having land to grow their crops on and be able to sale it in the market that is provided to them. The same goes with labour holding, sex of household head and soil fertility. Those variables will only have a positive impact in transforming households from below-subsistence level farm typology to subsistence and to constant improving and finally to commercial farm typology only if other variables such as land, irrigation, livestock and other variables is available to them.

20
4.3. Difference in farm income across farm typologies

Farm income in this analysis only includes the income gained by the household from sales of agricultural products produced by the household. This is helpful in identifying the farm income level a farm typology possesses only by performing agriculture as their primary livelihood strategy since there are alternative livelihood (off-farm and non-farm) activities applied by households to generate income. As it can be seen in Figure 3, the income difference between each farm typology is indicated with the corresponding grid line. The income difference i.e the difference between farm income gained from 32 subsistence level farm households and 21 below-subsistence level farm households in the study area is 780,517 ETB\(^{17}\). The result indicates a 265.7% increases in income gained from sales of agricultural products by subsistence farm typology than below-subsistence farm typology from the sampled households. In the case of constant improving farm households and subsistence level, the difference in farm income is 642,473 ETB. From subsistence level farm typology to constant improving the farm income gained increases is 59.8%. Since households are classified based on their production objective and their market share, farm income gained by commercial farm typology households shows a 124.5% increases from farm income gained by constant improving households. The difference between farm income gained from 20 commercial level farm households and 29 constant improving level farm households is 2,137,410 ETB (Figure 3).

Figure 3. Difference in farm income across farm typology (ETB/yr)

![Figure 3. Difference in farm income across farm typology (ETB/yr)](image)

Figure 4 shows the overall income range gained from the sales of agricultural product across each farm typology. The mean income gained from sales of agricultural products by below-subsistence level farm typology is 2,507ETB. Even though the below-subsistence level farm households are defined as those with no market share, the result indicates that some of the households had a market share earning farm income ranging from 0 to 7,500ETB for the last year. The reason behind the income gain from farm products sale for some households in the below subsistence level is the occurrence of good production season that resulted for households to put some of their product to market and be able to pay back some of the loans they took. With self-sufficiency as the production objective and very minimal market share; households belonging to subsistence level farm typology from the sampled household have a mean farm income of 8,407ETB. The income gained from the sales of farm outputs by subsistence level households ranges from 7,500 to 17,689ETB. In the case of constant improving farm typology, the farm income gain ranges from 14,500 to 253,100ETB. For commercial level farm typology the income gained from sales of farm product produced by a household ranges from 50,000 to 877,450 ETB. With mean farm income of 309,156ETB, households in commercial level farm typology have high market share from the produced farm outputs. Even though the mean farm income gained by constant improving farm typology is greater than the minimum farm income gained by commercial level farm typology, based on the production objective households with income of 50,000ETB remain to be classified as commercial level farm typology.

\(^{17}\) 1 ETB (Ethiopian Birr) = 0.37 Swedish Crowns
The income gained from farm production mainly goes to household consumption since the main target of the households is ensuring food sufficiency and security. From the analysis it was found that the majority of the households (24.2%) allocate their surplus income to improving their household through purchase of assets such as livestock, radio, TV, stoves and improving the house they live in. About 18.3% of the responded allocate the surplus income gained from sales of agricultural production to sending out their kids to school. This shows that through investing in human development households aspire to change their kid’s quality of life. About 15.9% allocate the income surplus for medication. The remaining households allocate their income surplus to improve their agricultural system by purchasing production inputs (fertilizer, pesticides and chemicals) (13.5%), to purchase improved seeds (10.2%), to rent in land (11.9%) and to purchase water pumps (5.9%).
5. Discussion

This section discusses the result found from the field survey which is helpful in answering the research question of what are the enabling socio-economic and bio-physical conditions for the transformation of subsistence smallholder farming systems to a level of better welfare status for a sustainable rural livelihood.

5.1. Enabling factors for agricultural transformation

Farm land topography has a positive association in transforming farm households from below-subsistence level to subsistence to constant improving and then to commercial level. Since the study looks at small-scale farm households agricultural transformation takes a long process of transforming from one farm typology to another. Both econometric and descriptive analysis result indicates that topography have positive impact in agricultural transformation. Households in the lowland and midland compared to highland benefits largely by growing cash crops such as rice and pepper because the land receives sediments and other soil nutrient components since the area is prone to flooding. This has resulted in a positive impact in farmer’s income where their living standards have changed through time. Due to the flooding of the lowland catchment farmers also benefit from rice production, which has a high market value. Flooding may have benefited the farmers in planting cash crops by providing fertile soil, but farmers residing in those areas have also listed flooding to be as one of the major bio-physical constraints they face in agricultural transformation where un-timely flooding have destroyed the grown crops. Interventions by the government and the households have been seen in order to control the damage flooding may have by applying water harvesting methods which in return have resulted in a positive impact to the community and the households from which they were able to harvest multiple time.

From both statistical and qualitative finding, using irrigation is important in transforming households to better farm typology. Greater intervention by the government has been done in recent years through the development of small-scale irrigation schemes to encourage smallholder agricultural commercialization. The evidence shows that farmers have started to grow crops which were not previously grown in the area which has impacted their income in a positive way and transform to a better farm typology. Households have started to incorporate vegetable farming as an integral livelihood strategy. The farmers themselves witnessed that it has a positive impact on their income as well as on the living standard of their families. Access to agricultural water supply plays critical role in the sustainable livelihoods of rural people since households will be able to harvest more than once a year through their irrigated fields. Furthermore, irrigation is one of the options which increase yield and output by facilitating diversification of products being grown and reducing vulnerability of rainfall season. Meanwhile; effort still needs to be made on provision of technical assistance to farmers in supplying variety of seeds, herbicides, pesticides and training provision in order to motivate farmers to reach to a commercial level farming typology. It is necessary to provide good market access in order to increase the magnitude of beneficiaries that produces perishable products such as vegetable through market and infrastructure accessibility. In addition, the finding also revealed that the un-timely availability of inputs and credit have affected farmers agricultural transformation. Therefore, intervention is needed on the availability of institutional support services such as input supply and credit extension.

Household asset such as farm land and livestock plays vital role in transforming smallholder agriculture to economically viable one. Both statistical and descriptive evidence indicated that, households which have larger size of land for agriculture and with higher TLU have positive association in household belonging to a higher farm typology. Since livestock is important for ploughing owning livestock can make farmers to transform to a better farm income and is therefore plays a great role in smallholder agriculture transformation. Moreover, livestock rearing is highly practiced by smallholder farmers as income generation activity transforming the households to favourable farm typology and earn better income. Households also earn extra income by selling livestock by-products which provide extra cash for the household’s basic necessity. When households have larger amount of farm land it is possible for them to diversify their crop production which is important in planting staple foods for home consumption and in turn to produce cash crops. This statistical result is found to be consistent with the descriptive result found in the study area where a large number of households having an average farm land of 2.5ha per person in commercial farming typology.

From the descriptive analysis, it was found that land fragmentation can hinder farm households from transforming to higher farm typology due to the distance they have to travel between each plot which makes it hard to properly and equally manage it. But in the econometric result it is found to be an enabling condition for farmers to transform to more desired farm typology. This is due to the fragmented land holding result in a
landscape of agro-ecological diversity which is helpful in reducing the risk of total crop failure for smallholder farmers. The analysis also indicated land fragmentation has both positive and negative relationship in transforming subsistence households to commercial level. Difference in the topography of each fragmented farm land, soil fertility, water availability and input requirement will benefit farmers to be shock resistance. Whereas managing each plot with few labour and livestock holding is a negative impact land fragmentation have. It was found from the result that households take the initiative to invest more in commercialization their agricultural system when they have supporting income from other livelihood strategy. The finding supports the sustainable livelihood framework (Scoones, 1998) which indicated that “sustainable rural livelihood can be achieved though integrating different livelihood strategies”. This is because households will be motivated to invest in improving their agricultural system if they have disposable income for their livelihood needs and helps them to be risk takers in adopting new technology and production.

The research evidence shows that access to markets have a positive impact in agricultural transformation. Since commercial farming system has a market oriented production objective it is necessary for households to reside closer to a market where they would sell their products. Major constraints listed by the sampled households with regards to market infrastructure are the poor pricing system that is set by brokers. Such system has made most households to be reserved in investing in agricultural development works in fear of having fewer prices for their product. Since the middlemen’s are profit making business people the price they estimate for agricultural product usually are very low and do not account the production price farmers exert in the first place. There are cooperatives that help in providing market linkages between rural and urban areas where member farmers benefit from that. Farmers have also indicated lack of storage has prevented them in getting the right price for their production. Commonly smallholder farmers use their own storage system where surplus production needs to be sold with fewer prices due to shortage of storage space. Combinations of the wide range of informal and formal institutions and organizations operating at different levels influence different people’s abilities to pursue combinations of different livelihood strategies, with what results for sustainable livelihood outcomes.

Farmers cooperatives provides basic advice and knowledge which have been effective in the lowland catchment of the study area where households have transformed their farming system to market oriented by producing rice and paper solely for sale. Farmer’s cooperative also provides major agricultural inputs such as improved seeds, fertilizers and farm implements. The cooperative also serves as a credit and saving institution which is usually used by the farmers due to its easiness to get loan at lower interest rate compared to the microfinance institutions that functions largely in the country. Microfinance institutions provide credit and loans for agricultural development through different payment procedures. Even though the service is provided in the service area, respondents have indicated that in fear of high interest rate and requirement of collateral to get loan, farmers did not utilize the provided service properly. Though cooperatives provide credit for the farmers, it is not a sufficient system to rely on the cooperatives for loan and amending the procedure in the microfinance is needed for better agricultural development and commercialization. Cooperatives also play a big role in providing market information and distribution of major products for their members. Irrigation cooperatives play a vital role by providing water pumps for households who cultivate using irrigation. Fishery cooperatives provide market opportunity in which harvested fish are sold to the nearby city and town. Local communities also rely in informal cooperatives (iqub, edir, debo and mahiber) where they maximize their agricultural production through saving, credit, sharing and renting out of land, drought animal and labour in order to share risk or in time of need.

Extension services provide support, training and advice for better agricultural production through skilled development agents (DA’s). The major services provided through extension workers are providing technical assistance, capacity building, demonstration and supply of training materials, providing market information, advocating adaptation of water harvesting methods, providing education in health and family planning. Agricultural extension services have played a great role in introducing rice plantation in the lowland catchment which has improved households livelihood through agricultural commercialization. In the highland catchment of the river, vegetable farming has been integrated in their farming system in order to get extra income to improve their livelihood.

5.2. Constraints factors for agricultural transformation

Different constraints reduce crop production and productivity in the study area which makes households to be less motivated or unable to invest in new practice that would transform them to better livelihood standard. Biophysical, socio-economic, cultural and institutional constraints hinder households in the Ribb sub-Catchment to transform to commercial farm typology.
Bio-physical: draught, insects and pests, weeds, diseases and floods are the major problems the study area faces. Households have strongly pointed out the unpredictable rainfall pattern the area received in recent years have resulted in excessive irrigation water discharge, drainage impediment and moisture stress caused by flooding from rivers that swell and overflow the farm land during the main rainy season. This has hindered crop growth at its critical stage as the common problem their community face. Moreover, the water logging condition and high humidity have also accelerated pest and disease infestation which has made horticultural crops to be damaged.

Socio-economic: such as high price of improved inputs (seed and fertilizer), unreasonable price estimation of agricultural products by traders, timely un-availability of improved seeds and fertilizers, poor quality of seeds in the market, un-availability of credit to buy seed and fertilizers, lack of storage facility where households could store in case of surplus production, labour intensive and time consuming traditional ploughing system using animal power and lack/ poor access to markets and information.

Land tenure right is one of the constraint households in the study area face. Although from the discussion with sampled households, weak land tenure governance has both positive and negative effect in smallholder agricultural transformation. In the 1991 constitution land is owned by state and the state can take any land for “better development”. Even though better development was not clearly stated by the constitution, smallholder farmers are becoming more motivated to move up to commercial farming system in hope that their land will not be taken for “better development” since their farming system will also be considered as one. In some cases farmers have also lost their motivation to invest in their farm land do you to the land right uncertainty that they tend to shift to other livelihood strategy abandoning their farm land. It is therefore important to develop clear land-use and agricultural policies in order for agricultural transformation which is important in sketching for sustainable rural livelihood path.

5.3. Implications for policy

From the field data it was found that households who are in commercial farm typology tend to diversify in crop production where as definition for commercial farm typology by Moti et al., (2009) indicated that household specialize. Since smallholder commercialization occurs through staple crop production, it is necessary to control farms becoming very specialized. In the Ribb sub-Catchment, flooding have resulted in rice production which have high commercial value and if households shift in producing only rice because of its economic return then securing food may be a problem. It is also necessary to look at the environmental implication smallholder transformation may have. Households have become very dependent in using fertilizer for higher agricultural yield due to poor soil fertility. This in return have a bad consequence in the water bodies of the region as well as in the downstream of the catchment. Under the implementation phase of the PASDEP, change has been witnessed in smallholder commercialization, though the measures to improve land tenure security have not been clearly defined. The report doesn’t indicate what kind of land would be available to large-scale farming system and who those stakeholders are. Clearly stating the aim of accelerating market based agricultural development under PASDEP and while implementing GTP is necessary if the country wants to continue in smallholder agricultural commercialization and improve rural livelihoods.
6. Conclusion

The study was undertaken in view of examining the importance of agricultural transformation to achieve sustainable livelihood in rural Ethiopia. Furthermore attempts have been made to classify sampled households into different farm typology based on household’s farm production objective. The result indicated the existence of four types of farm typology named below-subsistence, subsistence, constant improving and commercial level farm typologies. The generated results have looked at the different agricultural transformation components provided by PASDEP and their impact in transforming smallholder households across the identified farm typologies. From the components provided by PASDEP for smallholder agricultural transformation, irrigation has a significant effect in transforming subsistence smallholder farming system to the level of better welfare status in the study area. Supporting small-scale irrigation and introducing area irrigation through multipurpose dam has proved to be an enabling factor in smallholder agricultural commercialization. In the Ribb sub-catchment, difference in the topography of farm land has a significant effect in smallholder agricultural transformation. Households belonging to better welfare status are mainly located in the lowlands of the catchment where the soil is fertile and less prone to degradation. In the highland topography, households have to exert extra effort in order to transform from subsistence agricultural system to improved and commercial level. Specialized extension services such as providing access to adequate agricultural input service, irrigation, water harvesting and land management is important in achieving small-scale farm efficiency.

Agricultural transformation has resulted in farm income increases where households allocate the surplus income to invest in household’s member wellbeing improvement (health, education, assets building, etc.) and provide a gateway to achieve sustainable livelihood. Livestock ownership has a significant effect in smallholder commercialization. Households belonging to commercial farm typology possess large number of livestock. Since farm households allocate their surplus income generated from smallholder commercialization to purchase of assets such as livestock, the number of livestock holding increases across farm typology. Pre-ownership of livestock have also a significant effect in smallholder commercialization, where farmers livelihood strategy also includes sales of livestock and their by-products. In addition agricultural transformation play vital role in improving the quality of smallholder farmer’s life through income generation, poverty and hunger reduction where households aspire to invest more in their social and environmental capital which will in return result in a sustainable rural development. Further research and study must be done in designing strategies to strengthen integration among farmers and brokers for better agricultural output pricing in order for smallholder households to continue and contribute in production of staple food crops to achieve food security.
7. Acknowledgment

First and foremost, I would like to thank Lord Almighty for giving me the strength and courage to go through all this work for letting me do what I wish!

I would like to express how grateful I am to Dr. Louise Karlberg, my research supervisor for her remarkable role in giving constructive comments from the very inception of the work and guiding me throughout the study. Her insightful comment for the betterment of the whole work was appreciable. My heartfelt appreciation and gratitude also goes to my evaluator Dr. Atakilte Beyene for his invaluable and stimulating guidance. I greatly acknowledge his remarkable assistance in shaping up the research.

Especial thanks goes to my father Balcha Hailemariam and my mother Zuriash Tefera, who have been a persistent source of encouragements with their sweet and loving advice. My brother Samuel Balcha for being an inspiration and a help in shaping me to become the person I am now; my sister Lidya Balcha for giving me her good heart and support. I want them to know that I respect and memorize their boundless and invaluable support, beyond a simple thank you.

Much credit also goes to the Stockholm Environmental Institute (SEI) for granting me the financial assistance needed to complete the study. My special thanks also go to Meron Assefa, Holger Hoff, Yihun Dile, and Javier Godar for their inputs while doing my research. To the Fogera woreda Agricultural Office staffs for their remarkable help during my field work in Woreta and for providing me the required secondary information. I am also grateful to the DAs in the selected PAs for the cooperation exhibited during the survey. I also would like to thank Dr. Fitsum Hagos for his invaluable comments and encouragement not only during the thesis work but also throughout my academic career. Finally, all other people who helped me during the study are also acknowledged. I am especially thankful to the farmers who responded to my numerous questions with remarkable patience.
8. Reference

ARARI (Amhara Region Agricultural Research Institute), 2009: Agricultural potentials, constraints and opportunities in the Megech and Ribb rivers irrigation project areas in the Lake Tana Basin of Ethiopia. Bahir Dar, Ethiopia.


BoARD (Bureau of Agriculture and Rural Development), 2003: Rural household’s socioeconomic baseline survey of 56 districts in the Amhara Region. Bahir Dar, Ethiopia.


29


World Bank, 2003: Reaching the rural poor: A renewed strategy for rural development. Washington, DC.

Appendix

Appendix 1. Interview questioners for the selected households in the Ribb Sub-Basin

<table>
<thead>
<tr>
<th>Village Name</th>
<th>Date</th>
<th>HH head Name</th>
<th>Sex</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Interview questioners for the selected households in the Ribb Sub-Basin

<table>
<thead>
<tr>
<th>Major income source</th>
<th>Farm economy 18</th>
<th>Education Level</th>
<th>Religion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. Household composition

<table>
<thead>
<tr>
<th>No</th>
<th>HH member</th>
<th>Age 19</th>
<th>Sex 20</th>
<th>Relation to Head 21</th>
<th>Education in years</th>
<th>Farm Experience in Years</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Agricultural system

1. What kind of change does your household goes to in the past 3 years?
   1. Better off-farm activities  2. less/no off farm activities
   3. Better farm activities  4. Others (Specify) 

2. Do you consider the agricultural system in your area is highly uncertain?
   1. Yes 2. No

3. What is the reason behind this uncertainty?
   1. High population pressure resulted in agricultural land shortage
   2. Establishment of new investments in the area resulted in agricultural land shortage
   3. Shifting climate conditions resulted in less rain fall and water level
   4. Shifting climate condition that floods the area
   5. The slop of the land which resulted in erosion
   6. Poor soil composition (fertility)
   7. Lack of irrigation (water harvesting techniques)
   8. Land ownership right

4. What is the cropping season per year in your area?
   1. Once per year  2. Twice per year  3. Three times per year

5. What is your farming system? (multiple answers)
   1. Crop production
   2. Livestock fattening
   3. Sheep fattening
   4. Poultry farming
   5. Bee keeping

18. Below-Subsistance level (There are months where the households production isn’t sufficient)
   1. Subsistence (Could barely feed their households all year along)
   2. Constant Improving (there will be a surplus production on some occasions and will be marketed)
   3. Commercial (The cultivated products are aimed for market)

19. Children whose age is less than 1 are coded as 1 years old. And no decimal should be included

20. Male 2. Female


22. 1. Farmer 2. Student 3. Household chores  4. Other (Specify)

31
6. Do you diversify in your crop production?
   1. Yes
   2. No
7. What are the reasons for diversification?
   1. In order to reduce risk
   2. To develop marketing activity (since the crop is highly demanded)
   3. In order to get credit or loan because they diversify
   4. Other (Specify)

### C. Consumption Expenditure in the last 12 months

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Amount consumed from own production</th>
<th>Amount consumed through purchase</th>
<th>Price/unit</th>
<th>Unit</th>
<th>Amount sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potato</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haricot Bean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chickpea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar cane</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banana</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mango</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Papaya</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avocado</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pepper</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomato</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other vegetables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garlic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coffee</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water (including irrigation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooking oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clothing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blanket/bed sheet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Umbrella</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---
23 Do they only grow one type of crop or different type of crops?
Kerosene
Batteries
Radio
Corrugated iron
Furniture
Travel expense
School fees (books, uniform etc.)
Health/Medicine
Income tax/land tax
Religious contribution
Ceremonies
Jewelry
House rent
House construction
Cigarettes/tobacco
Electricity
Idir
Leisure (drinks, lotteries, etc)

D. Asset Holdings

### A. Land Ownership

<table>
<thead>
<tr>
<th>Plot No.</th>
<th>Plot size (sq.meter)</th>
<th>Distance from home to plots in meter</th>
<th>Current Ownership</th>
<th>Owned since (number of years)</th>
<th>Distance from land to Water point</th>
<th>Certified plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. If the farmer **rented in** part or all of his/her plot what are the reasons?
   a. Lack of labour
   b. Availability of labour
   c. Enough farm land
   d. Shortage of farm land
   e. Lack of money to purchase fertilizer and seeds
   f. Sick/disable
   g. To share risk
   h. Lack of oxen
   i. To pay debt
   j. Others (Specify)

   I. How much money was paid to rent in the plot? In birr____
   II. When was the amount paid?
       A) Immediately when contract made   B) Just after harvest   C) others, Specify ___
   III. Contract duration ____________ years
   IV. From whom did you rent in the land?
       A) relative   B) close neighbor   C) outside my kinship   D) others, Specify____
   V. How long have you been partner? ____________ years

2. If the farmer **rented out** part or all of his/her plot what are the reasons?
   a. Lack of labour
   b. Availability of labour
   c. Enough farm land
   d. Shortage of farm land

---

25 The water point is either, stream, pond, river, lake, irrigation canals or water conservation
e. Lack of money to purchase fertilizer and seeds
f. Sick/disable
g. To share risk
h. Lack of oxen
i. To pay debt
j. Others (Specify)

I. How much money was paid to rent out the plot? In birr________

II. When was the amount paid?
   A) Immediately when contract made   B) Just after harvest   C) others, Specify ___

III. Contract duration _______ years

IV. For whom did you rent out the land?
   A) relative   B) close neighbor   C) outside my kinship   D) others, Specify_______

V. How long have you been partner?________________years

B. Livestock Ownership

<table>
<thead>
<tr>
<th>Item</th>
<th>previous stock</th>
<th>Current Stock E.C 2004</th>
<th>Ownership</th>
<th>Livestock sold</th>
<th>Income from sale (birr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milking Cow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other cows</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heifer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ram</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lamb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bucks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mules</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Donkey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horse</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bee hives: Traditional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modern</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. Other Income Sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Total Income (Birr) in the last 12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings</td>
<td></td>
</tr>
<tr>
<td>Hiring out Oxen</td>
<td></td>
</tr>
<tr>
<td>Inheritance</td>
<td></td>
</tr>
<tr>
<td>Non-farm Salary (Employment)</td>
<td></td>
</tr>
<tr>
<td>Off-Farm Salary (Working on others farm)</td>
<td></td>
</tr>
<tr>
<td>Farm Income</td>
<td></td>
</tr>
<tr>
<td>Food for Work</td>
<td></td>
</tr>
<tr>
<td>Rent out Land</td>
<td></td>
</tr>
<tr>
<td>Migrant Income</td>
<td></td>
</tr>
<tr>
<td>Remittance Income</td>
<td></td>
</tr>
<tr>
<td>Food Aid</td>
<td></td>
</tr>
<tr>
<td>Government Transfer</td>
<td></td>
</tr>
<tr>
<td>Sale of firewood</td>
<td></td>
</tr>
<tr>
<td>Sale of Handicraft</td>
<td></td>
</tr>
<tr>
<td>Sale of beverage</td>
<td></td>
</tr>
<tr>
<td>Gifts</td>
<td></td>
</tr>
</tbody>
</table>

26 1. Own  2. Rented  3. Shared  4. Other (Specify)
D. Social network
1. Do you have any position in the community? 1. Yes 2. No
   If yes, what positions do the household head has?
   1) Chairman of the PA\(^{27}\)  2) Secretary  3) Milita (Tataki)
   4) Party Member  5) Others, Specify____________________
2) Is there a cooperative in your area? 1. Yes 2. No
3) What are those cooperatives? Which cooperative are you a member too? (Circle)
   1._________________________________________
   2._________________________________________
   3._________________________________________
   4._________________________________________
   5._________________________________________
   6._________________________________________
5) How far do you travel to sell your product?_________________meter

E. Land and water conservation
1. What is your plot’s Soil type?
   Plot 1.____________
   Plot 2.____________
   Plot 3.____________
   Plot 4.____________
   Plot 5.____________
2. What is your plot’s Soil depth?
   1. Shallow (<30cm)  2. Medium (30-60 cm)  3. Deep (> 60cm)
   Plot 1.____________
   Plot 2.____________
   Plot 3.____________
   Plot 4.____________
   Plot 5.____________
3. What is your plot’s Slope?
   1. Meda(plain)  2. Tedafat (foothill)  3. Daget (midhill)  4. Gedel (steep hill)
   Plot 1.____________
   Plot 2.____________
   Plot 3.____________
   Plot 4.____________
   Plot 5.____________
4. How is your plot’s exposure to erosion?
   Plot 1.____________
   Plot 2.____________
   Plot 3.____________
   Plot 4.____________
   Plot 5.____________
5. Degree of soil degradation?
   Plot 1.____________
   Plot 2.____________
   Plot 3.____________
   Plot 4.____________

\(^{27}\) PA= Pesant Association
Plot 5.
6. What kind of change does your land quality goes to?
   1. Improved in quality  2. No change  3. Worsened in land quality
7. What Type of water conservation structures do you have?
   1. Traditional ditches
   2. Cut-off drains
   3. Artificial water ways
   4. Raised boundary buds
   5. Stone/soil buds
   6. Grass strips
   7. Others, specify
8. How does your water conservation structure changed?
   1. Improved in quality  2. No change  3. Reduced quality
9. What is the reason for change in water conservation?
   1. More conservation structure constructed
   2. Conservation structure removed
   3. Due to decline in land quality
   4. Drought
   5. Pests and diseases
   6. Others, specify
10. What is the quality of your water conservation structure?
    1. Poor  2. Medium  3. Good

F. Credit status
1. Have you submitted an application to get credit in the last 12 month?
   1. Yes  2. No
   a) If yes, fill the Table below

<table>
<thead>
<tr>
<th>Purpose of credit</th>
<th>source</th>
<th>Amount given (birr)</th>
<th>Requested amount (birr)</th>
<th>Loan duration (month)</th>
<th>Collateral? 1. Yes 2. No</th>
<th>Amount repaid (birr)</th>
<th>Amount not repaid (birr)</th>
<th>Why failed to repay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dap (Kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea (Kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved seeds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize (Kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teff (Kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice (Kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat (Kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum (Kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash (Birr)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milking cow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fattening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Events</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others, specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   b) If no, why didn’t you apply to get credit?
   a. I assumed my application would be rejected since I didn’t repay previous loan
   b. I assume my application would be rejected because there are many applicant

    6. neighbour  7. informal institutions like edir, ekube  8. cooperative union  9. others, specify

29 1. crop failure due to rainfall shortage  2. low crop price coincides with the repayment time  3. I still have
    time to repay  4. most contacts are extended for some more time (months)  5. I prefer to pay later
    when the crop and livestock is ready including the fine  6. the credit was given to me as a package without my
    interest  7. illness  8. others, specify
c. I didn’t know to whom to apply
d. I do not want credit
e. High transportation cost to get credit
f. Lack of formal credit agency near by
g. High interest rate
h. Expensive to pay the initial payment
i. Fear of loss of assets
j. High penalty
k. Too risky to take credit
l. Others, specify_________

G. Storage Facility
1. In case of production surplus do you have a storage access?
   1. Yes  2. No
2. If yes, what kind of storage space access do you have in your community? (Multiple answer is possible)
   1. Own storage
   2. Shared
   3. Rented
   4. Cooperative storage space
   5. Others (Specify)_________
3. Which storage facility do you use for your surplus production?
   1. Own storage
   2. Shared
   3. Rented
   4. Cooperative storage space
   5. Others (Specify)_________
4. How much do you pay when you store your surplus production? __________ birr/year
5. How far is the storage space from your farm?________ meters

H. Institutional composition
1. Is there any institution in your area that works close with you to improve your farming system?
   1. Yes  2. No
2. How do they help?
   1. Providing storage space to your surplus products
   2. Supplying improved seeds
   3. Fertilizer
   4. Credit
   5. Market information
   6. Training
   7. Improved Livestock variety
3. What kind of incentives has been made by the state to improve agricultural system?
   1. Development of water shed developments, dams, irrigation…..
   2. Micro finance
   3. Developing communal or other means of production storage facility to help you sell your surplus products when the price is reasonable
   4. Land ownership right for longer period
   5. Better market structure
   6. Infrastructural development
   7. Safety net programme
   8. Training and knowledge sharing
   9. Providing market information and
   10. Others (Specify)
4. How frequently are you in contact with extension agents per year?

<table>
<thead>
<tr>
<th>Type of Advice</th>
<th>Never</th>
<th>Once</th>
<th>Two times</th>
<th>Three times</th>
<th>&gt; than three times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil and water conservation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manuring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compost preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credit supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credit repayment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

37
5. What do you do with your economic surplus every year with
   a) Do you send your kids to school?  1. Yes  2. No
   b) Do you purchase other assets (like radio, TV, Car, Stove..)  1. Yes  2. No
   c) Do you purchase fertilizer?  1. Yes  2. No
   d) Do you purchase improved seed?  1. Yes  2. No
   e) Do you apply the economic surplus on technological investment (irrigation, pump…)?  1. Yes  2. No
   f) Do you rent in land?  1. Yes  2. No
   g) Do you apply the economic surplus for medication?  1. Yes  2. No
   h) Do you modify your house?  1. Yes  2. No

6. What are the major constraints in your area in accessing key inputs for your farming system that would help you transform to commercial farming? (Rank from the major constraint to less)

<table>
<thead>
<tr>
<th>Socio-Economic</th>
<th>Bio-Physical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timely un-availability of improved seed</td>
<td>Drought</td>
</tr>
<tr>
<td>Prices of improved seed</td>
<td>Floods</td>
</tr>
<tr>
<td>Quality of seed</td>
<td>Pests</td>
</tr>
<tr>
<td>Availability of credit to buy seed</td>
<td>Diseases</td>
</tr>
<tr>
<td>Timely un-availability of fertilizer</td>
<td>Soil fertility</td>
</tr>
<tr>
<td>Price of fertilizer</td>
<td></td>
</tr>
<tr>
<td>Availability of credit to buy fertilizer</td>
<td></td>
</tr>
<tr>
<td>Access to markets and information</td>
<td></td>
</tr>
<tr>
<td>Un-reasonable price estimation of the products by traders</td>
<td></td>
</tr>
<tr>
<td>Un availability of Storage facility</td>
<td></td>
</tr>
</tbody>
</table>

Appendix 2. Tropical livestock unit (TLU) conversion factor of the different livestock species in Ribb sub-catchment

<table>
<thead>
<tr>
<th>Livestock type</th>
<th>TLU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>0.70</td>
</tr>
<tr>
<td>Sheep</td>
<td>0.10</td>
</tr>
<tr>
<td>Goats</td>
<td>0.10</td>
</tr>
<tr>
<td>Horses</td>
<td>0.80</td>
</tr>
<tr>
<td>Mules</td>
<td>0.70</td>
</tr>
<tr>
<td>Donkey</td>
<td>0.50</td>
</tr>
<tr>
<td>Chickens</td>
<td>0.01</td>
</tr>
<tr>
<td>Camels</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: ILCA, 1980; FAO, 1986

Appendix 3. Conversion factor for household labour into adult equivalent (AE)

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10-13</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>14-16</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>17-50</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>&gt;50</td>
<td>0.7</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Source Storck et al., 1991