SMALLHOLDER FARMERS' TEFF COMMERCIALIZATION IN GUDURU DISTRICT OF HORRO GUDURU WOLLEGA, ETHIOPIA

MSc THESIS

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OCTOBER 2018

JIMMA, ETHIOPIA

Smallholder Farmers' Teff Commercialization in Guduru District of Horro Guduru Wollega, Ethiopia

A Thesis Submitted to

Jimma University College of Agriculture and Veterinary Medicine, School of Graduate Studies, In Partial Fulfillment of the Requirements for the DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS

By

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October 2018
Jimma, Ethiopia

DEDICATION

I dedicate this thesis manuscript to my grandmother Fantaye Hayile Hambisa, who remained a source of Love, Support and Great contribution in my life!

STATEMENT OF THE AUTHOR

First of all I declare that this thesis is my own work and I acknowledged all of the sources that I have been used as reference in this work. This thesis has been submitted to Jimma University College of Agriculture and Veterinary Medicine in partial fulfillment of the requirements of MSc degree in Agricultural Economics. It is deposited in the University Library to make it available for borrowers under the rules and regulations of the Library. I also declare that this thesis is not submitted to anyone or any other institutions anywhere for award of any certificate, diploma, degree and above. But this thesis is allowed without any special permission provided that precise acknowledgement is made. However, any other special permission for special cases must be obtained from the author.

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BIOGRAPHICAL SKETCH

The author was born on October 2, 1992 in Guduru District, Horro Guduru Wollega Zone of Oromia National Regional state. He attended his primary school at Abbo Addis Primary School in between 2000to 2008, Secondary and Preparatory School at Kombosha Secondary and Preparatory School in between 2008 and 2012.

He joined Jimma University College of Agriculture and Veterinary in September, 2012 and graduated on June 25, 2015 with a great distinction score of B.Sc. degree in Agricultural Economics. Soon after graduation he has employed at Assosa University to serve as Graduate assistant-I on 20th August, 2015. After one year working again he had joined Jimma University for postgraduate program to specialize in Agricultural Economics field of study in September, 2017.

ACKNOWLEDGEMENTS

First of all thanks to Almighty **God** for everything that he made things to happen in my life. By next, the completion of this thesis and the entire graduate program would not have been possible without the support and encouragement from several people. I would like to express my deepest appreciation to my Major Advisor Amsalu Mitiku (Associate Professor) for his guidance and support throughout my thesis work and the MSc program. Many thanks for the detailed comments and suggestions that were instrumental in completing this final product. I am very grateful to my Co-Advisor Guta Regassa (Assistant Professor). His outstanding expertise motivated me very much.

I am also indebted to my grandmother Fantaye Hayile for her generous support more than mother starting in breast feeding to this fruitful work. May you always stay in healthy and happy! My next appreciation is to Tamiru Chalchisa, the former my staff colleagues and current lecturer in the Department of Rural Development at Jimma University, for his kindness and help through my work time. I am indebted to the Assosa University and Ministry of Education in financial assistance for my study. I am also grateful to all persons in the Agricultural Economics and Agribusiness Management department, Jimma University college of Agriculture and Veterinary Medicine, Jimma University, and my classmates for their various kinds of help.

My special gratitude goes to my relatives, without whose love, support and encouragement, this journey would not have been completed. Many thanks to Temesgen Neme and his family on whose counsel my very foundation is build today. Lastly but not least, I would like to extend my thanks to the enumerators, key informants and community at Guduru district who spent many hours in responding to my questions. Thank you all for your individual contribution in bringing this work to completion.

ACRONYMSANDABBREVIATIONS

AGRA	Alliance for a Green Revolution in Africa
AOGD	Agricultural Office of Guduru District
APE	Average Partial Effects
CC	Contingency Coefficient
WB	World Bank
CCI	Crop Commercialization Index
CSA	Central Statistical Agency
DA	Development Agent
DHM	Double Hurdle Model
FAO	Food and Agricultural Organization
FGD	Focused Group Discussion
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
Ha	Hectare
HCI	Household Commercialization Index
MLE	Maximum Likelihood Estimation
NGO	Non-Governmental Organization
OLS	Ordinary Least Square
PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
SSA	Sub-Saharan Africa
USD	United States Dollar
UNDP	United Nations Development Programme
VIF	Variance Inflation Factor

TABLE OF CONTENTS

TABLE OF CONTENTS (*continued)*

TABLE OF CONTENTS (*continued)*

LIST OF TABLES

TABLES **PAGE**

LIST OF FIGURES

FIGURES **PAGE**

LIST OF APPENDICES

APPENDICES **PAGE**

SMALLHOLDER FARMERS' TEFF COMMERCIALIZATION IN GUDURU DISTRICT OF HORRO GUDURU WOLLEGA, ETHIOPIA

ABSTRACT

Promoting commercialization of agricultural production is a cornerstone of the rural development strategies of Ethiopia and commercialization of smallholder farming is not yet adequate enough to enable farmers be profitable. This study was designed to analyze the current levels of teff commercialization, to analyze the smallholder farmers' teff commercialization in Guduru District, Horro Guduru Wollega, Ethiopia. Two-stages sampling procedure wasfollowed to select 154 teff producer farmers from four randomly selected kebeles. An interview schedule was used to collect household survey data during the 2016/2017 farming season. The Household Commercialization Index was used to assess the levels of market participation, Double Hurdle Model was used to identify the key factors that influence farmers' teff commercialization and Kendall's coefficient of concordance was used to assess the constraints. The results revealed that about 78% of sampled farmers sold teff during a production year of2016/2017. The model result indicated that education of household head, family size, land holding size, land allocated to teff, farm output, participation in off/non-farm activities, lagged teff market price, access to market information and cooperative membership were found to significantly influence the probability of participation in teff output market. Intensity of participation in the teff output market was significantly determined by sex of household head, age of household head, family size, family labor and distance to the nearest market. The results also revealed that high cost of fertilizer and delayed delivery and poor road were the most pressing teff production and marketing constraints, respectively. Based on the findings, the study recommends that government should give emphasize on rural education system, family planning program, productivity improving measures, access to communication facilities and institutional services, enhance the female headed households and improving rural roads.

Keywords: Smallholder Farmers, Teff Commercialization, Constraints, Double hurdle model, Kendall's Concordance Analysis, Guduru District

1. INTRODUCTION

1.1. Background

Smallholder family farming is the economic backbone in Sub-Saharan Africa (SSA), where smallholders, to a considerable degree, are oriented towards food production, primarily for own consumption (AGRA, 2014). About 440 million farmers in developing countries practice subsistence production which is large enduring misallocation of human and natural resources and it is becoming less and less viable due to population pressure and natural resource constraints (Von Braun and Kenedy, 1994). The transition from low productivity, semi-subsistence agriculture to high productivity, commercialized agriculture has been a core theme of development and agricultural economics for half a century (Barrett, 2008).

Commercialization of smallholder agriculture has been considered as a key strategy for sustainably reducing poverty and for achieving growth in many SSA countries. However, the levels of success of the strategy in different countries in the region were varied with some countries exhibiting far greater success than others (Kirsten *et al.*, 2012). The same scholars contended that, there is need for the development of new market models that will ensure the smallholder producers' gain, who are disadvantaged by pre-existing social, economic, environmental and political conditions. Thus, it is the design of programs and policies and their actual implementation that determine whether or not the poor obtain a fair, or even a positive, share of gains from agricultural commercialization, directly or indirectly (Von Braun *et al*., 1991).

In Ethiopia, agriculture sector remains a critical component of the government's economic development strategy, due to its central role in the life and livelihood of most of its population, where about twelve million smallholder farming households account for an estimated 95% of agricultural production (FAO, 2014). It remains the leading sector in terms of contribution to the country's overall economy as it accounts 38.8% share of GDP, contributes 73% of employment, and supplies 70% of the raw-material requirements of local industries, 40% of output and exports (African Economic Outlook, 2016; WB, 2016). The country's aspiration for achieving overall economic growth largely depends on the

performance of the agriculture sector (UNDP, 2015). It is also the foundation on which Ethiopia can achieve its short and long-term industrial and manufacturing ambitions and meet its food security objectives (ATA, 2016). Though the agriculture sector has shown steady annual growth rates (MoFED, 2010), it still dominated by subsistence oriented, natural resource intensive, low input-low output, rain-fed farming system and is vulnerable to frequent climatic shocks (UNDP, 2015; ATA, 2016). The rate of agricultural growth in the country depends on the rate of transformation of the small-scale and subsistence agricultural sector to market-led production system (MoARD, 2010). Thus, in Ethiopia agricultural commercialization is viewed as an essential part of the process of agricultural modernization, specialization, and structural transformation of the economy toward more rapid and sustainable growth (Pender and Dawit, 2007).

In development policy planning, transformation of smallholder agriculture to market-oriented production system is agreed to be a solution for the existing problems of poverty and food security in the rural Ethiopia (Habtamu, 2012; Showaye, 2016). Due to this, government has promoted the increasing commercialization of agricultural production through its different schemes, policies and programmes where smallholder farmers are considered as a principal source of agricultural growth and agriculture as the main source of overall economic growth. Moreover, commercialization of smallholder farming received high government policy priority through GTP (MoFED, 2006 and 2010). Commercialization of subsistence farmers in Ethiopia is at its infant stage and varied in different parts of the country and outcome of commercialization cannot be achieved for all farmers and in all places since many obstacles might exist (Berhanu and Hoekstra, 2009).Subsistence agriculture is not a viable activity to ensure sustainable household food security and welfare in the long run (Pingali, 1997). Accordingly, Ethiopia needs to achieve accelerated agricultural development along a sustainable commercialization path to alleviate poverty and ensure overall national development (Hagos and Geta, 2016). Ethiopia's potential with respect to commercial agriculture is largely untapped, and the current status of agriculture is a source of major concern as the sector is dominated by poor smallholders, often solely engaged in subsistence agriculture (Bonaglia *et al*., 2007; Moti *et al*, 2009).

In Ethiopia, teff is most important crop which was grown on 22% of all cultivated land with the second most popular crop, maize, occupying 15% in 2013/14 (CSA, 2014). It is recognized that, teff is a gluten-free, nutritious cereal whose consumption per-capita has steadily increased over the last fifteen years, particularly in comparison to other cereals (Tafere *et al*., 2010; Hailu *et al.,* 2016). The same scholars confirmed that consumption increase has occurred primarily in urban households and annual urban consumption per-capita was 81kg as compared to 24kg in rural areas. Thus, due to its high demand, income from teff is much higher than income from other cereals and making teff the important cash crop in the country (Minten *et al*., 2013; Worku *et al*., 2014).

About 25-30 million people are directly depend on teff production and the higher teff price followed by an increasing commercialization of smallholder farmers represents an opportunity to directly increase the living standard of rural communities (Samuel, 2015). Culturally, teff is viewed as a superior good, its consumption associated among many Ethiopians with a better quality of life and it's the same in study area. Even though, sustaining gain through teff commercialization is crucial, study area is fraught with challenges that threaten small scale teff farmers. Therefore, given the agriculture based economy of Ethiopia and the dominance of smallholder sub-sector, coupled with diverse agro-ecologies, it is imperative to conduct a study which focuses on identifying factors determining smallholder farmers' teff commercialization. Thus, analyzing smallholder farmers' teff commercialization in Guduru district was the main motivation of this study.

1.2. Statement of the Problem

Transforming the subsistence-oriented production system into a market-oriented production system has been in the policy spotlight of Ethiopia and commercialization of food crops has given priority under growth and transformation plan. However, some sources showed that policy involvement in input and output marketing were weak (Eleni and Goggin, 2006; Alemu, 2010). Hence, it is not possible for the smallholder farmers to integrate with the market and enjoy the benefits of commercialization unless the already existing hurdles are removed and policy formulation and implementation gap is narrowed.

At the local level commercialization is affected by market, institutional and resource factors that influence production and marketing behavior of smallholder farmers (Pender *et al*., 2006; AGRA, 2014; WB, 2016). Barrett (2008) indicated that commercialization is heterogeneous among smallholder producers because of differences in level of infrastructure which integrates them into local and international markets, transaction costs, access to productive assets and institutional arrangements that reduce the chances of getting high incentives for market participation. In Ethiopia commercialization of smallholder farming is not yet adequate enough to enable farmers benefit from increased income and farmers are not yet out of the subsistence-oriented agriculture (Mahelet, 2007).Agricultural product markets are characterized by seasonal gluts and shortages which in turn affect the marketing behavior of producers, traders, and consumers (Jema, 2008). Other empirical studies have showed that average crop output sold is not more than quarter of what is produced from year to year (Gebremesk el *et al.,* 1998; Bernard *et al.,* 2008; Leykun and Jemma, 2014). Despite effortsmade to commercialize and transform Ethiopian agriculture from subsistence to production of high value crops, the sector's performance has been below expectations (Alelign, 2017).Thus, to ensure that farmers are consistent with the market where the large proportion of farmers engaged in subsistence agriculture remains very high and those who participate in markets often do so only at the margins several issues need to be analyzed (AGRA, 2014; Azeb, 2016). Even though high prices ensured that adoption of modern inputs brought high returns and poverty reduction for those well connected to markets, poor market access for farmers is binding constraint to rural income growth among a wide range of constraints to progress in Ethiopia (WB, 2016).

The degree of commercialization at the local market level varies from market to market and from crop to crop, and ability for farmers to make investments in productivity-enhancing inputs and production methods (Barrett, 2008).The location and commodity-specific approaches work well in commercial transformation where numerous smallholders grow a variety of crops often both for subsistence and for sale in their survival which are diverse with varying farm and household characteristics (Delgado and Siamwalla, 1997).To this regard in the current policy push for smallholder commercialization, teff is one of the selected priority

crops under the Ministry of Agriculture and Rural Development's 2004 master plan for enhanced market-oriented production (Samuel and Sharp, 2008).

Teff is selective enterprise as it has become an important market-oriented crop, grown mainly as a cash crop by most farmers in Ethiopia (Demeke and Marcantonio, 2013); it is the most important crop for farm income and food security in Ethiopia (Minten *et al.*, 2015); It is the second most important cash crop after coffee and generating almost 500 million USD incomes per year for local farmers (Reda, 2015). Urban demand plays an important role, as would growth in food-crop prices which in turn benefit rural producers. This caused the price of teff to be increased in fast rate and as a result of this teff becomes highest priced cereal grown in Ethiopia (Bekabil *et al.*, 2011; Azeb, 2016). Thus, teff is particularly interesting in the context of smallholder commercialization, since it has high value as both cash and a food crop. As commercialization of subsistence agriculture may not instantly move onto high value cash crops, increased market-orientation of staple food crops production offers a more pertinent option to smallholder farmers (Berhanu and Hoekstra, 2009). However, there is significant variation inmarketed teff volume in the country from time to time and from place to place and marketed surplus of teff across country is far less than volume of production (Alemu *et al.*, 2006; Samuel and Sharp, 2008; Mabratom, 2014; Efa *et al*., 2016; Gutu, 2017).

In addition, Pender and Dawit (2007)confirmed that only a minority sell any food staples at all in an average year. Thus, since many are buyers of food crops (demand side) and smallholder farmers' are sellers of cash crops (crops intended primarily for sale), new insights about food crops (importantly single crop) farmers' commercialization behavior and supply response, is necessary. In spite of policy decision of government of Ethiopia to commercialize subsistence agriculture, there is dearth of information to crop specific (importantly teff) commercialization and marketing behavior of smallholders in Ethiopia in general and in study area in particular. In the study area, given large production and potential to produce marketable surplus, the supply of teff to the market is in small proportion to production, as well as it is subjected to seasonal variation (AOGD, 2017). Therefore, the study was designed to redress this gap by assessing the current level of teff commercialization, indentifying the

factors affecting teff market participation decision and level of participation and identifying constraints and opportunities of teff commercialization in Guduru District.

1.3. Research Questions

This research project attempted to answer the following research questions:

- What is the current level of teff commercialization in the Guduru district?
- What are the determinants of teff market participation decision and intensity of participation in the study area?
- What are constraints and opportunities of teff commercialization in the study area?

1.4. Objectives of the Study

1.4.1. General objective

The general objective of the study was to analyze the smallholder farmers' teff commercialization in Guduru District, Horro Guduru Wollega, Ethiopia.

1.4.2. Specific objectives

The specific objectives of the study were:

- To assess the current level of teff commercialization in the study area;
- To identify determinants of smallholder farmers' teff market participation and intensity of teff sales in the study area;
- To identify the constraints and opportunities of teff commercialization in the study area.

1.5. Scope and Limitations of the Study

The study was conducted in Guduru district of Horro Guduru Wollega Zone, Oromia national regional state, Ethiopia. One crop namely teff is selected for this study due to dominant production, its importance for consumption and most alternative cash crop for farmers in the study area. This study was restricted to one district which limited area coverage to draw conclusions at macro level due to, diverse agro-ecological and socio-economic assortment in

the country. The other limitation of the study is the use of cross-sectional data due to the fact that households may change their marketing decisions from year to year depending on production and market conditions, and the findings may not show changes that may occur over time.

1.6. Significance of the Study

At a time when demand for teff is increasing, improving rural households' market participation is of utmost significance. Hence, this study was designed to give valuable information on teff commercialization that might assist policy makers at various levels most importantly at study area. Hence, understanding marketing behavior and determinants of market participation of smallholders is required to aid in designing policy, organizational and institutional strategies to insure smallholders to benefit from process of commercialization. The result of the study can assist to make relevant decisions to intervene in the development of teff production, and marketing to improve income and livelihood of smallholder farmers through market participation and designing of appropriate policies and strategies. Moreover, study can also find options to promote market-oriented production system by giving more emphasis to marketing side which enable the farmers, traders, investors, and other development stakeholders, who need the information for making appropriate decisions. In addition the study can serve as a document for other researchers and may also provide a base for other similar studies.

1.7. Organization of the Thesis

This thesis is organized in to five parts. Introductory part comprises the background, statement of the problem, objectives of the study, significance of the study, scope and limitations and significance of the study. The second part presents the review of literature consisting of theoretical and conceptual literatures as well as related empirical works conducted in Ethiopia and elsewhere. The third part presents the research methodology followed including description of the study area, sampling techniques, data collection procedures and analytical techniques. Part four presents results and discussions of the study.

Finally, Part five summarizes and concludes the study and highlights the recommendations forwarded by the study.

2. LITERATURE REVIEW

2.1. Basic Concepts of Smallholder Agricultural Commercialization

2.1.1. Definition of small farms/smallholders

As there is no generally accepted definition, the notion of smallholder can be seen from a variety of angles. Small-scale agriculture is often used interchangeably with smallholder, family, subsistence, resource-poor, low-income, low-input, or low-technology farming (Abele and Frohberg, 2003). There are different definitions accordingly, for example Lipton (2005) defines family farms as operated units in which most labor and enterprise come from the farm family, which puts much of its working time into the farm. Whereas, the World Bank's Rural Strategy defines smallholders as those with a low asset base, operating less than two hectares of cropland (World Bank, 2003). Also, FAO defines smallholders as farmers with limited resource endowments, relative to other farmers in the sector(Wiggins *et al.*, 2011).Narayanan (2014) also describe a smallholder as a farmer (crop or livestock) practicing a mix of commercial and subsistence production or either, where the family provides the majority of labor and the farm provides the principal source of income.

Also there is no clear cut definition of small farms and smallholder farmers. The simplest and conventional meaning of a smallholder is the case when the land available for a farmer is very limited (Chamberlin, 2008 and Hazell *et al*., 2007). However, the meaning goes far beyond this conventional definition and consists of some general characteristics that the so called small farms or smallholders generally demonstrate. Hazell *et al*., (2007) defined small farms as those with less than two hectares of crop land while others define smallholders as those endowed with limited resources, such as land, capital, skills and labor.(Salami *et al.,* 2010) referred smallholder farming as family farming, subsistence farming and low-income farming.

In Ethiopia as it is the case in many developing countries too, there is no a clearly stated definition as to what constitutes a small farm. However, it is well recognized that small farmers in Ethiopia account for most of the Ethiopian population and the food grain production (Betre, 2006). The smallholders in Ethiopia are known for their resource

constraints such as capital, inputs and technology; their heavy dependence on household labor; their subsistence-orientation; and their exposure to risk such as reduced yields, crop failure and low prices (Betre, 2006; Mahelet, 2007; Mabratom, 2014).

2.1.2. Definition of agricultural commercialization

Commercialization of agriculture takes many forms and is defined in different ways. Generally, smallholder commercialization in agriculture can be defined in terms of smallholder participation in commercial input and output markets, type of crops grown by smallholder farmers and goals of smallholder farmers (Alelign, 2017). VonBraun, (1995) defined Agricultural commercialization as a process involving transformation of agriculture to market-oriented production which tends to impacts income, consumption and nutritional setup of the farm households. Importantly, it is more than producing surplus output to the market and thus includes household's decision behavior on product choice and input use based on the principle of profit maximization (Pingali and Rosegrant, 1995). However, there is also the prevalence of commercialization in subsistence agriculture where farm households supply certain proportion of their output to the market from their subsistence level (Gebre-ab, 2006; Okezie *et al.,* 2012) using the income concept of agriculture commercialization ranked based on the relative importance of subsistence production to total income. In this case, agriculture subsistence orientation is measured by the extent to which the farm households consume out of their aggregate agriculture produce as compared with the value of total production. Likewise Pender and Alemu(2007) defined agriculture commercialization as the ratio of the value of crop sales in households over the total value of crop production.

Pingali and Rosegrant (1995) define agricultural commercialization as extending beyond the marketing of agricultural output to include the product choice and input use decisions that are based on the principles of profit maximization. They argue that as farmers commercialize, household's mixed farming systems give way to specialized production units that are designed to rapidly respond to market and use quality inputs. Households also a shift from using non-traded inputs to tradable ones as the opportunity cost of family labor becomes high

such that households start to hire labor more and there is increased demand for agricultural commodities.

A broader definition of agricultural commercialization was provided by Jayne *et al.*, (2011). They referred to smallholder commercialization as the virtuous cycle in which farmers intensify their use of productivity enhancing technologies on their farms, achieve greater output per unit of land and labor expended, produce greater surpluses (or transition from deficit to surplus producers), expand their participation in markets and ultimately raise their incomes and living standards. Moreover, commercialization is not restricted only to cash crops as traditional food crops are also frequently marketed to a considerable extent (Von Braun *et al.*, 1994; Berhanu *et al.*, 2006). Commercialization of agriculture is not identical with commercialization of the rural economy following the arguments made by Von Broun and his fellow authors; commercialization refers both to marketing of high value cash crops (such as pulse, oil and horticultural crops) as well as primary food crops (such as teff, wheat and barley).

2.1.3. Market participation and market orientation

In most literatures there is no clearly stated way of viewing as market orientation drives-market participation or market participation drives market orientation. Different scholars argued that market orientation of farmers is an ultimate result of agricultural commercialization (Timmer, 1997; Balint, 2003; Osmani and Hossain, 2016). Commercialization of agricultural systems leads to greater market orientation of farm production; progressive substitution out of non-traded inputs in favor of purchased inputs; and the gradual decline of integrated farming systems and their replacement by specialized enterprises for crop, livestock, poultry, and aquaculture products (Timmer, 1997). It requires access to emerging high-income agricultural markets for buying input and selling output (Balint, 2003; Wiggins *et al.*, 2011).

Strong "learning-by-doing" effects create significant economies of scale in early stage of agricultural transformation where there is little specialization and as market develop for local

produce farmer tends to specialize in one or more crops. It is the development of efficient markets for inputs and outputs, including the market for rural labor that allows farm households to separate production decisions from consumption decisions (Timmer, 1997). According to Gebr-ab, (2006), what to produce and how to allocate resources is differently decided upon in subsistence and commercialized farming. The decision to be made about what crops to produce and how much with the given limited resources would simultaneously apply to both production and consumption and a small portion of what is produced emerges as a marketable surplus and the marketable surplus occurs as a residual outcome. In the case of subsistence, farmers' technical know-how, irrespective of climatic and agro-ecological factors due to long term cropping experience, crop rotation and land fertility, farmers decide for choosing a crop and cropping pattern, disregarding respond to market and advance in technology (Jaleta *et al.,* 2009).

This dates back to the original two different approaches seem to prevail one considers market orientation as mainly organizational culture, while the other regards it as basically a specific set of behaviors. Narver and Slater, (1990), defined market orientation as organizational culture, which they argue drives behavior. This means that market orientation can only exist if there is a culture that is oriented towards customers. The alternative conceptualization of market orientation, based on its conception as a specific set of behaviors, has been advanced by Kohli and Jaworski, (1990). These authors conceptualized market orientation as the implementation of the marketing concept. In their own words: "*Market-orientation is the organization wide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organization wide responsiveness to it."*

According Gebre-ab (2006) and Timmer (1997), internal characteristics of smallholder farmer, behavior importantly determine, decision making of how and what to produce and marketable surplus is the result of favorable conditions. This lead one to generalize market participation leads to market-oriented farming.

On the other side ability and skill of farmers and market development as result of external factors lead market orientated farming. So that to bring realistic transformation in agricultural activity, farmers must be trained to improve their knowledge, skill and attitude towards deciding on their own affairs, access to information, exposure to improved farming and living practices (Berhanu *et al.,* 2006).According to Poole (2017), market participation is the ability of an entity to participate in a market efficiently and effectively. It is a process as well as an outcome. The transition from subsistence, or from a lower to a higher level of market participation, is influenced by the ability of farmers to produce products which meet market expectations in terms of quality, standards, supply consistency, and ability to deliver products on time for sale at a viable price, thus, farmers need to acquire new skills and techniques in order to farm for profit. Market-oriented farming requires that farmers are knowledgeable about farm management since their main goal is to increase profits and are more influenced by markets, prices of produce and the costs of farm inputs (FAO, 2013;Adenegan *et al.*,2013).

As of Berhanu and Moti, (2010), market-orientation in agriculture is basically a production decision issue as influenced both by production conditions and market signals defined, as the degree of allocation of resources (land, labor and capital) to the production of agricultural produce that are meant for exchange or sale. The authors argued, due to policy implications to enhance commercial transformation of subsistence agriculture drawn from the analysis of the determinants of household market participation alone could be inadequate, the determinants of market orientation and market participation are not the same or not consistent with each other. Abafita *et al., (*2016), asserted that, even though selling into the market is just one part of the picture, conceptually; commercialization entails increasingly market-oriented patterns of production and input use, and the separation of household production and consumption decisions.

2.2. Concepts and Measures of Agricultural Commercialization

2.2.1. Modes of agricultural commercialization

As of Leavy and Poulton (2007)**,** different modes of commercialization co-exist and interact with each other hence the plural term, commercializations. Following this in Ethiopia, Samuel

and Sharp (2008), suggested that the four existing categories of farmer could benefit from enhanced commercialization (market-oriented agricultural growth). The authors' referred these as *Smallholder family farms:* - these are further classified into two groups, small-scale non-commercial farmers (Type A) and small-scale commercial farmers (Type B); *Small investor-farmers; Large-scale agri-business.* These categories represent four potentially complementary pathways for commercialization policy that the government can possibly adhere to, in the course of assisting smallholder farmers to increase their income and mainly to come out of poverty.

2.2.2. Process of agricultural commercialization

Agricultural commercialization usually takes a long transformation process from subsistence to semi-commercial and then to a fully commercialized agriculture (Pingali and Rosegrant, 1995). These three levels based on the farm households' objective for producing a certain crop, their source of inputs, their product mix and their income sources. Separation of household decision of production and consumption begins at the moment commercialization initiates. Household decision-making of production and consumption is non-separable in subsistence farming while it is separable in market-oriented farming (Neway, 2006; Goitom, 2009). In situations where decisions are non-separable, the objective of the household is to maximize utility and where it is completely separable, the objective is profit maximization. The behavior of households' in-between the two situations aforementioned is guided by a mixture of two objectives directed at utility, on one side, and profit, on the other. The objective of utility maximization is dominant in the early phase of commercialization whiles that of profit maximization dominates in the subsequent phase. In subsistence production, the farmer's objective is food self-sufficiency by using mainly non-traded and household generated inputs. The objective and the input sources change in semi-commercial farms into generating surplus agricultural outputs and using both traded and non-traded farm inputs.

In a fully commercialized agriculture, however, inputs are predominantly obtained from markets and profit maximization becomes the farm household's driving objective (Pingali and Rosegrant, 1995). In other words, production decisions of commercialized farmers are based

on market signals and Comparative advantages, whereas those of subsistence farmers are based on production feasibility and subsistence requirements, and selling only whatever surplus product is left after household consumption requirement are met (Pingali and Rosegrant, 1995 and Berhanu and Hoekstra, 2008). Since staple food crops have been produced for a longer period under the subsistence system, it is believed that smallholders have the technical know-how and experience in the production of these commodities. Thus, new yield-enhancing technologies for these crops could help in generating more surpluses to the market, increasing household income at a lower risk and improving national-level food security. On the other hand, different modes of production targeting high-value non-traditional commodities could help farm households generate more income per unit of resources used on the farm but at a higher production and market risk (Dolan and Humphrey 2000).

Pingali *et al.*, (2005) argued that, for many farmers, the transition from subsistence to commercial staple crop production is far more pertinent than a complete shift to specialized high-value commodities. Similarly, Neway, (2006) stated that the production of marketable surplus of staple food over what is needed for own consumption is initially the most common form of commercialization in a peasant agriculture. Through time, as the level of smallholder commercial orientation increases, however, one observes mixed staple and cash crop production systems giving way to specialized production units for the production of high-value crop and livestock products (Pingali*et al*., 2005; Neway, 2006). Thus, although agricultural commercialization is believed to put increased emphasis on specialization, it is not confined to the production of high-value commodities.

2.2.3. Measuring agricultural commercialization

The relevance of measuring the level of smallholder commercialization arises from the interest to make comparisons of households according to their degree of commercialization (Govereh *et al*., 1999). In addition, it also helps to gauge to what extent a given farm household is commercialized in its overall production, marketing and consumption decisions, and to analyze the determinants of commercialization (Strasberg *et al*., 1999).

There are diverse methods or indicators used for measuring the level of commercialization. Focusing on commercialization in its static form, various authors have used different index in measuring the level of agricultural commercialization at household level. In measuring household-specific level of commercialization Govereh *et al*., (1999) used a Household Commercialization Index (HCI), which is a ratio of the gross value of all crop sales per household per year to the gross value of all crop production. Crop Commercialization Index (CCI) which is computed as the ratio of gross value of all crop sales over gross value of all crop production multiplied by hundred.

Von Braun *et al*., (1994), mentioned three types of commercialization indices at household level: output and input side commercialization, commercialization of the rural economy, and degree of a household's integration into the cash economy. In addition to the above indices, Von Braun *et al.*, (1994) have measured commercialization in terms of proportion of land allocated by farmers to commercial crops and in terms of the value of output sales and input purchases weighted by the value of agricultural production. The authors have specified the forms of commercialization and integration into the cash economy from three different angles and measured the extent of their prevalence at the household level with the four types ofratios: commercialization of agriculture (output side) as the ratio of the value of agricultural sales in the market to agricultural production value; commercialization of agriculture (input side) as the ratio of value of input acquired from the market to agricultural production value; commercialization of rural economy as the ratio of value of goods and services acquired through market transaction to total income and degree of integration into the cash economy as the ratio of value of goods and services acquired through cash transaction to total income.

Gebremedhin *et al*., (2007) used four approaches to measure the level of household commercialization: sales-to-output and sales-to-income ratios, net and absolute market positions (either as a net buyer, net seller or autarkic/self-sufficient household), and income diversification or level of specialization in agricultural production.

The implication of these arguments is that market participation cannot adequately measure commercialization. Hence, in measuring market participation using commercialization, one

must clearly indicate which aspect of commercialization is being used as a proxy for market participation. Therefore, based on the commercialization literature, market participation in this study has to do with the pillar of commercialization that strictly deals with increased output market participation of households. With respect to the output market participation, this study takes a sensor of households' output market participation for sales only and excludes output market participation for purchases. Market participation in this study does not also include households engaging in the market to buy inputs. Therefore, the main indicator of this pillar of commercialization that this study adopts is households engaging in the market to sell their produce. This dimension of commercialization is to be used extensively in empirical works.

2.3. Effects of Agricultural Commercialization

One of the major roles of agriculture is to ensure sufficient amount of domestic food production and food security at the household level and also to decrease dependence on external food sources. But with the absence of appropriate markets, farmers output cannot reach the increasing urban population particularly for crop commercialization. The transformation of peasant agriculture from a subsistence economy to a more commercialized system based on well developed markets is critical in promoting economic growth and poverty reduction based on the different theoretical arguments (Abbott, 1987 and Mosher, 1966).Von Braun (1995) argued that commercialization has direct effect on household's income level which possibly leads to an increase in food and non-food expenditure. This postulation is directly associated with the famous Engel's law which shows the inverse relationship between the share of food consumption expenditure and total income (FAO, 2008).Based on this law, household are likely to spend more on food items as their income level grows up, but with a diminishing budget share allocated to food.

Von Braun and Kennedy (1994) stated that commercialization plays a significant role in increasing incomes and stimulating rural growth, through improving employment opportunities; increasing agricultural rural productivity; direct income benefit for employees and employers; expanding food supply and potentially improving nutritional status. In most

cases, these increased incomes have led to increased food consumption and improved nutrition (Pender and Alemu, 2007).

Others look at the benefits of commercialization from the perspective of comparative advantage. According to Govereh *et al*., (1999), commercialization increases productivity and income. The basic assumption embedded in the comparative advantage is that farmers produce mainly high value cash crops which provide them with high returns to land and labor and buy household consumption items using the cash they have earned from cash crop sales (ibid). Smallholder agricultural commercialization is significantly related with higher productivity, greater specialization and higher incomes. It also gives way to improvement in food security, poverty reduction and economy-wide growth (Timmer, 1997).Similarly, it is argued that better access for food depends on income growth; in particular, to most African smallholders where agriculture is the main source of income. This implies that improving degree of commercialization can have a big impact on the status of farmers' food security (Strasberg *et al.*, 1999). Notably, the process of agricultural growth involves unavoidable process in terms of increased commercialization, integration of rural credit market (Timmer, 1997).

Further, the net effects of commercialization on household's food consumption expenditure can be analyzed by considering the effect of price level as lower income households may not guarantee an improvement in welfare aspects if they face higher market price. Rather, those households with higher income may have better tendency to enjoy from commercialization mainly in those countries like Ethiopia where the share of food consumption expenditure accounts a significant part of income. However, evidences from Malawi suggested that food security status of small scale farmers are less likely to be affected than large scale farmers during price shock time as food is mainly supplied from home production (Wood *et al.*, 2012). Therefore, the overall implication behind promoting commercialization on household food security level comprises complex relationship that links income and price level. The poverty-reduction strategy adopted by Ethiopia seeks to achieve growth through the commercialization of smallholder agriculture. The Plan for Accelerated and Sustainable Development to End Poverty (PASDEP), Ethiopia's strategic framework for 2005/06 –

2009/10, relies on a massive push to accelerate growth. This is to be achieved by efforts in two directions: commercialization of agriculture, based on supporting the intensification of marketable farm products (both for domestic and export markets, and by both small and large farmers); and promoting much more rapid non-farm private sector growth (MoFED, 2006).

As various scholars pointed out, agricultural commercialization is a bridge through which smallholder farmers are able to achieve welfare goals. Many of them describe farm household welfare to represent consumption of basic food (grains), high value foods (livestock products), expenditure on clothes and shoes, durable goods, education and health care. Further, greater engagement in output markets would result in higher agricultural productivity which is, in itself, an intermediate outcome rather than a welfare goal. Nonetheless, agricultural productivity can facilitate the achievement of the welfare goals of small farms Samuel and Sharp, 2008;Wasseja *et al*., 2016;Abdullah *et al*., 2017.

2.4. Constraints to Smallholder Farmers Commercialization

Commercialization is more often than not, thought in large scale, ignoring the fact that even small farmers and poor farm households participate in the market either because they produce a little surplus or sell to earn cash income to meet other family necessities. Jayne *et al.,* (2011) admitted that the small scale farmers generally lack land, capital and education, needed to respond quickly to technological changes and agricultural market opportunities. To a large extent, the production choice is determined by the land potential available to small farmers. The land holding is a key determinant of commercialization, as the land allows the farmers to cultivate more than is required for household consumption.

This resource constraint also deters small scale farmers from high-value crop production options; which though promises higher rewards, is not open to most small farmers. Pingali *et al.,* (2005) speculated that for small scale farmers, commercialization can at best; offer the possibility of some diversification, but not a total specialization. While perceived risks in food markets compel small scale farmers to stick to the self-sufficiency objectives, both in their production and consumption decisions (Jaleta *et al.,* 2009); unreliable and costly food markets and fluctuations in market prices put the relatively market oriented resource-

allocation decisions of semi-subsistence households at stake, due to less reliability of food markets to guarantee household food security (Von Braun *et al.,* 1994; Govereh *et al.,* 1999). Apart from risks in markets, poor market access also deters small scale farmers from the commercialization process. The potential benefits from commercialization such as higher product prices and lower input costs, are not effectively transmitted to poor households when market access is poor (Chirwa and Matita, 2012).

An overabundance of other factors constraining smallholder commercialization have been identified in the literature include the effects of agro-climatic conditions, infrastructure, community and household resources and asset endowment, laws and institutions, cultural factors affecting consumption preferences, production and marketing opportunities (Von Braun and Kennedy, 1994; Von Braun 1995; Jaleta *et al.,* 2009). Some exogenous forces such as population and demographic changes, urbanization, availability of new technologies, macro-economic and trade policies also affect commercialization. Pender and Alemu (2007) concluded that these factors affect commercialization, by altering the conditions of commodity supply and demand, output and input prices, transaction costs and risks that farmers and others in the agricultural production and marketing system have to cope with.

2.5. Teff Production and Its Economic Importance in Ethiopia

Eragrostis tef, also known as teff, a species of love grass native to Ethiopia, also occasionally known by the native names *taf*(Tigrinya: ጣፍ *ṭaff*; Amharic: ጤፍ *ṭēff* and afaan Oromo: *xaafii*). Teff is an important cereal crop in Ethiopia providing the livelihoods for the majority of smallholder farmers. Within Ethiopian food production, teff plays an essential role. It accounts for the largest share of cereal area under cultivation. About 6.62 million farmers grow the crop (Worku *et al*., 2014) that occupies 28.7% about 2.9 million ha of cultivated land covered by cereals and is second only to maize in terms of volume of production (CSA, 2016). It is being produced by 48% of Ethiopian farmers (Worku *et al*., 2014) and regarding the fact that it is a very labor intensive crop (Setotaw, 2013). However, given the relatively low yields of teff*;* the total national production of teff was 5.1 million tons lower than maize which was 9.5 million tons (CSA, 2016). One of the presumed reasons is that the prevailing

agronomic practices restraining its productivity. Field demonstrations of row planting of teff showed that through planting seeds in rows the incidence of lodging is reduced and yields increase on average by 70% compared to the national average (Tareke *et al*., 2011). Improved varieties of teff also produced a grain yield of 17-22 qt/ha on research fields and well managed large farms (Anteneh *et al*., 2014). Consequently, these new production technologies are being promoted on a large scale to Ethiopian farmers (Bekabil *et al*., 2011).

In Ethiopia, teff production is a source of employment and livelihood for an estimated 25-30 million people. Further, teff is the most commercialized crop with approximately 36% of the total produced being marketed (Minten *et al*., 2013). According to CSA (2013) cited in Efa*et al.*, 2016 as commercial surplus data indicates teff value was estimated to be 464 million USD on quarter lower than coffee (599 million USD), Ethiopia's most important export product. However, teff is the most expensive grain in Ethiopia since it requires labor intensive land preparation, weeding, harvesting and processing operations, while producing the lowest yield per hectare of all cereal crops (FAO, 2015).

Teff is relatively resistant to extreme weather conditions, as it can grow under both drought and waterlogged conditions better than other cereals (Minten *et al*., 2013). Combined with its low vulnerability to pest and diseases, as compared to other cereals, it is considered as a reliable and low risk crop (Bekabil *et al*., 2011). It can also be stored easily under local storage conditions for many years without being seriously damaged by common storage insect pests (Demeke and Di Marcantonio, 2013).In most parts of Ethiopia, teff is usually sown during the main summer rainy season between July and August, while harvesting is done in most cases from November to February. Seeds are broadcasted on a well ploughed soil and lightly covered with soil until germination (Kebebew *et al*., 2011). The sowing period of the crop is different from location to location on which wet sowing is preferred to avoid false start to improve seedling establishment (Araya *et al*., 2010). The duration of teff growing period ranges from 80 to 85 days. Farmers typically broadcast seeds in a scattered way by hand at high seed rates. This hampers teff yields since uneven distribution of the seeds makes weeding difficult and increased competition with weeds (Tareke *et al*., 2011). Technologies such as row planting and transplanting, where the seed rate is reduced and more space

between seedlings is given, are assumed to be superior to traditional broadcasting because they allow for weeding and diminish competition between seedlings (Bekabil *et al*., 2011).Teff is a staple food crop for most households in rural and urban areas in Ethiopia. It is primarily grown to prepare *Injera*, bread, and some native alcoholic drinks (MoA, 2010).

Teff has a vital role for growth yet it has been given little attention in research and development. It is still competitive to other cereals and is increasing in acreage. Moreover, it has remained an economically indispensable crop to Ethiopian farmers for several reasons namely: generation of household income, fulfilling concerns of nutritional needs, the price for its grain and straw are higher than other major cereals and its grain can be stored for a long period of time without being attacked by weevils. In Ethiopia, teff is mainly grown in Oromia and Amhara, with smaller quantities in the Tigray and SNNP regions (CSA, 2015).

2.6. Empirical Studies of Agricultural Commercialization in Ethiopia

Study by Tadele *et al.,* (2016) analyzed factors affecting teff and wheat market supply in Dendi District, West Shoa Zone, Ethiopia using multiple linear regressions. The author incorporated 11 explanatory variables and examined separate analysis for teff and wheat market supply. Among 11 explanatory variables, sex of the household head, teff production, access to market information and extension service were statistically significant factors affecting teff market supply; whereas, price of teff in 2013/14, wheat quantity produce and credit access significantly affect market supply of wheat

The study conducted by Mohammed (2011) applied multiple linear regressions to quantify determinants of market supply of teff and wheat in Halaba Special Woreda, Southern Ethiopia. The author runs separate regression analysis for the teff and wheat. Among 11 explanatory variables, sex of the household head, teff production, access to market information and extension service were statistically significant factors affecting teff market supply; on the other hand, price of other crops, wheat production and credit access affect market supply of wheat.

A study by Berhanu and Moti (2010) on commercialization of smallholders entitled "Is Market Participation Enough?", analyzed the determinants of household participation in crop output market as seller, and the household participation in crop input markets as buyer, using tobit model considering that these variables are lower censored at zero. Their study reported that literacy, ownership of traction power and proximity to market, distance to the nearest market, value of crop production, and market orientation were significant factors affecting market participation.

Pender and Alemu (2007) in their study on determinants of smallholder commercialization of food crops theory and evidence from Ethiopia they used non-linear least square regression in estimating the determinants of teff sale and purchase showed that quantity produced access to roads, endowment of fixed assets such as land, livestock, and farm equipment were the key factors in determining smallholder production and commercialization of maize and teff.

2.7. Empirical Studies on Teff Commercialization in Ethiopia

Gutu (2017), conducted a study at North Shewa Zone of Oromia national regional state, entitled with degrees of smallholders' commercialization and progress out of poverty in light of logistic and climate change challenges in Ethiopia. Household Commercialization Index (HCI) approach was used to measure degree of commercialization, while a double hurdle regression model was employed to identify the key determinants for market participation and degree of teff commercialization. The researcher indicated that significant proportion of households was out of a product market and the degree of commercialization still remains very low. The author found that sex and distance between farm plots were significant factor affecting market participation negatively, while participation in local institutions, volume crop production and ownership of television were factors that affect market participation positively. Household income and distance from market place were factors that affect intensity of crop commercialization negatively, while size of land, midland agro-ecology, lowland agro-ecology, level of land fertility, proportion of land under cultivation, level of climate change perception and access to market information were found to affect intensity of

crop commercialization positively. Volume of crop production and lowland agro-ecology were factors that affect both market participation and intensity of commercialization.

Efa *et al*., (2016) conducted study on determinants of market participation and intensity of marketed surplus of teff producers in Bacho and Dawo districts of Oromia State, Ethiopia. Double hurdle model was used to identify factors affecting market participation and intensity of marketed surplus of teff. The authors found that market participation of smallholder farmers was significantly affected by access to credit, perception of farmers on lagged market price of teff, family size, agro-ecology, farm size and ownership of transport equipment. The intensity of marketed supply was significantly influenced by family size, agro-ecology, distance to the nearest market, farm size, perception of current price, income from other farming and off-farm activity, and livestock holding.

Girma (2015) conducted a research aimed at analyzing the performance and determinants of marketed surplus of teff in Bacho Woreda of Oromia region. The researcher revealed that *woreda* in general and sample *kebele*in particular generates income about 79.34% from teff sale out of the total agricultural income of the respondent households. Multiple linear regression models was used and found that sex of the household head, land allocated for teff, market information and frequency of contact with extension agents on teff production to marketing had significant effect on volume of teff marketed.

Mabratom (2014) conducted study on determinants of commercialization of teff and its factor productivity outcome in Tahtay Qoraro *Woreda*, Northwest Zone of Tigray at north of Ethiopia. The researcher used OLS econometric model to identify and analyze factors that determine the extent of smallholders' participation in output market. Researcher found that 9 variables were significantly influence the volume of teff sold. Of which, Ownership of equine, cash expenses for farming, specialization in teff (% of land allocated to teff) and total factor productivity, market price of teff and ownership of oxen were those explaining the variation of teff output sale positively while distance from homestead to the nearest market place and distance from homestead to all-weather road found to affect negatively.

Another study by Goitom (2009) on determinants and welfare outcomes of commercialization of smallholder farming in Enderta district of Tigray, Ethiopia focusing on identifying the micro-level factors determining market participation, the level of commercialization as well as evaluating the welfare outcomes of participant smallholders in Enderta District of Tigrai. The cross-sectional data from a sample of 125 households was used to assess the households' decision to participate in the output market using a Probit model which was followed by a second-stage switching regression model to understand the extent of market participation. The findings from the probit regression analysis revealed that production level (in value terms), use of improved seeds, use of irrigation and total landholding size are the most important factors affecting the ability of a smallholder to participate in output markets. Moreover, the findings from OLS estimation showed that the level of food and cash crop production (in value terms), gender, technology use (irrigation, improved seeds), use of fertilizer and the number of oxen owned per household are important factors determining the level of commercialization of smallholder farms. More over findings indicated that farmers can be better integrated with the market if better support services are provided and efforts to enhance farmers' access to technology and assets are strengthened.

Samuel and sharp (2008) conducted study on the commercialization of smallholder agriculture in selected Teff-growing areas of Ethiopia using a sample of 155 households in 4 *woredas*. The authors found that descriptive analysis for measurement of the level of commercialization indicated that the level of commercialization is such that a slight majority (about 58%) consumed more than they marketed, while 38% sold more than they consumed and the remaining 4% consumed and marketed an equal proportion of their output. Farmers operating at full commercial level (i.e. those who sold 100% of their production) constitute 5%, while another 7% operated at full subsistence level. Two stage least square regression model were used to examine determinants of the degree of participation in output market for all *weredas* together. Size of output produced, value of farm production, degree of food security, and non-farm activities were the determinant factors which affect market participation and level of participation. In addition, the authors showed that about 63% of the variation in trade was explained by the volume of production, keeping other factors constant,

thus land size, technology and access to service which determines the volume of production are important factors of commercialization level.

Gebremedhin and Hoekstra (2007) studied cereal marketing and household market participation in Ethiopia, with respect to teff, wheat, and rice. Descriptive statistics and regression analysis were used. The study found that smallholder farmers' participation in agricultural marketing had a significant role in improving the use of agricultural inputs and enhancing productivity apart from increasing production. Household level regression analysis of the study showed that community level factors, household characteristics, and access to services are important in explaining household decision to produce teff and the rate of household's participation in teff market among those who produce the commodity. Interval regressions of the determinants of the proportion of teff produce sold shows that population density, age of household head, ownership of land and bullocks, ownership of small ruminants, involvement in extension and access to credit the previous year, and rainfall have significant effect.

2.8. Conceptual Framework

Literatures revealed that at household level, commercialization is affected by many factors, including agro-climatic conditions and risks, access to markets and infrastructure; community and household resource and asset endowments; development of local commodity, input and factor markets, laws and institutions, and cultural and social factors affecting consumption preferences, and market opportunities and constraints (Pender *et al.,* 2006; Moti and Berhanu, 2010; Efa *et al*., 2016; Gutu, 2017). The farm external factors include population growth and demographic change, technological change and innovations, development of infrastructure, market institutions and regulations, property rights and land tenure, cultural and social factors, agro-climatic conditions, development of the non-farm sector and the broader economy, rising labor opportunity costs, macroeconomic, trade and sectoral policies affecting prices and other driving forces (von Braun *et al*., 1994;Pingali and Rosegrant,1995; Pender *et al*., 2006). On the other hand household asset holdings (land, oxen, farm implements), and human capital (education, experience, skills, capabilities etc), individual factors such as age of household head, household size, and access to credit are essential household specific and

considered internal determinants of market participation at a smallholder level (Von Braun and Kennedy, 1994; WB, 2007).All these are determinants of agricultural commercialization whose effects are also influenced by the drivers of commercialization, and when these factors are favorable they facilitate commercialization making it successful but when they are unfavorable they will hinder the process causing a failure. It is however worthy to note that the conceptual model deal with market participation from output perspective, hence, volume of produce sold at the household level is used as index (indicator) of commercialization in this study.

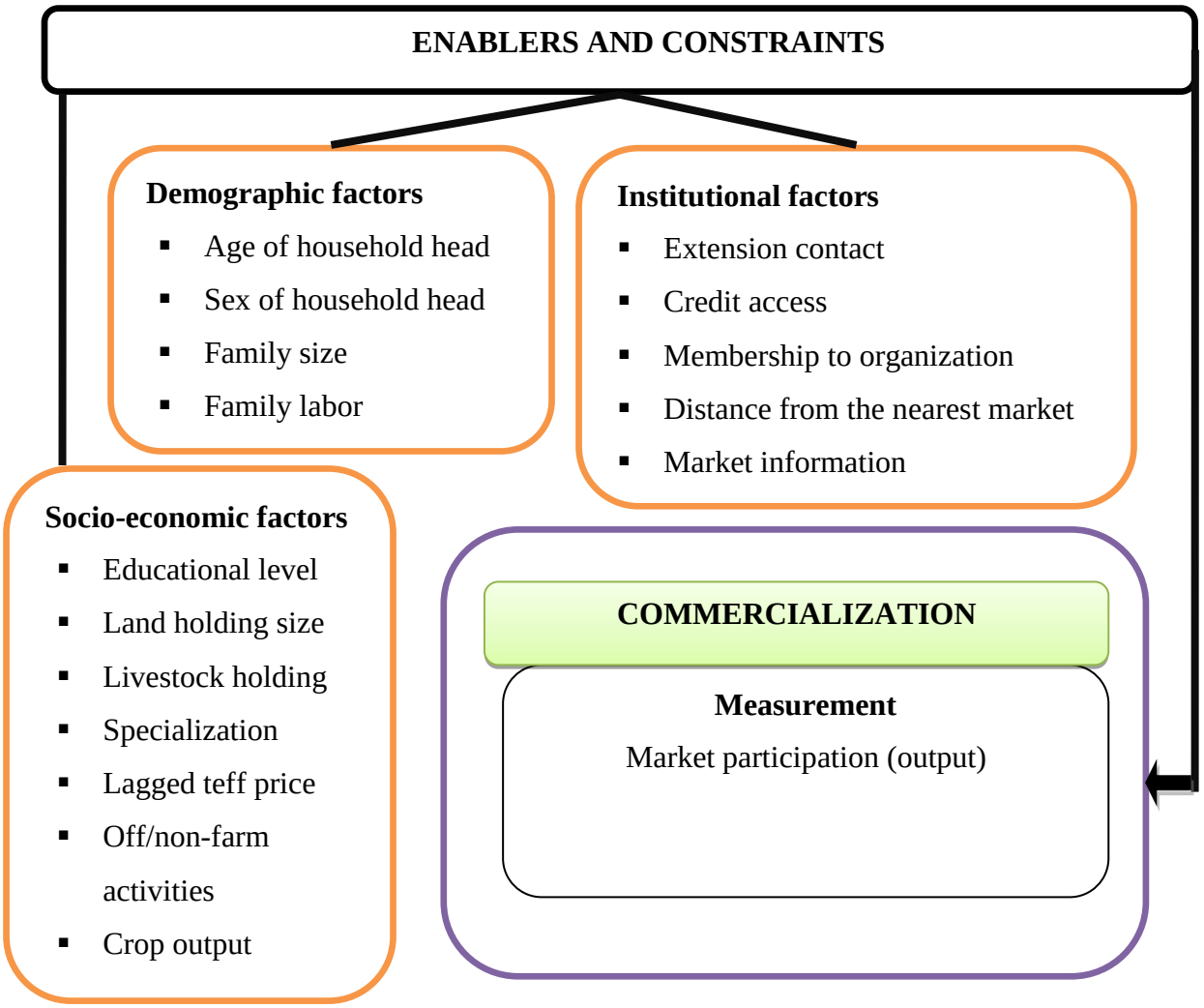

Figure 1: Conceptual framework of study
Source: Adopted and Modified from Zhou *et al.*, (2013)

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

Guduru district is one of ten rural districts of Horro Guduru Wollega zone of Oromia national regional state in Ethiopia. The district town, Kombosha is found 282 kilometers away from capital city of Ethiopia, Finfinne. The district consists of 31 rural and 8 urban *Kebeles* and is bounded by Jimma-rare district at south, Jimma-Ganati district at west, Abbay-choman and Hababo-Guduru district at north, Gindabarat district at east (AOGD, 2017).

According to the Guduru District Agricultural office (2017), Agro-climatic classification of the district is 21% Kola (lowland) and 79% Weinadega (mid-highland) coverage. The study area has an altitude range of 1,316 to 2,430 above sea level and receives an average annual rain fall of 1,350 mm. The temperature range is 20°C to 30°C and the annual average is 25°C.

The district has total population of 128,041 of male 63,765 and female 64,276. The total number of households in the district is about 15,472 of which 14,594 are male headed and the rest 878 are female headed. The land area of the district is about 159,689 Hectare among 53,406 hectare is under cultivation (AOGD, 2017). Mixed crop-livestock farming system is the main livelihood base of the population in the district. Crop production is one of the main activities in the districts and is dominated by small holdings practiced predominantly under rain-fed farming system. Teff production takes the lion share and main source of income generation to farmers in the district. According to CSA, (2016/2017), teff constituted the largest area in hectares at national level, Oromia regional state and Horro Guduru Wollega zone, 3,017,914.36, 1,441,029.78, 91,939.17, respectively.

The dominant crops grown in the district are Teff, Maize, Niger Seed and Wheat. Among these teff (12,753ha) is the first dominant annual crop grown in the district in terms of area coverage and other crops like maize(12,750ha), wheat(8,272ha), bean(2,606ha), peas(1,550ha), sorghum(1,432ha), Niger seed(10,675ha), sesame(1,580ha) cultivated during 2016/2017. Livestock production is also one of the major economic bases in the districts next

to crop production. Cattle, donkey, horse, sheep, goat and poultry are important livestock species reared by farmers (AOGD, 2017).

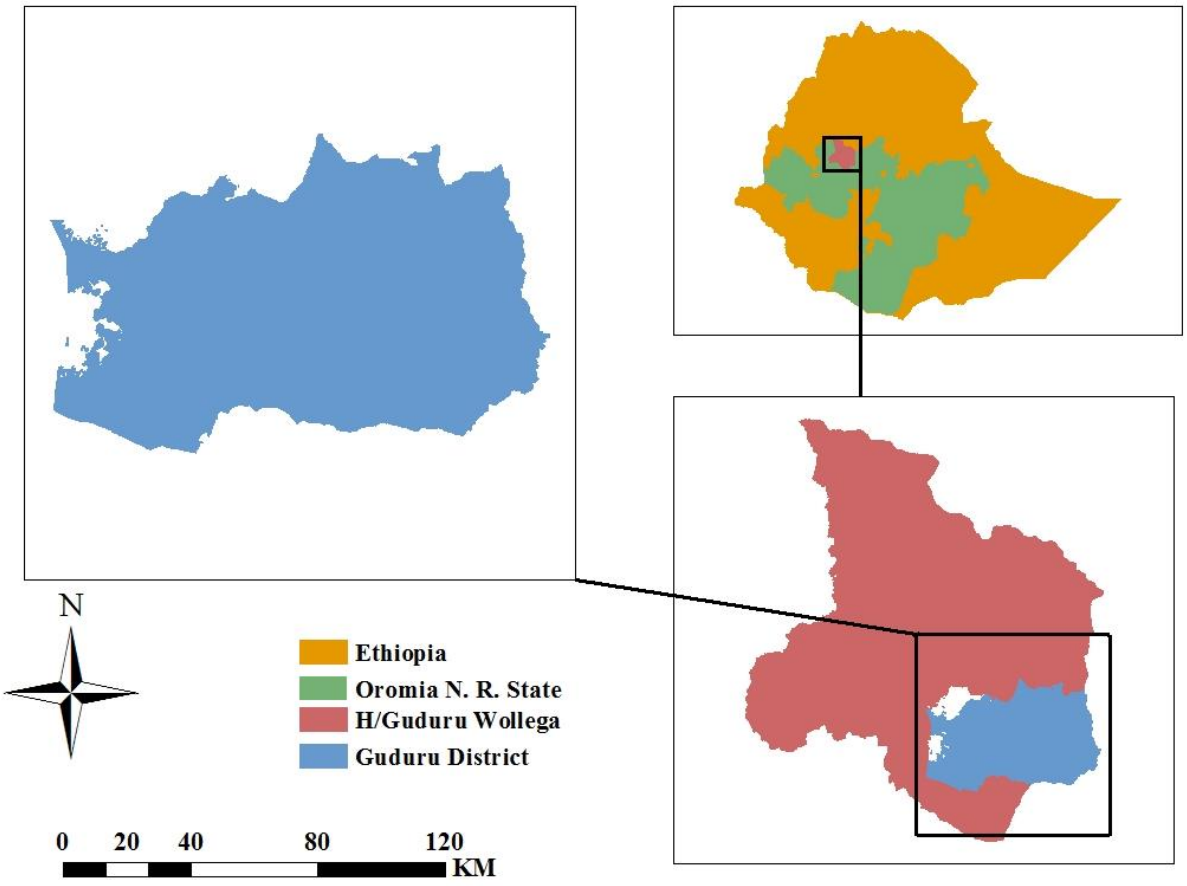

Figure 2: Map of study area

Source: Drawn using GIS (Geographic Information System)

3.2. Data Type, Sources and Methods of Data Collection

The study used data from both primary and secondary sources. Interview schedule[1]was used as a data collection tool. Accordingly, primary data that contains both quantitative and qualitative were collected by interviewing smallholder farmers producing teff during the 2016/2017 production season. Two focus group discussions (FGD) of six members each at two closer *kebeles* into a single group for synthesis and confirmation of the issues discussed at the group level. The FGD was used to elicit information on constraints in teff production and marketing with carefully constructed checklist. This was followed by a formal survey in which data were collected through interviews using structured questionnaires.

Well-structured questionnaire was designed, pre-tested and used to collect primary data from sampled households. Before the administration of the interview schedules, the respondents were informed about the objectives of the survey. Data collection was made with local trained enumerators. These local enumerators were recruited and trained to administer the interview under close supervision of the researcher. During the personal interview, primary data on key demographic, institutional and socio-economic factors affecting market participation and intensity of teff sale, as well as constraints were collected. In addition to this, key informant interview and personal observation were employed to supplement the research finding with qualitative information. The secondary data from different sources such as records, regulations and reports, were collected from Guduru district agricultural office, administration, CSA and organizations operating in the district to support the primary data. Published and unpublished documents were reviewed to secure pertinent secondary information.

[1]An interview schedule is a written list of questions, open ended or closed, prepared for use by an interviewer in a person-to-person interaction (this may be face to face, by telephone or by other electronic media) (Kothari , 2004).

3.3. Sampling Procedure and Sample Size Determination

Two-stages sampling procedure was followed for the selection of sample household heads. At the first stage, simple random sampling technique was employed to select four representative *kebeles*, among the 31 rural *kebeles* in district, since all are producers and predominance of teff production in the district. At the second stage, from the total of 2247teff grower households in the selected four *kebeles*, 154 sample household heads were selected randomly, using probability proportional to size. The maximum numbers of respondents for this research was determined by using a formula developed by Yamane (1967), with 8% level of precision.

$$n = \frac{N}{1 + N(e)^2} = \frac{10{,}436}{1 + (10{,}436 \times 0.08^2)} = 154 \qquad (1)$$

Where;

n = is the sample size of teff producer households;

N= is the total teff producer households in the district (N = 10,436)

e = maximum variability or margin of error 8%,

Probability proportional to size was used to determine sample sizes from each *kebele* and distribution as follows;

Table 1: Sample distribution of teff producers in selected *kebeles*

No	Selected *kebeles*	Teff producer HHs	Proportion	Sample size
1	Ifa Bane Abo	832	37%	57
2	Gudane Sombo Wako	331	15%	23
3	Gamachisa Berji	793	35%	54
4	Wal-Jallanne Bilif-Jarso	291	13%	20
	Total	**2247**	**100%**	**154**

Note: HHs represents Household Heads

Source: AOGD, 2017 and Own Computation.

3.4. Methods of Data Analysis

Estimation method, descriptive and econometric analyses were employed using the primary data to meet the objectives of the study.

3.4.1. Estimation Method

The estimation of the market participation and intensity models represented in equations 6a and 6b can be achieved by first estimating the levels of participation for teff output market. This was to achieve the first specific objective of the study. The Household Commercialization Index (HCI) was used but modified for targeted single crop to estimate the levels of teff Commercialization Index (TCI). The HCI proposed by Goverehe*t al.,* (1999) and Strasberg *et al.,* (1999) estimates a single index for all crops cultivated by a household. Estimating the index follows the formula;

$$HCI_{it} = \left[\frac{Gross\,value\,of\,teff\,sold\,by\,HH_{ij}}{Gross\,vaue\,of\,teff\ \,production\,by\,HH_{ij}} \right] * 100 \qquad (2)$$

Where HCI_{it} is the i^{th} household commercialization index for teff; the numerator is the total amount of teff sold by the i^{th} household in the j^{th} year (j = 2016/17 farming season) and the denominator is the total value of output of teff by the i^{th} household in the j^{th} year (j = 2016/17 farming season). The result in the bracket is multiplied by 100 to convert it to percentage. The various indices measure the extent to which the farm households are oriented toward the market (Strasberg *et al.*, 1999). A value of zero would signify a totally subsistence-oriented household; the closer the index is to 100, the higher the degree of commercialization. The estimation of the HCI sets the tone for estimating equations 6a and 6b. Equation 6b suggests that only farmers who sell a proportion of their teff output are considered while farmers who tend to consume their produce without selling in the market are excluded from the sample.

3.4.2. Descriptive statistics

Descriptive statistics such as frequency, percentages and means were employed in describing household characteristics. In addition, inferential statistics, t-test and chi-square tests were used to make comparisons between market participant and non-participant with respect to continuous and dummy variables specified, respectively. To assess and rank the importance of teff production and marketing constraints among the farmers, the Kendall's coefficient of concordance (*W*) specified in equation (11) was used.

3.4.3. Econometric analysis

There are alternative econometric approaches to analyze the factors affecting the amount sold to the market and the market participation decision data type. Two of them are Tobit and Heckman two-stage (Gujarati 2004; Heckman 1979). The Tobit Model was the original model developed to analyze what are more commonly known as censored dependent variables. The model takes in to account the fact that there are a number of households who do not make any sell that is they have zero marketed surpluses. However, Tobit model has some limitations. A key limitation of the Tobit model is that the probability of a positive value and the actual value, given that it is positive, are determined by the same underlying process (that is, the same variables). Due to its limitation, it leaves the room for other alternative models.

Heckman two-stage model is one of the alternative models that can be used to cater the problem of Tobit model. It can be employed because of its advantages over the Tobit model in its ability to eliminate selectivity bias and it separates the effect of variables on the probability of market participation from the effect on the volume that can be sold (Heckman 1979). However, this model also has limitations and it assume that there are no zero observations in the second stage once the first-stage selection is passed. The Double Hurdle model relaxes this assumption and allows zero observations to arise in both the participation hurdle and sales hurdle. It postulates that individuals must pass two separate hurdles before they are observed with a positive level of sales. The first hurdle corresponds to factors affecting participation in the market and the second corresponds to the volume of marketed surplus. A different latent

variable is used to model each decision process. In effect Double hurdle model can be thought of as a flexible version of both the Tobit and Heckman model. The model features both the selection mechanism of the Heckman model (which is not a feature of the Tobit model) and the censoring mechanism of the Tobit model (which is not a feature of the Heckman model).

3.4.3.1. Choice of econometric models

Examining the description and the likelihood functions of the Tobit and the Craggit models, one can notes that the Tobit model is nested with the Craggit model i.e. restricting some parameters of the first hurdle equation of the Craggit model will result in the Tobit model. Hence, employing the Likelihood Ratio (LR) test to validate these restrictions empirically justify the use of either model. Wooldridge (2002) indicated that the second stage of the DHM is defined by a Truncated Normal Distribution which provides the nesting of the Tobit model in it. This implies that we can test whether the Tobit model or the DHM best fits the data. According to Humphreys (2013), the DHM can be tested against the Tobit model using a standard likelihood ratio test specified as:

$$LR = 2(LL_{DH} - LL_{TO}) \quad (3)$$

Where

LR *is* likelihood ratio test, equal to the difference in the maximum log-likelihood of the two models, LL_{DH} is the log likelihood value from the DHM and LL_{TO} is the log likelihood value from the Tobit model. This test statistic has a chi-square distribution with degrees of freedom equal to the number of parameter restrictions made to get the Tobit model. The decision rule is, if the absolute value of test statistic is greater than the critical value, one can declare statistical significance and reject the null hypothesis.

As a result of the weakness of the standard likelihood ratio test to test models of non-nested nature (Vuong, 1989; Humphrey, 2013) proposed a modified likelihood ratio test for non-nested maximum likelihood estimators' which is based on a transformed value of the log likelihood function, using a simple transformation as:

$$Wn = \left(\frac{1}{n}\right)[LR_1]^2 - \left[\left(\frac{1}{n}\right)LR_1\right]^2 \quad (4)$$

Where, n is the number of observations, LR_1 is the likelihood statistic formed from the difference between the value of the log likelihood function for the DHM evaluated at its maximum and the Heckman model evaluated at its maximum and specified as: $LR_1 = LL_{DH} - LL_{HM}$ with a Voung's statistic which has a standard normal distribution specified as:

$$v = \sqrt{n}\,\frac{LR_1}{W_n} \quad (5)$$

The decision rule is that if the test statistic is greater in absolute value than a critical value from the standard normal distribution, then the DHM fits these data better than the Heckman model.

3.5. Model specification

Double hurdle model originally formulated by Cragg, (1971), postulates that individuals must pass two separate hurdles before they are observed with a positive level of sales. The first hurdle corresponds to factors affecting participation in the market for the good and the second to the level of commercialization. In order to observe a positive level of marketed output, two separate hurdles must be passed. A different latent variable is used to model each decision process, with a Probit Model to determine participation and a Truncated Regression Model to determine the intensity of volume of sale.

The Double Hurdle Model can be specified as follows;

$$P_i^* = Z_i\alpha + u_i \qquad Participation\ equation \tag{6a}$$

$$P_i = \begin{cases} 1\ if z_i\alpha + u_i > 0 \\ 0\ if z_i\alpha + u_i \leq 0 \end{cases}$$

$$Y_i^* = X_i\beta + \varepsilon_i \qquad Intensity\ \ equation \tag{6b}$$

$$Y_i = \begin{cases} Y_i^* if Y_i^* > 0\ and\ P_i = 1 \\ 0\ \ Otherwise\big(or P_i = 0\ or (Y_i^* \leq 0\ and\ P_i = 1)\big) \end{cases} \tag{6c}$$

Where

$P_i^*$is a latent endogenous variable representing households' participation decision, $Y_i^*$is a latent endogenous variable representing households level of sells decision and *Pi* and *Yi* are their observed counterparts,αand β are parameters of the models, Z_i is the vector of variables explainingparticipation decision, $X_i$is a vector of variables explainingmarketed surplus, and $u_i$and $\varepsilon_i$are respective error terms assumed to be normally distributed($u_i \approx N(0,1)$, $\varepsilon_i \approx N(0,\delta^2)$); and independent ($corr(u_i,\varepsilon_i) = \rho = 0$), ρrepresents unobserved factors affecting participation may or not affect intensity of participation.

The Log likelihood function of *Craggit* DHM assumes the Probit and Truncated regressions to be uncorrelated and is given as below following Cragg (1971);

$$Log(L) = \sum Y_i = 0\left[\log\left\{1 - \Phi\left(\mathrm{Z_i}\alpha, \frac{X_i\beta}{\sigma}, \rho\right)\right\}\right] +$$

$$\sum Y_i > 0\left[\log\left\{\Phi\left(\frac{\mathrm{Z_i}\alpha + \frac{\rho}{\sigma}(Y_i - X_i\beta)}{\sqrt{1-\rho^2}}\right)\right\} - \log[\sigma] + \log\left\{\phi\left(\frac{Y_i - X_i\beta}{\sigma}\right)\right\}\right] \tag{7}$$

$\Phi\ (\ )$ denote a standard normal cumulative distribution function, and $\phi\ (\ )$ represents the standard normal density function. Through maximizing the function using the maximum likelihood estimation (MLE) technique estimates of parameters of the model obtained.

After estimating the DHM, to assess the impact of the explanatory variables on the dependent variable (Average Partial Effect) of changes in the explanatory variables on the probability of being a market participant and on the conditional and unconditional expected values of quantity of teff sold need to calculated. The average partial effect is simply an average of all partial effects for every observation in the dataset (Wooldridge, 2002).

3.6. Statistical and specification tests

Before executing the final model regressions, all the hypothesized explanatory variables were checked for the existence of statistical problems such as multicollinearity problems. Multicollinearity is a situation that arises where there is strong linear association among the explanatory variables included in the model (Maddalla, 1992). Prior to running the Double Hurdle Model, an assessment for an existence of multicollinearity was checked. Accordingly a separate test for continuous and dummy variables included in the model was undertaken using VIF and contingency coefficient procedures respectively. According to Maddalla (1992), VIF was computed by using the following formula:

$$VIF = \frac{1}{1 - R_i^{\,2}} \tag{8}$$

Where, $R_i^{\,2}$ is the squared multiple correlation coefficient between xi and the other explanatory variables. As a rule of thumb a VIF value of more than 10 indicates high correlation among explanatory variables, while a VIF value less than 10 indicates weak association among explanatory variables (Gujarati, 2004).Similarly, the existence of association among discrete explanatory variables was tested using contingency coefficient method by using the formula shown below. A value of 0.75 or more indicates stronger associations while a value less than 0.75 indicates weak association among explanatory variables.

$$CC = \sqrt{\frac{\chi^2}{n + \chi^2}} \tag{9}$$

Where: CC = Contingency Coefficient, n = sample size, and χ^2 is chi square value.

3.7. Working Hypothesis and Definitions of Variables

Dependent variables: In the analysis of this study, Market participation decision of teff farmers is the binary dependent variable for the Probit stage of the Double-Hurdle Model assigning one if the household sold teff in 2016/2017 production season, or zero otherwise. However, the Truncated Regression Model assumes a continuous value, in this case, percentage of total teff output sold by each individual household head during production season of 2016/2017 represented by Teff Commercialization Index (TCI) is dependent variable of second stage hurdle.

Independent (explanatory) variables: The explanatory variables of importance in this study were those variables, which are thought to have influence on farmers' decision to commercialize and the intensity of teff commercialization. These variables were chosen based on the available literature reviewed as and the same explanatory variables were hypothesized for both models and discussed as following;

Sex of the household head (SEHH): This is a dummy variable, which takes a value of one if the household head is male and zero, if female. In most cases males are more endowed with farm resources than females and it is found that sex has a significant and positive relationship with level of total crop sales in the market implying total value of crops sold is higher if the household head is male (Goitom, 2009; Alelign, 2017).Thus it is hypothesized that being male headed affect probability and intensity that the farmer to commercialize positively.

Age of the household head (AGHH): It is a continuous variable and measured in number of years from birth. Geoffrey *et al*., (2013) showed that younger people participated more in the market of agricultural crops because they are more receptive to new ideas and are less risk averse than the older people. Also, Berhanu and Hoekstra (2007) in their study showed that there is a U-shaped relation between age of household head and market participation of household in the cereal crops. It is, therefore, hypothesized that the age of the household head affects the probability and intensity that the farmer to commercialize positively.

Education level of the household head (EDHH): It is a continuous variable representing respondent's formal year of schooling. Basically education improves the decision making of individuals as literate households have better skills, better access to information and ability to process information, and thus positively associated with marketing decision and level of market participation (Berhanu and Moti, 2010). This is probably due to the fact that agricultural productions require managerial abilities. Education is therefore expected to have positive influence on market participation and intensity of participation.

Distance of household home from nearest market (DISMAR): It is a continuous variable measured in kilometers and refers to distance of the farmer's house from the nearest market. Lack of proximity of market to the farmer's house shows limited access to the market system to sell their output. Study by Berhanu and Moti (2010) found significant negative effect of market distance in crop output market participation. Further Alelign, (2017), found that households residing in places far from markets are less likely to participate in markets probably because of higher transaction costs. Thus, market distance is hypothesized as to have negative influence on market participation and intensity of participation in teff output market.

Credit use (CREDIT): It is a dummy variable, which takes the value one if the farm household is credit user and zero otherwise. Credit is considered as an important source of investment and helps to improve livelihood strategies of households, and households who are credit user can have better investment in preferred livelihood strategies which in turn reducing poverty as confirmed by Pender and Dawit (2007). In addition using credit, leads to increased agricultural productivity and greater commercialization through enhancing the financial and decision making capacities of the farmer forwards improved production (Berhanu *et al*., 2009). In this study, it is hypothesized that credit service has positive influence on the participation decision and intensity of participation in teff output market.

Size of landholding (LANDSIZE): it is continuous variable that refers to the area of land the household holds in hectare. The size of the land under disposal of the household is a variable affecting the decision a farmer make to participate in output market positively (Alelign,

2017). Therefore, it is hypothesized that as the size of the holding of land increases, the probability and intensity that the farmer to commercialize is expected to increase.

Farm output (OUTPUT): is total volume of annual crop produced during 2016/2017 production season by sampled households. It is an economic factor and continuous variable that assumed to affect the household level of teff commercialization and measured in quintals. The variable is expected to have a positive contribution in the smallholder marketable supply of teff. Gutu (2017) found that total volume of farm product yielded significant variable that affected positively farmers' market participation decision and intensity in teff output market. Thus this variable is assumed to affect smallholder farmers' teff commercialization and its level positively.

Family size (FAMSIZE): Family size in this study refers to the number of members who are currently living within the family measured in adult equivalent. Given the level of teff production per household, household participation in teff output markets could depend on household size or the per capita consumption requirement that could be satisfied from owned production. Efa *et al*., (2016) in their study showed that an increase in the household size by one person decreases likelihood of market participation by 2%. Thus, it is hypothesized that family size negatively affects the decision to commercialize and its level.

Livestock owned (TLU): A continuous variable and measured by tropical livestock unit (TLU) excluding oxen. It is assumed that ownership of livestock is negatively associated with crop output market participation by offering alternative cash income sources on one hand. But on the other hand livestock can serve as input for crop production like for land preparation, for transportation and their byproduct as fertilizer which can contribute for high surplus produced for market hence leads to higher commercialization in one side that leads high probability of commercial participation and level of commercialization in crops (Berhanu *et al*., 2009). Hence, this variable is hypothesized to influence market participation and volume of teff sold positively or negatively.

Number of oxen owned (OXEN): It is a continuous variable that refers to the number of oxen the respondents owned during 2016/2017.An ox is the most important means of land cultivation and for teff threshing in study areas and is one of the major assets to farm households. Goitom (2009) found that total sales value is strongly and positively associated with the number of oxen owned by farm households. Thus, it is hypothesized that lack of draught power to influence probability and intensity that the farmer commercialize negatively.

Participation in off/non-farm activities (OFNCOMEH): This is a dummy variable indicating farmer's involvement in off/non-farm activities. Participation in off/non-farm activities is expected to have negative relationship with teff crop sales and degree of commercialization. This is because of the assumption that households that generate income from off and/or non-farm activities fill financial need from that income and use output produced for home consumption or store for betterment and hence low market participation (Showaye, 2016). As a result, this variable is hypothesized to negatively correlate with both market participation decision and intensity of participation.

Extension contact (EXTEN): This is a continuous variable measured by number of visits by extension agents in production year of 2016/2017. Farmers that contact with DAs frequently will have better access to information and are more likely to know the advantage of commercialization that would increase their marketable supply of teff. According to Berhanu *et al*., (2006), extension service was found to enhance farmer skills and knowledge and develops their production and market participation. Hence, this is hypothesized to affect decision to commercialize and intensity of sales positively.

Land allocated to teff (LATEFF): It is a continuous variable measured in hectare of land allocated to teff by sampled households during the production season of 2016/2017. The likelihood of quantity sold is expected to be high among smallholders specializing in teff (the major cash crop produced in the study area). Similarly, households who are relatively more specialized are more productive than those who are highly diversified (Pingali and Rosegrant, 1995; Alelign, 2017). Hence, this variable is hypothesized to influence market participation and volume of teff sold positively.

Lagged market price of teff (PRTEFF): This is a continuous variable and is annual average price of teff in 2015, i.e. the one year lagged price of teff in birr per quintal respondents' received. When teff price is high in the market in the previous year, farmers will be interested to produce and supply more. Research conducted by Mabratom(2014), showed that the average annual selling price of sample households during the previous year of his research work had positive effect on marketed quantity of teff. Therefore lagged teff price is expected to have positive effect on volume of produce to be sold.

Access to market information (MKTINFO): It is proxy variable determined by access to communication facilities. This is a dummy variable taking value one if farmers have access to communication facilities and zero otherwise. Access to market information through access to communication facilities tends to remove the fixed transaction costs facing the smallholder farmers in entering the markets (Okoye *et al.,* 2010; Showaye 2016). According to Goetz (1992), in his household food marketing behavior study found that better information, significantly raises the probability of market participation for potential selling households. Therefore, it is hypothesized that market information is positively related to market participation and intensity of teff sales.

Family labor (FMLABOR): This is a continuous variable referring to farmer's access to active and productive family member in the household measured in terms of man equivalent. According to Berhanu and Moti (2010), teff is a laborious crop and households with higher family labor supply are more likely to grow it, given the labor market imperfection in their study area. Hence, this variable is hypothesized to have positive influence on decision to commercialize and its level.

Cooperative membership (MCOOP): This is a dummy variable, which takes the value of one if the farmer is a member of cooperative and zero otherwise. This variable is expected to affect the household supply of teff positively. This is due to producers who are members of cooperatives are likely to get inputs and market information and thus could participate and supply teff to the market than non-members (Alelign, 2017).

Table 2: Hypothesized definition of dependent and independent variables for analyses

Variables	Type	Measurement	Hypothesis	Model *
Dependent variables				
Participation decision(TEMPAR)	Dummy	1=participant,0=otherwise		PBT
Percentage of total output sold(TCI)	Continuous	HCI		TM
Independent variables				
Sex of the household head (SEHH):	Dummy	1= male,0=female	+	PBT/TM
Age of the household head (AGHH)	Continuous	Number of years	+/-	PBT/TM
Education household head (EDHH)	Continuous	Years of schooling	+	PBT/TM
Distance of household home from the nearest market (DISMAR)	Continuous	Kilometer	-	PBT/TM
Credit use (CREDIT)	Dummy	1=if user, 0= otherwise	+	PBT/TM
Size of landholding (LANDSIZE)	Continuous	Hectare	+	PBT/TM
Farm output (OUTPUT)	Continuous	Quintal	+	PBT/TM
Family size (FAMSIZE)	Continuous	Adult equivalent	+/-	PBT/TM
Total livestock owned excluding oxen (TLU)	Continuous	TLU	+/-	PBT/TM
Number of oxen owned (OXEN)	Continuous	Number of oxen	+	PBT/TM
Participation in off/non-farm activities(OFNCOMEH)	Dummy	1=if engaged, 0=otherwise	-	PBT/TM
Extension contact (EXTEN)	Continuous	Number of visit days	+	PBT/TM
Land allocated to teff (LATEFF)	Continuous	Hectare	+	PBT/TM
Lagged market price of teff (PRTEFF)	Continuous	selling price of previous year (ETB)	+	PBT/TM
Access to market information (MKTINFO)	Dummy	1, if have information,0=otherwise	+	PBT/TM
Family labor (FMLABOR)	Continuous	Man equivalent	+	PBT/TM
Cooperative membership (MCOOP)	Dummy	1= if member; 0=otherwise	+	PBT/TM

***denotes model in which variable is applied: PBT is Probit model (Participation/Tier1), TM is Truncated model (intensity model/Tier2)**

3.8. Assessing Constraints facing Teff Farmers in Study Area

The Kendall's Coefficient of Concordance test was used to rank the constraints to smallholders' teff commercialization in the study area. The Kendall's coefficient of concordance measures the agreement among the rankings of the constraints by the respondents. It is a non-parametric statistical procedure used to identify a given set of constraints or problems, from the most influential to the least influential as well as measure the degree of agreement or concordance among the respondents. The mean rank for each constraint is calculated and the constraint with the lowest mean rank is said to be the most pressing. The null hypothesis states that there is no conformity among the rankings of the constraints by the respondents. The alternative states that there is conformity among rankings of the constraints by the respondents (Legendre, 2010). The Kendall's coefficient of concordance (W) was used to rank constraints in this study and the equation for the Kendall's coefficient of concordance is given as:

$$W = \frac{12\left[\sum T^2 - \left(\sum T\right)^2 / n\right]}{nm^2(n^2 - 1)} \qquad 11$$

Where, W = Kendall's Coefficient of Concordance, T = Sum of ranks for constraints being ranked, m = Total number of respondents, n = Total number of constraints being ranked and Σ= summation symbol. The numerator and denominator degrees of freedom is calculated as $(n-1)-(2/m)$ and $m-1(n-1)-2/m$, respectively

The Coefficient of Concordance (W) was tested for significance in terms of the F-distribution given as:

$$F = \left[(m-1)w/(1-w)\right] \qquad 12$$

4. RESULTS AND DISCUSSIONS

4.1. Descriptive and Inferential Analysis result

4.1.1. Characteristics of surveyed households over discrete explanatory variables

Household head sex: As indicated in table 3- Male headed households constitute 88.3% among 17.5% were non-commercialized while 70.8%were commercialized of the sampled households and the remaining 11.7% were female headed households among 4.5% were non-commercialized and 7.2% were commercialized. The chi square test of variability between the two groups is significant indicating there was variability at 10% significance level between market participants and non-participants.

Participation in off/non-farm activities: Majority of household heads (79.9%) among commercialized households constituted 63.6% and non-commercialized accounts 16.3% were not engaged in off/non-farm activities in the 2016/2017 farming season and about 20.1% households(5.8% non-commercialized and 14.3% commercialized) engaged in off/non-farm activities. Statistical test showed absence of significant difference in terms of off/non-farm income activities engagement between commercialized and non-commercialized teff farmers of the sample households.

Access to market information: From the total sampled household's majority of sampled households (86.4%) had access to market information through access to communication facilities. Disaggregation also showed that among those who had market information access 20.2% were non-commercialized and 66.2% were commercialized households. Those households who had no access to market information constituted small percentages (13.6%) among 1.9% were non-commercialized households and 11.7% were commercialized. The statistical test showed that there was no significant percentage difference between groups of sampled households.

Credit use: About 87% of the total sample households were not credit users, where non-commercialized and commercialized households constituted 15.6% and 71.4%, respectively. The rest 13% were credit users with 6.5% score each group of sampled respondent. The

statistical test results revealed that there was statistically significant percentage difference between non-commercialized and commercialized households at 1% significance level in terms of credit using available in the study area.

Cooperative membership: About 84.4% of the total sample households were cooperative member, among non-commercialized and commercialized households were 17.5% and 66.9%, respectively while the rest 15.6% were not member of cooperative (about 4.6% were non-commercialized and 11% were commercialized. The chi-square results reveals there were no statistically significant percentage difference between the groups.

Table 3: Summary statistics for dummy variables

Variables	Non Commercialized		Commercialized		χ^2 value	Total	
	No	%	No	%		No	%
Sex of HHs							
Female	7	4.5	11	7.2	3.348*	18	11.7
Male	27	17.5	109	70.8		136	88.3
Off/non-farm activities							
Not engaged	25	16.3	98	63.6	1.091	123	79.9
Engaged	9	5.8	22	14.3		31	20.1
Market information access							
No	3	1.9	18	11.7	0.858	21	13.6
Yes	31	20.2	102	66.2		133	86.4
Credit user							
Non-users	24	15.6	110	71.4	10.417***	134	87
Users	10	6.5	10	6.5		20	13
Cooperative membership							
Non-members	7	4.6	17	11	0.830	24	15.6
members	27	17.5	103	66.9		130	84.4

Note: ***,* shows 1% and 10% significance level.
Source: Computed from household survey, 2018

4.1.2. Characteristics of respondents over continuous explanatory variables

Household head age: Table 4 shows that mean age of the total sampled household heads is about 45.56 years. This implies that farm households in the study area can be described as relatively young and within the economically active population. The mean age of non-commercialized and commercialized households was about 44 and 46 years, respectively and

statistical test showed that there was no significant difference in the mean age between commercialized and non-commercialized households.

Family size: Mean family size of total respondents is about 6.86 in adult equivalent and disaggregation shows that 6.37 and 6.30 were the mean age of non-commercialized and commercialized respondents, respectively with no significant mean difference between them as revealed by statistical t-test (table 4).

Education level of the household head: The mean years of education also shows that on average the highest level of education attained for total sampled household head 4.49 means is primary education (about grade 5) whereas grade 4 and grade 5 were average education level of non-commercialized and commercialized households. Statistical analysis showed that there was no significant difference in the mean of education for commercialized and non-commercialized households (table 4).

Farm output: The study showed that the average annual production of the respondents was 92.56 quintal. The average total crop output score of 68.23 and 98.04 quintals were the average annual farm output of non-commercialized and commercialized households, respectively. Statistical analysis showed there was a significant mean difference in terms of farm output between teff output market participants and non-participants in the sampled households at 1% significance level (table 4).

Family labor: Family labor is the major labor source in smallholder farm households. As indicated in table 4, on average the total sample households were supplied a family labor of 3.9 (in man equivalent) persons per household while for commercialized and non-commercialized households were supplied 4.06 and 3.36 per household, respectively. Statistical test of mean difference showed that there was significant mean difference between family labor of teff market participants and non-participants at 1% significance level.

Size of landholding: The most important resources of farmers are land and livestock. The total land size owned by sampled households was 6.87 hectare on average. The difference in average area of land owned by the two groups was statistically significant at 1%significance

level. On average commercialized households owned 7.3 hectare while non-commercialized owned about 5.2 hectare of land (table 4).

Land allocated to teff: Table 4 below shows that the land size under teff production cultivated by sampled households was about 2 hectare on average while non-commercialized and commercialized respondents cultivated teff over an average land of 1.19 and 2.31 hectare respectively. Statistical test of mean difference showed that there was significant difference among the two groups in terms of land under teff production at 1% significance level.

Livestock owned: Livestock is another crucial physical capital for farmers by serving as, land preparation, threshing, transportation and also means of asset saving to indicate wealth in addition to serving as source of food and cash income. As indicated in Table (4) the sampled households own on average 9.66 tropical livestock unit (TLU) animals excluding oxen. There was statistically significant mean difference of total livestock owned between commercialized and non-commercialized households at 1% significance level and the mean livestock that commercialized and non-commercialized sample household owned was 10.32 and 7.32, respectively (table 4).

Number of oxen owned: An ox is an important and the only draught power used in the study area. The total sampled households were own on average about 4 oxen while disaggregation showed that the average number of oxen commercialized and non-commercialized households owned was about 5 and 3, respectively. There was a statistically significant mean difference between commercialized and non-commercialized households at 1% significance in terms of the number of oxen owned (table 4).

Extension contact: Survey result indicated that, the average extension contact total households made during the production season was about 8 times and it was almost similar to the whole sample for non-commercialized (8) and commercialized (8.25) households. The statistical test also showed that there was no significant difference in the mean of extension contact made by sampled respondents during production season (table 4).

Lagged market teff price: The average lagged price of teff output sold received by farmers was about 998 Ethiopian birr per quintal for the whole respondents. While average lagged teff price received by commercialized and non-commercialize was about 1260 and 73.52 Ethiopian birr. The statistical test of the mean difference showed that there was statistically significant difference at 1% significance level (table 4).

Distance to the nearest market: The average distance to be traveling from total surveyed households' home to the nearest market center was found 11.98 kilometers while it was 11.64kilometers and 13.18 kilometers for commercialized and non-commercialized households, respectively. The statistical test showed that there was significant difference among the two groups by distance to the nearest market at 1% significant level (table 4).

Table 4: Summary statistics for continuous variables

Variables	**Non-commercialized**		**Commercialized**			**Total**	
	Mean	Std. Dev	Mean	Std. Dev	**t-test**	Mean	Std. Dev
Age (years)	43.765	9.2836	46.075	9.8391	1.223	45.5649	9.7370
Education(no)	4.4118	3.5770	4.5167	3.7077	0.224	4.4935	3.668
Family Size(AE)	6.3721	1.5562	6.3012	1.6448	-0.147	6.3169	1.6209
Land size(Ha)	5.1949	1.4199	7.3396	2.5145	4.756***	6.8661	2.4797
Land under teff(Ha)	1.1912	0.4769	2.3104	1.3040	4.903***	2.0633	1.2604
FM Labor(ME)	3.3618	1.0921	4.0642	1.3033	2.868***	3.9091	1.2899
Output(in Ku)	68.235	26.7808	98.042	43.9802	3.754***	92.5649	42.0199
Livestock(by TLU)	7.3282	4.1428	10.322	5.1168	3.131***	9.6614	5.0614
Oxen (no)	3.1765	0.9035	4.6583	1.6977	4.889***	4.3312	1.6727
Extension contact(no)	8	1.9694	8.25	1.7692	0.709	8.1948	1.8116
Lagged teff price(in Birr)	73.529	300.8159	1260	150.2938	31.608***	998.052	529.9489
Distance to market(Km)	13.177	4.8019	11.638	4.3322	-1.785*	11.9773	4.4700

Note: *** and * shows 1% and 10% significance level, respectively

Source: Computed from household survey, 2018

4.1.3. Other important teff farmers' characteristics

4.1.3.1. Land allocation and production pattern of the surveyed households

Allocation of resources, most importantly land, for production of different crops is common in the smallholder farmers. This proportion of resource allocation indicates the emphasis given for different enterprises by the households. As different products have different value and require different resources, the value of crops produced and sold by household is strongly determined by the type of crop produced. As can be seen from Table 5 farmers under the study allocated most of their land for teff production (36%) of total land they cultivated and it ranks second in terms average output(18.05 Quintal) next to maize(63.86 Quintal). Land proportion under maize (28%) and oilseed (Niger seed) (26%) were holding the second and the third rank, respectively. Small proportion (11%) of land was under crops like pulses, burley and wheat.

Table 5: Percentage share of cultivated crops and mean output by sampled households

Land allocation	**Proportion of land {in Ha}**		**Mean of output {in Ku}**	
	Percentage	**Rank**	**Average**	**Rank**
Teff	36%	1st	18.05	2nd
Maize	28%	2nd	63.86	1st
Oilseeds(Niger seed)	26%	3rd	6.28	3rd
Others(Pulses, Wheat and Barley)	11%	4th	4.37	4th
Total	**100%**		**92.56**	

Source: Computed from household survey, 2018

4.1.3.2. Farm inputs and technology used in teff production

Using fertilizers to improve soil fertility and thereby intensifying production, use of improved seeds has also become popular in study area. Improved agricultural inputs help to increase productivity and thereby increase production for consumption and market. The major agricultural inputs used by teff farmers include chemical fertilizer (DAP/NPS and UREA), herbicides (2-4-D), improved seed and organic fertilizers like animal manure by rotational paddoking and compost, labor both family and hired. The farmers used chemical fertilizer

(DAP/NPS and UREA) about 1.56 quintals per hectare and Herbicides (2-4-D) about 0.76 Liter per hectare on average. Organic fertilizers using is also common way to boost their production in study area. About 44.8% of sampled households were users while non-user were 55.2% *and Rotational Paddocking* (42.9% of respondents reported) was one of most commonly used and others like animal manure, and compost were also used by some respondents. Another important input is labor which very important in teff production and about 20.1% of responds were used their own source of labor while about 79.9% produced teff by hiring and payment was in kind(one out of five teff common in study area known as ***Aballii***. Almost all farmers reported that they were using improved teff seed locally they call it as *Bashanana, Quncho, Badugala and Sharite*, with very much long time, not less than ten years, redundancy from year to year.

Table 6: Farm inputsused and distribution of households in teff production

Inputs		**Average/ha or % tages**	**Min**	**Max**	**St.dev**
Chemical fertilizers (Ku)		1.5559	0.38	3.00	0.3559
Herbicides(L)		0.7635	0.20	1.33	0.2111
Organic fertilizers (%)	Users	44.8 (69)			
	Non users	55.2 (85)			
Improved seed (%)	All	All			
Labor (%)	Own	20.1 (31)			
	Hired	79.9 (123)			

Source: Computed from household survey, 2018

4.1.3.3. Farmers way of transportation and buyers of their teff produce

As indicated in Figure 3 majority (about the 94.2%) of the sampled households transport teff from home to market using animal back (donkey) and the rest 3.2%, 2.6% of sampled households transport teff using animal cart, vehicle, respectively. These respondents reported that they use animal back to transport their produce due to poor road available from their home to nearest market. Majority of respondents sold their produce to local collectors (79.2%) and about 25.3% sold to direct consumers and small percentage (2.6%) sold their produce to wholesalers with their Vehicle.

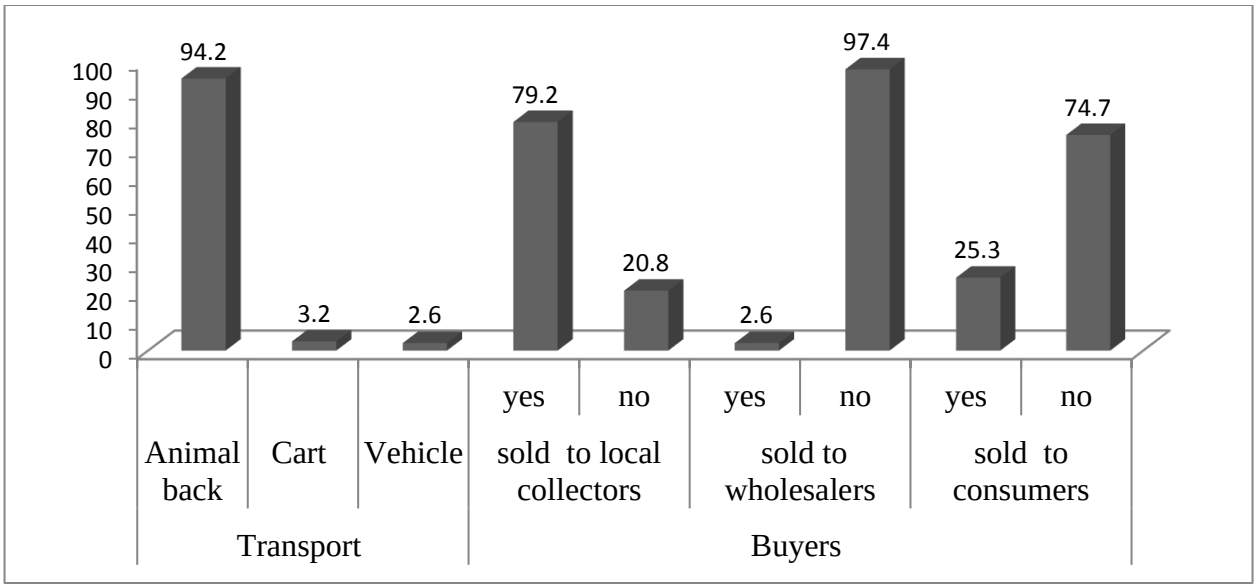

Figure 3: Means of transportation and teff buyers of surveyed households

Source: Household survey, 2018

4.2. Marketing characteristics and level of Household Teff Commercialization

4.2.1. Household participation in the market

As presented in table 7, the study revealed that about 78% of the surveyed households were participants or commercialized in teff market and the remaining 22% were non-participant (non-commercialized) sample households in teff output market. This implies that about 78% of sampled teff farmers sold teff output during 2016/2017 production season while about 22% did not. This result reflects that in study area teff is produced for household consumption and for sale. It was revealed that households do not just decide to produce teff for consumption alone in study area.

Table 7: Farmers' participation in teff output market

Description	Frequency	Percent
Participant	120	78
Non-participant	34	22
Total	**154**	**100**

Source: Computed from household survey data, 2018

4.2.2. The level of teff commercialization by smallholder households

The levels of market participation or commercialization of smallholder teff farmers from the data gathered indicate that 39.08% average teff commercialization index. This implies that on average amount of teff sold was about 39% of teff output during the production year. The result shows a moderate teff commercialization index in the study area during 2016/2017 production season. Among teff market participants (120 households), the average level of commercialization is 50.16%, ranging from 13.33% to 83.33% (table 8)

Table 8: Teff commercialization index of households

	Average TCI	**Min**	**max**
Overall sample	39.08	0	83.33
Commercialized	50.16	13.33	83.33

Source: Computed from household survey data, 2018

4.2.3. Proportion of output sold and percentage of households selling

From summary of the proportion of output sold and the percentage of households selling teff crops as indicated by figure 4 below, the greater percentage (37%) of households sold between 51% and 99% of their teff output. This means that majority of households producing teff sold higher proportions of their output which ranges from 51% and 99%. Proportion of output sold ranging between 26% and 50% had 34.4% of teff producer households while the least percentages (6.5%) of households are those whose proportion of teff output sold is between 0 and 25% and non-commercialized households constitute 22.1% of surveyed teff producer households. The trend of percentage of households selling teff is increasing reflects that the market-oriented nature of teff where larger marketed surplus is raised.

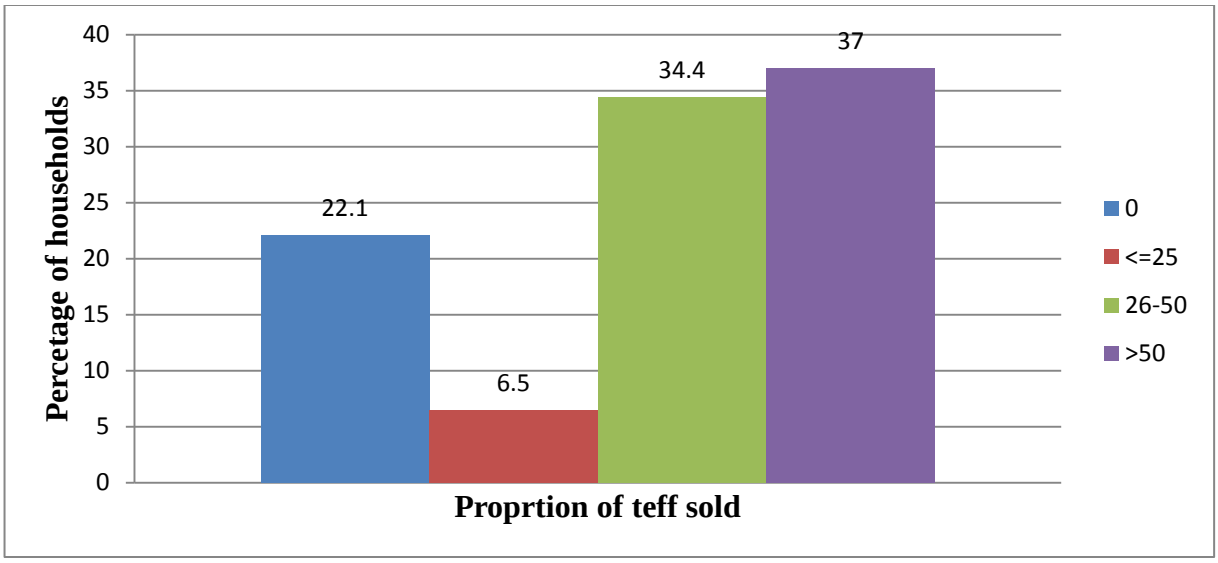

Figure 4: Proportion of smallholder farmers' teff commercialization

Source: Drawn from Household Survey Data, 2018

4.2.4. Characterization of households based on the level of commercialization

The farmers' level of commercialization was used to categorize farmers according to subsistent, less-commercialized farmer, moderately commercialized farmer, highly commercialized farmers and fully commercialized farmers even if fully commercialized farmers were not found in surveyed samples. The scholars, Gutu (2017), has grouped farmers as non-commercialized those who do not sell their output in the market at all, those who supply less than 25% of their produce, those who supplying 25 to 50% of their produce, those who supply 50 to 75% of their produce, those who supply more than 75% of their produce as semi-commercialized and those who supply 100% of their output as fully-commercialized farmers. Musah *et al*., (2014), categorized smallholders as low commercial farmers those who sell only up to 25% of their product, medium-commercial farmers those who sell 26-50% of their product and considered as high-commercial farmers those farm households who sell 50% and more of their product.

The categorization of level of commercialization of teff farmers in study area was made following Musah *et al*., (2014) and Gutu (2017). As indicated in the table 9, the level of commercialization of teff farmers in the area is between medium and high level as the two

categories constitute the highest percentage of surveyed households (34.4% and 37%) respectively.

Table 9: Extents of smallholders' commercialization in teff output market

Level of commercialization	Frequency	Percentage
Not supply at all(subsistent)	34	22.1
Supply less than 25% of their produce (less commercialized)	10	6.5
Supplying 26 - 50% of their produce (moderately commercialized)	53	34.4
Supply more than 51% of their produce (highly commercialized)	57	37.0
Supply 100% of their output (fully commercialized)	0	0.0
Total	**154**	**100.0**

Source: Computed from household survey, 2018

As indicated in the table 9 above, 6.5% of teff farmers sampled were characterized as less commercialized farmers. 34.4% and 37% of teff farmers were characterized as moderately commercialized and highly-commercialized farmers, respectively. This implies that mass of respondents were found between medium and high commercialized farmers and this can be evidence to conclude that teff is cultivated for both household consumption and for commercial purpose in study area.

4.3. Econometric results

STATA version 13 was used to estimate the probability of market participation and intensity of smallholder farmers' teff output market participation using the written command *'craggit'* used by Burke (2009). This command estimates the first and second hurdles of DHM simultaneously. Before the execution of the econometric analysis the hypothesized independent variables were tested for the presence of serious multicollinearity problem. The variance inflation factor and contingency coefficient were computed to check association among continuous variables and dummy variables, respectively. The values of VIF for continuous explanatory variables were less than 10 (Appendix 1) and contingency coefficients for dummy explanatory variables were less than 0.75(Appendix 2). This implies that multicollinearity is not a problem in the estimated models for both sets of continuous and

dummy variables. In addition, as heteroscedasticity is a common problem with typical cross-sectional data, the established procedure for the correction is to estimate the models using robust standard errors. Therefore, the model was estimated using robust standard errors to correct for heteroscedasticity using "*vce(roubust)"* option with craggit command on the stata.

Again before execution of DHM it is important to test hypothesis between the DHM and the Tobit models to identify which of them best fits the data using Likelihood Ratio (LR) test. LR test result shows that the DHM best suits the data. From Appendix 3, the test values of 44.779underway the critical value of 33.4. Therefore, this test statistic showed that the DHM was strongly preferred to Tobit model. Also, the test between the DHM and the Heckman model as displayed in (Appendix 3) showed that the DHM is best applicable to the data and hence suitable than the Heckman model. Therefore, DHM was used in this study to identify the determinants of smallholder teff producer farmers' market participation decision and intensity of teff sales by considering the possibility of zero observations in the participation decision or not.

Since the dependent variable in the first hurdle of the DHM was binary, the coefficients of the explanatory variables just indicated the direction of the relationship and not their marginal effects on the dependent variable. Therefore, further post-estimation analyses were carried out to compute the average partial effects (APE) of the explanatory variables. These APE were computed at three levels i.e. on the probability of teff commercialization (selection model), on the expected value of commercialization intensity conditional on the household having commercialized, and on unconditional expected value of commercialization intensity (overall average commercialization intensity in the sample regardless of household commercialization status). These all were obtained by one step command on STATA package, following the procedure proposed by Burke (2009)

Additionally, the source by Burke (2009) indicated that the standard deviation of the predicted partial effects should not be used as standard errors (SE) for drawing prediction on the average partial effects. For that matter, standard errors used to draw inferences on the average partial effect were computed using the delta method (Burke, 2009; Geoffrey, 2017). The

computed average partial effects (APE) are presented in table 11. The first column of table 11 (Tier 1) presents the APE on the probability of a household commercializing while the second column (Tier 2a) presents the conditional expected values of commercialization intensity. On the other hand, the third column (Tier 2b) presents the APE on the unconditional expected values of commercialization intensity.

4.3.1. Determinants of market participation of smallholder households

The results for the determinants of market participation (estimated by the Probit Model, Tier 1 of DHM) are displayed in table 10 below. The Wald chi-square value of 69.27 is statistically significant at 1% indicating that the explanatory variables in the model explain the probability of participating in the markets. Out of the seventeen explanatory variables included in the model, nine variables, namely education of household head, family size, land holding size, land allocated to teff, farm output, participation in off/non-farm activities, lagged teff market price, access to market information and cooperative membership were found to significantly influence the probability of participation in teff output market of producers in the study area.

Education level of the household head: The model result showed that education of household head has a positive effect on participation decision which is statistically significant at 1% significance level (table10). A household whose household head had one more year of formal education was about 0.25% more likely to participate in teff output market compared to household with one year less of formal education (table 10). This means that a higher level of education is associated with an increase in the probability of participating in the teff output market. This finding is in conformity with Yallew (2016), that educated farmers' tendency to accept different agricultural technologies is high, so that they can produce more surplus for market. Aman *et al*., (2014) also stated that education increases the ability of farmers to get and analyze relevant market information which would improve their marketing performance. It is also confirmed with Simuyu (2015) who found that education endow the household with accurate information processing and enable households to participate in crop output market in a more profitable way than otherwise.

Family size: family size found that significant and negatively associated with the probability to participate in teff output market at 5% level of significance (table10). A household with one more adult equivalent was likely to be less teff market participant by about 1.4% compared to a similar household with one less adult equivalent (Table 11). The implication is that households' participation decision in teff market strongly depend on family size as consumption requirement is satisfied from own production. Thus, the probability of being a seller in teff market decreases for households with larger family size and increases for households with smaller family size. This finding is consistence with the finding of Dube and Guveya (2016) and Yallew (2016) that households decide to sell when they cannot consume all they have produced and hence, the more members the household has the more likely that most the produce will be consumed thereby decreasing the possibility of selling. This result is also confirms finding of Efa *et al*., (2016) and Musah (2013)that households with large family sizes fail to produce marketable surplus beyond their consumption needs.

Size of landholding: The total land size household owned had a positive effect on the probability of participating in the teff output market and statistically significant at 10%significance level (table 10). A household with one hectare more was likely to be more participant by about 1.5% compared to a similar household with one hectare less (Table 11). This means that farmers with larger land sizes are more likely to participate in teff market. The result implies that households with a bigger land size are likely to diversify their production into cash and have a higher probability of producing more food crops beyond their subsistence consumption. According to Simiyu, (2015) households with bigger land holding sizes have a higher probability of producing more food crops beyond their subsistence consumption levels thus selling the surpluses. Moreover, findings of Efa *et al.,* (2016) and Yallew (2016) announced that shortage of land is one of the binding factors for the rural households' inability to produce marketable surplus; since they have to first sustain their food self-sufficiency.

Land allocated to teff: The model result showed that the land allocated to teff by households has a positive effect on the probability of participating in the teff output market and statistically significant at 10% (table 10). Household with one hectare more of land allocated

to teff is more likely to be participant in teff output market by about 1% than household with one hectare less of land allocated to teff (table 11). This reveals that, the larger the land size under teff production the larger the quantity produce and thereby increasing the quantity of produce available for sale. Finding of the present study is consistent with Adam and Dawit (2015), that the cultivated land had greater positive impact on household's market participation and Mabratom (2014) that farmers' specialization in teff had increased the probability to be market participant as it had a positive and significant impact on the volume of teff sold.

Farm output: The total volume of farm output was found with significant positive effect on the likelihood of participation in teff output market at 10% significance level which is consistent with expectation since a higher output ensure marketable surplus (table 10). The household with one more quintal of farm output is more likely to be participant by about 0.4% than household with one quintal less of farm output (table 11). This result is due to the fact that whatever is taken to the market is always what is in excess of household consumption and thus the volume of product is critical in allowing households to participate in crop output market. This confirms the findings of Gutu, (2017), who forwarded that the total volume of farm product is critical in allowing households to participate in a market. Nuri *et al.,* (2016) also contended that the higher the produce the higher is the farmer willing to participate in the market. Moreover, the study by Gani and Adeoti, (2015) showed that, natural increase in the size of gross output implies an increase in the output commercialization ratio that is the ratio of quantity consumed to that sold.

Participation in off/non-farm activities: The model result showed that participation in off/non-farm activities has a negative effect on likelihood of teff output market participation at 5% significance level (table 10). The probability to be market participant decrease by about 3.6% for households who participated in off/non-farm activities than households who do not engaged in off/non-farm activities (Table 11). This implies that farmers who had engaged in off/non-farm activities earn more cash from these sources and able to satisfy their needs by income earned that reduce the probability to participate in teff output market. This recognizes that the negative coefficient in the probability model is that teff farming and off/non-farm

activities in the study area are to some extent substitutes since teff is staple food crop produced more likely for consumption. This result confirms the finding of Musah (2013) that off-farm income triggers off-farm diversification a situation that reduces the probability of farm households from participating in the market. Further, Nuri *et al.,* (2016) found that farmers who have better off/non-farm income will not tend to generate cash from sell of agricultural rather from their non/off farm income. The study finding affirms that participation in off/non-farm activities contributes less to marketable output. This can be changed if off/non-farm income is reinvested in teff farming, consequently, farm outputs rises that enable farmers to produce marketable surplus.

Lagged market price of teff: The regression coefficient was significant and positively influenced the probability of teff output market participation at 1% significance level (table 10). This implies that as households who perceived the lagged market price of teff was high enough, producers would be interested to produce and supply more than those who perceived the lagged market price as not as such. As lagged market price of teff increase by one birr, the probability to be participant in teff market increases by about 3%, other factors held constant (table 11). This finding confirms Yallew (2016) and Shewaye (2016) who concluded that where the household perceives previous year price was good the decision to participate will increase. Moreover, Efa *et al.,* (2016) showed that when perception of lagged market price by farmers is high, it motivates the farmers to produce more, they have surpluses to supply to the market and the lagged price can act as a motivation for them to participate or not participate in the market.

Access to market information: The regression result showed that those households who have access to market information, especially price information have more probability to be teff market participant as the coefficient is positive and statistically significant at 10% significance level (table 10). Average partial effect result indicates that a unit increase in access to communication facilities for households who have access to market information, the probability to be market participant increase by about 4.6% than their counterparts (Table 11). Access to price information and communication services are key in prompting the market participation decision and encourage the degree of commercialization. This confirms

Showaye (2016), who found that those households who have high access to communication facilities have increased information flow which enables farmers to link to buyers at a lower cost. Gani and Adeoti (2015), also found that households who are receivers of market information are more likely to take market participation more seriously than non-receivers In addition, Nuri *et al.,* (2016), market information is vital instrument during marketing because it informs the farmers about marketing conditions, hence farmers who have price information prior to marketing tend to sell more of their produce than those without.

Membership in cooperative: The model result showed that cooperative membership has positive influence on probability to be participant in teff output market and statistically significant at 5% level of significance (table 10). The probability to be market participant increases by about 0.01% for households who have cooperative membership than who were not cooperative members (Table 11).The implication is that membership in cooperative could have better access of market information, inputs, extension services and/or technical advice, and access to credit facilities important to production and marketing decisions. Findings by showaye (2016) and Gani and Adeoti, (2015) showed that agricultural cooperatives enhance members' market participation by easing access to productive inputs and facilitating extension linkages.

Table 10: Double Hurdle Regression Result

Tier 1: Probit regression			Tier 2: Truncated regression	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
SEHH	-1.2075	0.7938	10.1302**	4.8074
AGHH	0.0034	0.0185	-0.3155**	0.1577
EDHH	0.1193*	0.0651	0.1285	0.3967
FAMSIZEAE	-0.6679**	0.3014	-3.6941***	1.1771
LANDSIZEHE	0.7113*	0.4187	1.6491	1.3034
LATEFF	0.4579*	0.2356	1.2495	1.6535
FMLABOR	-0.2036	0.1691	2.2199*	1.2343
OUTPUT	0.0178*	0.0102	-0.0583	0.0584
OFNCOMEH	-1.7414**	0.7156	1.0593	3.3986
LIVESTOCK	-0.0108	0.0399	0.0550	0.3424
OXEN	0.1654	0.2244	0.4497	1.2493
EXTEN	0.0558	0.0589	1.2391	0.7784
PRTEFF	0.0052***	0.0011	0.0010	0.0084
DISMARKM	-0.0527	0.0321	-0.5034*	0.2967
MKTINFO	1.4877*	0.8317	2.9546	8.6767
CREDITACCE	0.9892	0.8140	-3.0480	6.1860
MCOOP	2.1769**	0.9660	10.4494	9.5171
_cons	-7.7513***	2.7931	38.0191**	18.9768
sigma_cons			12.59152***	0.7119006
Obs. = 154 Wald $chi^2(17)$ = 69.27 Prob > chi2=0.000 Log pseudolikelihood = -480.22268				

Notes: ***, **, and * shows significant at 1%, 5%, and 10% significance level, respectively.

Source: Household survey data, 2018

4.3.2. Determinants of the intensity of market participation teff farmers

The model results for the determinants of intensity of farmers' teff output market participation (estimated by the truncated regression model, Tier2 of DHM) are also displayed in Table 10.The intensity of participation in the teff output market is significantly determined by five variables out of the seventeen explanatory variables. The identified determining factors were sex of household head, age of household head, family size, family labor and distance to the nearest market.

Sex of the household head: The second tier of model output announce that sex of the household head was household characteristic that affect teff marketed surplus of households positively in the study area which was statistically significant at 5% significance level (table 10). The conditional and unconditional commercialization intensity was found to increase by about 10 and 7 times, respectively, for male households (Table 11). Yallew (2016) had reasoned out that most of the time female household heads are more concerned about feeding their families rather than taking their production out to the market. Males often receive the support of the females on their farms more than the females do and most of the female headed households were widowed with less economic and physical power to farm intensively (Aman *et al*., 2014, Musah *et al.,* 2014).This implies that male household head sold more percentage of crops they produced than female headed households.

Age of the household head: Result indicated that age of household head is negatively influenced teff marketed surplus at 5% significance level (table 10). This implies that household that is younger is likely to be more intensively commercialized compared to a similar household that is older. Average partial effect results showed that a one year older household head was likely to be 31% less conditional marketed surplus of teff and about 24% less unconditional marketed surplus of teff (Table 11). This relation of age with teff marketed surplus has most likely resulted from resource redistribution among household that resulted in low surplus produced and also increased demand for home consumption as family size increases over time coupled with loss of power. This finding is supported by Tekalign (2014), finding that as the ability of younger farmers to produce more output raising larger marketable

surplus and the tendency of having smaller household sizes permitting them to have a higher likelihood of selling than older farmers. In addition there is a tendency of younger heads to have relatively a higher educational level in terms of highest completed grade than older heads, hence better accessing price information.

Family size: Household size was found that significantly and negatively affected teff marketed surplus at 1% significance level (table 10). The average partial effect showed that increase in family size by one adult equivalent decrease the conditional marketed surplus of teff by about 3.67 on average and unconditional marketed surplus of teff by about 3.46 on average (table 11). The result is expected because large family needs more teff to consume and less to sell as compared to the small one. This also confirms the result of Musah *et al*., (2014) that households with large family sizes need to feed their family first and take the remaining small portion surplus to the market especially if the crop is consumable at home.

Family labor: Family labor was found that it has positive effect on the quantity of teff marketed and statistically significant at 10% significance level (table 10). The positive and significant relationship between the variables indicates that as the family labor increases, the proportion of marketed surplus of teff sold at the market also increases. The average partial effect showed that one additional family labor in man equivalent increase the conditional marketed surplus of teff by 220% and unconditional marketed surplus of teff by 154% (table 11). Thus, farmers who have more access to family labor were more intensively commercialized than those who have less family labor. Tigist (2016) reported that as, an important input for agricultural activities, labor supply is positively correlated with marketed surplus of cereal crops market participation. The author contended that, this indicates that the competitive advantages of small farms have over large commercial farms would be using family labor to reduce the cost of production.

Distance of household head home to the nearest market: Distance of household head home to the nearest market was found that negatively affects intensity of teff output market participation and is statistically significant at 10% significance level (table 10). As distance between household head home and nearest market increase by one kilometer, conditional

intensity of teff commercialization decreases by 50% and unconditional intensity decreases by about 44% (table 11). Distance can separate farmers from accurate and recent price information which exposes farmers to for cheaters resulted in sale of their produce by low price (Tekalegn, 2014). Moreover, It is found that long distance to the nearest market is a challenge for most Ethiopian farmers in rural areas facing imperfect or incomplete markets for surplus crop production and market supply (Tigist, 2015, Alelign, 2017)

Table 11: Average Partial Effects (APE) of DHM explanatory variables

	Tier 1: Market participation (N=154)		Tier 2a: Conditional intensity (N=120)		Tier 2b: Unconditional intensity (N=154)	
Variables	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
SEHH	-0.0256	0.0674	10.0693	0.1584	6.7783	5.1212
AGHH	0.0001	0.0002	-0.3136	0.0049	-0.2418	0.1282
EDHH	0.0025	0.0067	0.1277	0.0020	0.2069	0.2679
FAMSIZEAE	-0.0142	0.0373	-3.6719	0.0578	-3.4672	2.0063
LANDSIZEHE	0.0151	0.0397	1.6392	0.0258	1.9189	1.6684
LATEFF	0.0097	0.0256	1.2420	0.0195	1.3811	1.0994
FMLABOR	-0.0043	0.0113	2.2066	0.0347	1.54023	1.0445
OUTPUT	0.0004	0.0010	-0.0579	0.0009	-0.0293	0.0483
OFNCOMEH	-0.0370	0.0973	1.0529	0.0166	-0.7419	3.9761
LIVESTOCK	-0.0002	0.0006	0.0547	0.0009	0.0330	0.0345
OXEN	0.0035	0.0092	0.4470	0.0070	0.4977	0.3970
EXTEN	0.0012	0.0031	1.2317	0.0194	1.0120	0.5029
PRTEFF	0.0316	0.0831	0.0010	0.0001	0.0055	0.0116
DISMARKM	0.0210	0.0553	-0.5004	0.0079	-0.4381	0.2246
MKTINFO	0.0462	0.1216	2.9369	0.0462	3.6296	3.4343
CREDITACCE	-0.0256	0.0674	-3.0297	0.0477	-1.4773	2.6432
MCOOP	0.0001	0.0002	10.3867	0.1634	10.0659	6.1293

Source: Household survey data, 2018

4.4. Constraints Facing and Opportunities of Teff Farming Households

4.4.1. Production constraints teff farmers encountered

Despite the current volume of teff produced and offered to the market, farmers face a number of problems in the production and marketing process. Based on farmers' identification, the major production problems reported were high cost of and late delivery of fertilizer, followed by credit problem, shortage of land, uncertain climatic conditions, limited improved seed acquisition, shortage of labor, declining soil fertility (table 12).Kendall's coefficient of concordance (W^a) was 0.52 which indicates that there is 52% agreement among ranking of constraints by teff farmers. The chi-square was asymptotically significant at 1%, thus null hypothesis that there is no agreement among ranking of constrains is rejected.

High cost of fertilizer and delayed delivery: High cost of and late delivery of fertilizer has been a perennial problem indicate that farmers were receiving fertilizer as late as after sowing season from private fertilizer retailers to cheat farmers by increasing cost of input. This problem has persisted for a long time despite government's promises that inputs should be delivered in a timely manner in the next agricultural seasons. This caused to lower farmers' output, owing mainly to the limited use of improved seeds, inefficient agronomic practices and fragmented farm plots.

Credit problem: it is determined that farmers demand for loans is very low, the main problems, farmers have limited income to repay debts and they settle repay obligation by selling to rural assemblers immediately after harvests at a low price during harvest. This has resulted farmers interest to reduce on credit use, more over collection procedures leading to distortions, delays in sales and unnecessary strains on the farmers. Delays in processing loan applications by the local authorities have also reflected from farmers. This system does not accommodate the interests of farmers who are willing to incur additional interest costs by delaying teff sales in hopes that prices will rise later in the year.

Shortage of land: The most basic resource for peasant life, however, the almost all of the farmers use a small and fragmented in to three or four or even more plots. Small land sizes

restrict commercialization in two ways. One, most clearly, is that they have less land to devote to commercial farming. Two, in the absence of reliable food markets households try to produce much of their own food: with small farms they are obliged to use much of their land for relatively low value staples with little scope to plant crops for sale.

Uncertain climatic conditions: Weather changes, very low and very high, intra-seasonal variations in rainfall distribution during crop growing periods, unnecessary rainfall with snow during harvest was one constraint that faced farmers during production season. This may cause farmers to change their production pattern in allocation of land to other cop that adopt adverse climatic conditions.

Limited improved seed acquisition: it is identified that due to experiences and expectations of farmers, on improved teff seed, because farmers seek crop varieties that are adapted to the local environment. As research identified, the vast majority of farmers use their own seeds, rarely require the improved seed from government institution. This is due to long practical knowledge of farmers in cultivating the crop and limited on field support of technical advice to farmers.

Labor shortage: Teff production is labor intensive activities, the most labor-intensive activities are weeding, harvesting and tilling, gathering and piling, threshing and winnowing. Farmers used that family labor and hired labor and in some cases "*dabo"* to perform these activities. However time the most important factor due to one person cannot perform all in one rotational work make time to delay and affect the production.

Declining soil fertility: The farmers in study area were found that they use crop rotation (legumes and oil seeds, most importantly Niger seed), to enhance their production and there is loss of soil fertility from time to time. This shows that still there are problems in the awareness of the farmers in using fertilizer even the already existing husbandry is not that much productive due to little awareness in using modern technology and absence of proper land management system among others.

Table 12: Respondents ranking of identified constraints in teff production

No	Constraints	Mean rank	Overall rank
1	High cost of fertilizer and delayed delivery	4.98	1st
2	Credit problem	5.18	2nd
3	Shortage of land/capital	5.2	3rd
4	Unpredictable rainfall/climate change	5.33	4th
5	Limited improved seed acquisition	5.42	5th
6	Insufficient labor	5.89	6th
7	Loss of soil fertility	6	7th

N= 154, Kendall's W^a = 0.52, chi-square = 31.86, df = 6, Asymp.sig.= 0.000

Source: Household survey data, 2018

4.4.2. Marketing Constraints teff farmers encountered

This research found that the majority of smallholders' teff farmers faced various limitations in marketing their produce. As indicated in table 13, the major problems faced by farmers in marketing their produce were poor road, followed by limited alternative outlets, price fluctuation, low bargaining power of farmers, inadequate market information and week farmers' cooperative. Kendall's coefficient of concordance (W^a) was 0.49 which indicates that there is 49% agreement among ranking of constraints by teff farmers. The chi-square was asymptotically significant at 1%, thus null hypothesis that there is no agreement among ranking of constrains is rejected.

Poor road/transport problem: teff farmers in study area had complained poor road to market centers, which confirm with high marketing costs especially, transportation costs as a result of far distance from the farmers to market their output and to buy their inputs. Farmers use animals (donkeys) to transport teff to market and sell to rural assemblers after long journey due to poor roods. They generally preferred to sell in nearby areas so they could return home and perform other duties.

Limited alternative outlets: Due to small volume handled by traders and the limited number of large scale buyers, local collectors create price instability to cheats so as to benefit themselves by misinforming farmers about the crop market prices as the farmers. The limited alternative outlets for framers is found the second constraint to teff farmers, indicates that of the farmers faced difficulties in forecasting their gross returns, leading to poor planning.

Fluctuation of teff price: Farmers also reported that frequent teff price fluctuation, lowest at peak production and highest at lean period, is the third major concern. Too much seasonal variation in price especially during harvest, such that low price did not offer sufficient incentive for sufficient supply.

Low bargaining power of farmers: Because of producers' lack of market information, the role of brokers in the exchange system is substantial. However, in study area brokers in local markets, who plays important role to negotiate traders with farmers, are very limited and farmers are very poor of price information that made them to have limited bargaining power on fixing the price.

Inadequate market information: is the sixth bottle neck of teff farmers that despite the fact that that producers with good access to market information can make better decision on how much to produce and market. However, there was no organized market information system to support farmers in the study area. This made producers to resort sales at the nearby markets thereby losing greater proportion of their supposedly income to exploitatively dubious middlemen in the area. In the local markets prices also vary within days and weeks in which traders are more informed than farmers about the prices in the central or regional markets

Weak farmers' cooperative: The agricultural marketing cooperatives had the practice of combining agricultural input supply and output marketing. Cooperatives though exist in study area, their focus is only on input side and there limited support to enhance farmers' cooperative in marketing their output. This comes from corrupted leaders of cooperatives that very significantly affecting farmers' production.

Table 13: Respondents ranking of identified constraints in teff marketing

No	Constraints	Mean Rank	Overall rank
1	Poor road/transport problem	3.01	1st
2	Limited alternative outlets	3.31	2nd
3	Price fluctuation	4.07	3rd
4	Low bargaining power of farmers	4.26	4th
5	Inadequate market information	4.34	5th
6	Weak farmers' cooperative	4.92	6th

N= 154, Kendall's W[a] = 0.49, chi-square = 82.99, df = 5, Asymp.sig.= 0.000

Source: Household survey data, 2018

4.4.3. Opportunities in teff production and marketing in study area

The study area has not only problems associated with production and marketing there is also diversified opportunities that need to be exploited, subsequently, production and marketing could be increased. On production side, farmers having better land holding and irrigable areas with potential water, of study area call for new technologies and facilities that scale up farmers ability increase yield and to produce alternative food crops for consumption and leave teff for cash requirement. The district is abundant with livestock which can create opportunities in improving soil fertility, and alternative cash income to reinvest in teff production. As they commercialized, farmers took up mechanized farming and used more inputs, which has benefits but also led to abandoning traditional practices and seed varieties. On marketing side, high demand for teff available in the study area and in urban centers would create opportunities for farmers to be commercialized and improve their income. Improving links between farmers and traders, selling in groups rather than individually to improve farmer bargaining power were also found that as opportunities to improve teff marketing in study area.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary

This study scrutinized the extent, determinants and constraints and opportunities of smallholder teff farmers' commercialization in the Guduru district of Horro Guduru Wollega, Oromia Regional State, Ethiopia. Primary data for this study were collected from 154 teff producer households randomly selected in four *kebeles* using interview schedule. In addition Focus Group Discussion and Key Informant interview were carried out to collect general information of interest. The study employed HCI to assess extent of teff commercialization, DHM to indentify determinants of teff commercialization and Kendall's concordance analysis to assess constraints. The descriptive statistics indicated that about 78% of sampled respondents were commercialized households while the remaining about 22% were not commercialized households. The levels of market participation or commercialization of smallholder teff farmers for the whole sampled households indicate that 39.08% average teff commercialization index, while for teff market participants (120 households), the average level of participation is 50.16%, ranging from 13.33% to 83.33%.

5.2. Conclusions

The descriptive result shows a moderate teff commercialization in the study area during a production season that implies teff is produced both for consumption and income purpose. Categorization of households based on their level of commercialization of teff output in the study area showed that majority of households found in between medium and high level as the two categories constitute the highest percentage of surveyed households (34.4% and 37%), respectively.

Results from Double Hurdle Regression showed that commercialization decision of teff in study area was significantly influenced by education level of household head, family size, land size, land allocated to teff, farm output, off/non-farm income engagement, lagged teff market price, access to market information and cooperative membership. Family size and off/non-farm engagement were those that negatively influence participation decision while all other have positive influence. Factors like age of household head, family size, and distance to

the nearest market were found to affect intensity of teff commercialization negatively and significantly, while sex of household head and family labor were those factors positively and significantly affecting intensity of teff commercialization in study area. The Kendall's coefficient of concordance result revealed that production constraints like high cost of fertilizer and delayed delivery, credit problem, shortage of land, unpredictable rainfall, limited improved seed acquisition, insufficient labor, loss of soil fertility and marketing constraints like poor road, limited alternative outlets, fluctuation of teff price, low bargaining power of farmers, inadequate market information and week farmers' cooperative were most pressing constraints in order of their importance.

5.3. Recommendations

The study showed that, educational status of the household head positively and significantly affected households' decision to participate in teff output market. This showed that education is a key to the farmers' commercialization since it increases the awareness and managerial skill of the farmers. Education is believed to increase a household's understanding of market dynamics thus educated farmers find it easy to manage production and marketing activities which need certain skill of management. Moreover, education enhances the capacity of individuals to obtain, process, and utilize information disseminated by different sources. So the government should increase its focus in strengthening the rural education system which can be improved through encouraging farmers to learn and market based production training programs for farmers to provide them with knowledge and strategies for marketing their crops.

Households with high family size were also not able to sell more of their teff output in the market since the consumption took most of it. Government need to strengthen the family planning program and should create enabling environment for smallholder farmers to train farmers coupled with investment in irrigation facilities. This incentive will enable farm households to target off-peak season production so as to take advantage of feeding alternative

The most important factors, land holding size, total farm output and land allocated to teff were found that significantly and positively affect teff commercialization. The higher levels of crop

production enhanced smallholders' market participation, implying that strategies that aim at improving household capacity to produce surplus production through enhancing productivity could have high proceeds in initiating teff output market. However, the positive effect of land size to market participation needs availability of agricultural input. Looking for productivity improving measures is optional strategies that enable the farmer to produce more from the same plot of land so that increased participation and intensity of teff market participation will be achieved since land cannot be widened.

Productivity enhancements, Enhancing output directly through investments such as irrigation equipment and technology (improved seed) is likely to have a more consistent impact on both productivity and market participation. Thus, Government and NGO play a useful role by developing public infrastructure, hybrid seeds, to provide improvements in yield and management, improving access to finance, investment in multidisciplinary research, in providing educational extension services that disseminate knowledge to farmers to boost and encourage farmers to be market oriented. More focus should be on provision of sustainable and timely availability of inputs, increasing the farmers' awareness on production packages like agronomic practices and proper application of inputs, land allocation and management practices.

Other factors that enhanced market participation was, cooperative membership, lagged teff market price and market information. The implication of this finding is that promotion of better access to communication facilities and institutional services may significantly contribute to promoting market participation and hence commercialization of smallholders.

Given the significance of membership of cooperatives as a determinant factor affecting teff farmers' commercialization government should encourage the formation of cooperatives, farmer groups and associations. This might be achieved through employing cooperative leader and giving training for group member on overall importance and intervention through legal agreement in order to encourage farmers' production objective to be market based. Efforts to improve service delivery in areas where cooperatives dominate should run in parallel, with effort to expand cooperative functions into relatively "new" areas such as crop marketing.

This enables farmers to get benefit of good price and dividends for their output and enhancing farmers' cooperatives to market their outputs improves the households' access to markets. Government should encourage farmers' cooperatives and unions and financial support to satisfy their immediate need and linking cooperative to more open trade that could help teff farmers increase their revenues and lead to increased investment and expansion of production.

Markets and their integration play a crucial role in sending signals for households to allocate resources to their best use. Market participation requires market-oriented production system and market-oriented production system in turn requires information about markets. However, smallholder farmers often face information asymmetry in product markets which forces them in to production for subsistence. Therefore, government interventions in improving communication facilities infrastructure and improving the existing one to access up-to-date information should be given attention.

In the second hurdle, sex of the household head was one of significant factors. Therefore it will be good if policies strengthen the support being given to the female headed households using different methods like by increasing their awareness through affirmative action's, by increasing their participation in different institutions and support them to engage in cooperatives. These gender differences in marketed surplus between male and female headed farmers are due to gender differences in access to resources and services. Active policies that support women's access and participation are essential that can be achieved by providing gender-specific training in educational and business skills, marketing; and promoting participation of women in rural cooperatives; analyzing and supporting the constraints women face in accessing financial services, inputs, such as tools, improved seeds.

Longer distances to the market center was also found to be another inhibiting factor for taking more amount of the teff output to the market. Thus Governmental or nongovernmental organization interventions in improving rural roads and strengthening the already started construction of roads would assist farmers to supply their market surplus of their farm.

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7. APPENDICES

Appendix 1: VIF values for hypothesized continuous explanatory variables

Variable	**VIF**	**1/VIF**
LANDSIZEHE	7.06	0.141600
OUTPUT	4.78	0.209311
OXEN	3.26	0.306866
LATEFF	3.12	0.320511
FAMSIZEAE	1.98	0.505787
FMLABOR	1.93	0.517991
LIVESTOCK	1.91	0.523273
PRTEFF	1.40	0.714029
AGHH	1.39	0.722005
EDHH	1.21	0.828026
DISMARKM	1.14	0.880743
EXTEN	1.05	0.955855
Mean VIF	**2.52**	

Source: Computed from household survey, 2018

Appendix 2: Contingency coefficient value for discrete explanatory variables

	SEHH	MKTINFO	CREDIT~E	MCOOP	OFNCOMEH
SEHH	1.0000				
MKTINFO	-0.0634	1.0000			
CREDITACCE	0.0843	0.0402	1.0000		
MCOOP	-0.0439	-0.0585	-0.4213	1.0000	
OFNCOMEH	0.1096	-0.2770	-0.0494	0.0174	1.0000

Source: Computed from household survey, 2018

Appendix 3: Test of hypothesis among Craggit DHM, Tobit and Heckman Models

Test	**Likelihood Ratio Test**	**Vuong's Test**
Hypothesis	H0 = Tobit best fits data H1 = Double Hurdle best fits data	H0 = No difference between Heckman model and DHM
Test statistic	-2(H0-H1)= - 44.77904	Z = 2284.656
Critical value	$\chi^2(0.01,17)$ = 33.40866	Z = 0.494
Decision	**Reject null hypothesis**	**Reject null hypothesis**

Source: Computed from household survey, 2018

Appendix 4: Conversion factors for Man Equivalent and Adult Equivalent

Age group(year)	Man equivalent		Adult equivalent	
	Male	Female	Male	Female
<10	0	0	0.6	0.6
10-13	0.2	0.2	0.9	0.8
14-16	0.5	0.4	1	0.75
17-50	1	0.8	1	0.75
>50	0.7	0.5	1	0.7

Source: Storck *et al., 1991*

Appendix 5: Conversion factors to compute tropical livestock unit (TLU)

Animal Category	Conversion factor
Oxen	1.1
Cows	1
Donkey	0.5
Horse	0.8
Sheep and Goat	0.13
Poultry	0.013
Calves	0.2
Heifer and Bull	0.75
Mules	0.7

Source: Storck *et al., (*1991)

Appendix 6: Research Questionnaires

Smallholder Farmers' Teff Commercialization

General Information

Date of interview: Day ____ Month ____ Year _____

Interviewer _____

Kebele: _____

Respondents Demographic and Socio-economic Characteristics

1. Sex of household head 1. Male 2. Female
2. Age of household head _____years old.
3. Household head year of schooling (in years) _____
4. Marital status household head 1. Single 2. Married 3. Divorced 4. Widowed
5. Family size by age and sex category, fill the table below.

No	Family member list	Relationship to Household Head 1.Wife 2.Son 3.Doughter 4.Others	Sex 1.Male 2.Female	Age (years)
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				

6. Did your household members participate in farming work? 1. Yes 2.No

7. If (Q6) **yes**, how many of them participated in teff production?_____ (in number), fill table below,

Activity	Duration or Volume	Total amount for the specified time or volume (in Birr)
1. Ploughing		
2. Weeding		
3. Harvesting		
4. Transporting		
5. Threshing		
6. Others		

8. Have you faced labor shortage in teff production? 1. Yes 2.No

9. If (Q8) is **yes**, during which farm operation do you face labor shortage? 1- Land preparation 2- Plantation 3- Weeding 4- Harvesting 5- Threshing

10. If (Q8) **yes**, how do you solve labor shortage problem? 1- By hiring 2- asking for cooperation (Jigi/Debo) 3- Assistance from relatives 4- Combination of all 5-Others (Specify)_____

11. Have you used hired labor in teff production during 2016/2017? 1. Yes 2. No

12. If (Q11) is **yes**, what type of labor cost? 1. In cash 2. In kind

13. If (Q12) is **in cash**, what is the wage rate per day for hired labor in teff production?

Activity	Number of workers	Number of days spent by each worker	Wage rate per day per person
1. Ploughing			
2. Weeding			
3. Harvesting			
4.Transporting & threshing			
Total			

14. If (Q12) is **in kind** how much you paid for each activity?

Activity	Number of workers	Amount in Quintal
1. Ploughing		
2. Weeding		
3. Harvesting		
4. Transporting & threshing		
Total		

Land holding pattern and owned

15. Did you own land in 2016/2017?? 1. Yes 2.No

16. If (Q15) is **yes**, which of the following and amount do you have?

Type	Cultivated	Grazing	Fallow land	Plantation	Rented in	Rented out	Irrigated	Share crop	**Total**
Hectare /Sanga									

Land allocation pattern and output of year 2016/2017

Cultivated crops	Land allocated (in Hectare)	yield in Quintal	Amount Consumed	Amount Sold	Unit price	Annual Income
Annual						
Teff						
Maize						
Wheat						
Barley						
Sorghum						
Pulses						
Oil Seeds						
Vegetables						
Others						
Perennial						
Fruits						
Trees						
Gesho(hops)						
Others						
Total						

17. What is the main source of your livelihood?

    1. Agriculture 2.Off/Non-farm 3. Combination of both 4. Other, specify _____

18. If (Q17) is **Agriculture**, for how long you engaged in agriculture? _____years.

Income

19. How much you earn from farm land annually? _____Quintal.

20. Have you involved in off/non-farm activities in 2016/2017 production season?

    1. Yes 2.No

21. If (Q20) is **yes**, how much you earn from off/non-farm source of income annually? _____Birr.

22. If (Q20) is **yes**, what is the type of off/non-farm activity you involved and the income earned?

No	Type of activity	Earn in Birr	No	Type of activity	Earn in Birr
1	Handcraft		7	Rent from assets	
2	Selling Charcoal and firewood		8	Pension payments	
3	Daily labor		9	Carpenter	
4	Remittance		10	Hired in other farm	
5	Selling local drink		11	Petty trade	
6	Causal labor work		12	Others	
Total cash income			**Total cash income**		

23. What is the reason behind for you or your family members to be engaged in off/non-farm activities? 1-Shortage of land; 2- Excess family labor; 3- Attractive income from off/non-farm activities; 4- Other, specify_____

Livestock Holding

24. Did you own livestock during 2016/2017? 1. Yes 2.No

25. If (Q24) **yes**, what is the total number of livestock you own and annual income in 2016/2017?

Type	Total owned	Total sold	Selling price	TLU	Total income	*purpose
Oxen						
Cows						
Donkey						
Horse						
sheep						
Goat						
Poultry						
Calves						
Heifer						
Bull						
Mules						
Total						

*1-for purchasing farm inputs 2-for settling debts 3- for buying clothes for family 4-to buy food grains 5- others (specify) _____

26. Income from sales of livestock product in 2016/2017

No	Product type	Amount collected	Amount Consumed	Amount Sold	Unit price	Revenue	*Purpose of sold
1	Butter						
2	Egg						
3	Honey						
4	Hide and skin						
5	Cheese						
6	Milk						
7	Others						
Total							

* 1-for purchasing farm inputs 2-for settling debts 3-for buying clothes for family 4-To buy food grains 5-others (Specify) _____

Extension service

27. Have you consulted extension agents on teff production activities? 1. Yes 2. No
28. If (Q27) **yes**, how frequently do the DA visit you per month? _____
29. When does extension agent visit you? 1-During planting for technical advice 2-during input provision 3-During land preparation 4-During harvesting 5-Others (specify) _____
30. What types of extension messages given by the agents? 1-Fertilizer use 2-Insecticide use 3-Improved seed use 4-Manure use 5-Land use practices 6. Other (specify)_____

Teff market participation, Access to Market and Infrastructure

31. Have you sold teff in last cropping season (2016/2017)? 1. Yes 2. No
32. If (Q31) **yes**, how much did you sold? _____ Quintal.
33. What was the selling price _____ Birr per Quintal?
34. What was last (2015/2016) year selling price _____ Birr per Quintal?
35. Fill the table below to whom did you sold teff last year (2016/2017)

	Local collectors	Farm gate	wholesalers	Retailer	Consumers	Others
Did you sell? (1.yes 2. No)						
*Why you prefer						
Price per quintal						
*1-preferable price 2-unable to transport 3- small amount to sell 3-other(specify)_____						

36. If you sell teff at different time with different price, please list down each sell respectively with its selling price;

Months	Amount sold	Selling price

37. Do you store teff? 1. Yes 2. No

38. If (Q37) is **yes,** mention the major reason for storing it. 1-Later consumption 2-to get better price 3- for security (to sell when cash is needed) 4- other (specify)_____

39. How far do you travel to sell your agricultural product and to buy inputs to/from the nearest market (round trip)? _____ Hour/Km.

40. What are the means of transport you used for transporting your products to the common market in 2016/2017?1-Animal back, 2-Cart (animal drawn), 3-Vehicle 4-Carrying by human beings, 5- Others (Specify), _____

41. How much does it cost (round trip cost) if you have traveled by car? _____Birr.

42. Who is the major buyer of your farm outputs? 1. Rural consumers 2.Cooperatives 3.middlemen from towns 4. Urbanconsumers 5. Others (specify), _____

Market Information and Institutional variables

43. Did you get information on teff grain selling price 1. Yes 2. No

44. If (Q43) **yes**, specify your source of information?

45. 1- Self (From Market) 2- Mobile 3- Radio 4- DA 5- Cooperative 6- From Others (Neighbor, Trader or Buyer) 8- Others (specify),_____

46. Did you own Radio? 1. Yes 2. No

47. Did you own Mobile? 1. Yes 2. No

48. Have you taken any credit in 2016/2017? 1. Yes 2. No

49. If (Q48) is **yes**, specify the source in the table below.

SN	Sources	1.Yes 2.No	Type of credit	Amount in Birr	Interest rate	* If **yes** Conditions	**If **no** why
1	Bank						
2	Microfinance						
3	Cooperative						
4	Local money lenders						
5	NGO						
6	Others (informal)						

*1- collateral (property) 2- Group collateral 3-willingness to repay higher interest 4-membership 5-No collateral

**1.Enough resource/self-sufficient 2-Unable to feet requirement 3- No need for credit/Fear of inability to repay 4-High interest rate -Lack of asset for collateral 6. Others (specify) _____

50. If you have not so far received credit or if you have declined to receive it what is the reason? 1-You are self-sufficient; 2- You are unable to repay loan; 3-you are unable to provide collateral; 4-required credit not available; 5-credit not available; 6-other (specify) _____

Membership to organizations

SN	Organization	Membership (1.Yes 2.No)	*Service	**Reason you prefer membership
1	Cooperative			
2	Saving and credit institution			
3	Ikub			
4	Iddir			
5	Irrigation group			
6	Women's association			
7	Others			

*1-Loans/credit 2-Farm inputs 3-Labor sharing 4-Others (specify)_____

**1- Input Delivery; 2-Affordable Input price; 3-Fair Output Price; 4-Strong Bargaining Power; 5-Reliable Storage Facility; 6-Easy Access To Credit; 7-Low Cost Credit; 8-Increased Savings Habit; 9-Others (Specify)_____

Input and Technology Use

51. Have you rented in oxen for teff production? 1. Yes 2. No

52. If (Q51) is yes, what is the rental value of a pair of oxen?

Activity	Number of oxen	1.In cash 2.In kind	Unit cost	Total
1. Ploughing				
2. Threshing				
Total				

53. Have you used fertilizer and chemicals (pesticides/herbicides) in 2016/2017 production season? 1. Yes 2. No

54. If(Q53) is **yes**, fill the amount in the table;

Use of fertilizer and chemicals for teff production in year 2016/2017					
Item	Did you use? 1. Yes 2. No	If **yes**, amount(Quintal or liter)	Unit cost	Total cost	*If **not** use why?
NPS/DAP					
UREA					
Pesticide					
Insecticide					

* 1-Too expensive; 2-Lack of knowledge; 3-Not timely available; 4- it is unnecessary (if the land is fertile or if there was no disease and pest occurrence); 5-Not effective; 6-Risky for animals; 7-Other (specify) _____

55. Did you use organic fertilizer on teff field? 1. Yes 2. No

56. If (Q55) is **yes**, kind of organic fertilizer, 1-Green manure 2-Animal waste 3- Compost 4-Rotational Pad docking 5 others, specify_____

57. Have you used improved seed of teff during last season (2016/2017)? 1. Yes 2. No

58. If (Q57) is **yes**, what is the source of that seed? 1-government; 2-NGOs; 3-Market; 4-other

59. If (Q57) is **no**, why? 1-Too expensive 2-Not better than local varieties 3-It is not easily accessible; 4-other(specify) _____

Major constraints for teff production and marketing

60. What are the major constraints you faced in the teff production and marketing? Give 1 for most serious constraints, 2 the second most constraint and so on and 0 for not constraint.

No	**Production Constraints**	1-Yes 2- No	Rank according to importance
1	High cost of fertilizer and delayed delivery		
2	Credit problem		
3	Shortage of land/capital		
4	Unpredictable rainfall/climate change		
5	Limited improved seed acquisition		
6	Insufficient labor		
7	Low soil fertility		
8	Others, specify		
No	**Marketing Constraints**	1-Yes 2- No	Rank according to importance
1	Poor road/transport problem		
2	Limited alternative outlets		
3	Price fluctuation		
4	Low teff market price		
5	Low bargaining power of farmers		
6	Inadequate market information		
7	Weak farmers' cooperative		
8	Others, specify		

Remark: This questionnaire is only for academic purpose with the objective to Analyze Smallholder Farmers Teff Commercialization in Guduru District of Horro Guduru Wollega, Ethiopia. The personal profile obtained from respondent will be kept confidential and will not have any consequences on the respondent in any ways.

BAAY'EE GALATOOMAA!!!

Appendix 7: Checklist for FGD

- Primary means of livelihoods for the people in this *Kebeles*/district.
- Main food and cash crops grown in this *Kebeles*/district and reason.
- Source, method and timely availability of market information to farmer.
- Supply, regularity and quality of improved seed and inputs.
- Environmental condition on the *kebeles/*district on cultivating teff.
- Historical and current condition of cultivating teff.
- Why teff is major crop produced in this area?
- Market access, credit using and cooperative services for teff commercialization.
- What are the major constraints that hinder teff production and marketing?
- What are opportunities for teff market in the *Kebeles*?
- What do you suggest for the improvement of teff marketing in the future?

Appendix 8: *Craggit* DHM regression results from STATA

```
. craggit TEMPAR SEHH AGHH EDHH FAMSIZEAE LANDSIZEHE LATEFF FMLABOR OUTPUT OFNCOMEH LIVESTOCK OXEN EXTEN PRTE
> FF DISMAR MKTINFO CREDITACCE MCOOP, second(TCI SEHH AGHH EDHH FAMSIZEAE LANDSIZEHE LATEFF FMLABOR OUTPUT OF
> NCOMEH LIVESTOCK OXEN EXTEN PRTEFF DISMAR MKTINFO CREDITACCE MCOOP) vce(robust)

Estimating Cragg's tobit alternative
Assumes conditional independence

initial:       log pseudolikelihood =     -<inf>  (could not be evaluated)
feasible:      log pseudolikelihood = -641865.14
rescale:       log pseudolikelihood = -3388.5699
rescale eq:    log pseudolikelihood = -620.02207
Iteration 0:   log pseudolikelihood = -620.02207  (not concave)
Iteration 1:   log pseudolikelihood = -551.34495
Iteration 2:   log pseudolikelihood = -529.04385
Iteration 3:   log pseudolikelihood = -485.15377
Iteration 4:   log pseudolikelihood = -480.90185
Iteration 5:   log pseudolikelihood = -480.31083
Iteration 6:   log pseudolikelihood = -480.22615
Iteration 7:   log pseudolikelihood =  -480.2227
Iteration 8:   log pseudolikelihood = -480.22268

                                                Number of obs   =         154
                                                Wald chi2(17)   =       69.27
Log pseudolikelihood = -480.22268               Prob > chi2     =      0.0000
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
Tier1						
SEHH	-1.207464	.7938249	-1.52	0.128	-2.763332	.3484045
AGHH	.0034448	.0184722	0.19	0.852	-.0327601	.0396496
EDHH	.1193366	.0651066	1.83	0.067	-.00827	.2469433
FAMSIZEAE	-.6678912	.3013753	-2.22	0.027	-1.258576	-.0772064
LANDSIZEHE	.7112786	.4187036	1.70	0.089	-.1093654	1.531923
LATEFF	.4579012	.2355791	1.94	0.052	-.0038252	.9196277
FMLABOR	-.2035689	.1690874	-1.20	0.229	-.5349742	.1278364
OUTPUT	.0177731	.0102002	1.74	0.081	-.002219	.0377652
OFNCOMEH	-1.741388	.715586	-2.43	0.015	-3.143911	-.3388652
LIVESTOCK	-.0108172	.039859	-0.27	0.786	-.0889393	.0673049
OXEN	.1654387	.2244088	0.74	0.461	-.2743944	.6052718
EXTEN	.0558359	.0588832	0.95	0.343	-.059573	.1712449
PRTEFF	.0051953	.0010651	4.88	0.000	.0031078	.0072828
DISMARKM	-.0527065	.0320944	-1.64	0.101	-.1156104	.0101975
MKTINFO	1.487722	.8316712	1.79	0.074	-.1423238	3.117767
CREDITACCE	.9892109	.8140429	1.22	0.224	-.6062838	2.584706
MCOOP	2.176899	.9659663	2.25	0.024	.2836402	4.070158
_cons	-7.751345	2.793101	-2.78	0.006	-13.22572	-2.276967
Tier2						
SEHH	10.13016	4.807405	2.11	0.035	.7078209	19.5525
AGHH	-.3154774	.1576885	-2.00	0.045	-.6245413	-.0064136
EDHH	.1285178	.396717	0.32	0.746	-.6490333	.9060689
FAMSIZEAE	-3.694129	1.177124	-3.14	0.002	-6.00125	-1.387008
LANDSIZEHE	1.649138	1.303443	1.27	0.206	-.9055626	4.203839
LATEFF	1.249488	1.653474	0.76	0.450	-1.991262	4.490238
FMLABOR	2.219949	1.234304	1.80	0.072	-.1992414	4.63914
OUTPUT	-.0582587	.0583709	-1.00	0.318	-.1726635	.0561461
OFNCOMEH	1.059266	3.398593	0.31	0.755	-5.601855	7.720386
LIVESTOCK	.0549837	.3423517	0.16	0.872	-.6160132	.7259807
OXEN	.449722	1.249308	0.36	0.719	-1.998876	2.89832
EXTEN	1.239147	.778357	1.59	0.111	-.2864046	2.764699
PRTEFF	.0010427	.0084377	0.12	0.902	-.0154948	.0175802
DISMARKM	-.5034309	.2967422	-1.70	0.090	-1.085035	.0781731
MKTINFO	2.954616	8.676676	0.34	0.733	-14.05136	19.96059
CREDITACCE	-3.047982	6.186028	-0.49	0.622	-15.17237	9.076411
MCOOP	10.44946	9.517084	1.10	0.272	-8.203681	29.1026
_cons	38.01906	18.97677	2.00	0.045	.8252702	75.21284
sigma						
_cons	12.59152	.7119006	17.69	0.000	11.19622	13.98682