

**ANALYSIS OF MARKET DECISION AND LEVEL OF
PARTICIPATION OF SMALLHOLDER WHEAT FARMERS: THE
CASE OF ADOLA REDE DISTRICT OF GUJI ZONE, OROMIA
REGIONAL STATE, ETHIOPIA**

MSc THESIS

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**Analysis of Market Decision and Level of Participation of Smallholder
Wheat Farmers: The Case of Adola Rede District of Guji Zone, Oromia
Regional State, Ethiopia**

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DEDICATION

I dedicate this thesis manuscript to my parents for their continuous contribution throughout my academic endeavors.

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this thesis is my own work. I have followed all ethical principles of scholarship in the preparation, data collection, data analysis and completion of this thesis. All scholarly matter that is included in the thesis has been given recognition through citation. I affirm that I have cited and referenced all sources used in this document. Every serious effort has been made to avoid any plagiarism in the preparation of this thesis.

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ACRONYMS AND ABBREVIATIONS

ACC	Agricultural Commercialization Cluster
AGP	Agricultural Growth Program
AIC	Akaike Information Criteria
ARANRO	Adola Rede Agricultural and Natural Resources Office
ARBoFED	Adola Rede Bureau of Finance and Economic Development
ATA	Agriculture Transformation Agency
CSA	Central Statistical Agency
DHM	Double Hurdle Model
EGTE	Ethiopian Grain Trading Enterprise
ESPAR	Evans School Policy Analysis and Research
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan
H2SE	Heckman Two Step Estimation
HMLE	Heckman Maximum Likelihood Estimation
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
MoA	Ministry of Agriculture
MPI	Market Participation Index
NGOs	Non-governmental Organizations
OLS	Ordinary Least Squares
SNNPR	Southern Nations Nationalities and Peoples Region
TLU	Tropical Livestock Unit
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USDA	United States Development Agency
WB	World Bank
WFP	World Food Program

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Analysis of Market Decision and Level of Participation of Smallholder Wheat Farmers: The Case of Adola Rede District of Guji Zone, Oromia Regional State, Ethiopia

ABSTRACT

In Ethiopia, agricultural transformation is taken as a pathway to transition from a traditional subsistence orientation to one that is market focused and commercialized. In this regard, efforts to enhance smallholders' participation in cereal market in general and wheat in particular, through surplus production have been made, but there is dearth of information on the status of market participation particularly in Adola Rede district. The aim of this study was to analyze market participation of smallholder wheat farmers in Adola Rede district. The study used cross sectional data collected in 2016/17 from a sample of 150 smallholder farmers selected through two stage sampling technique. To identify factors affecting market participation decisions and level of market participation, double hurdle model was used. The study shows that, households in the study area sold 39% of their wheat to the market. Double hurdle model regression result showed that, perception on lagged wheat price, quantity of wheat produced, size of land allocated for wheat and education level of household head had significant positive effect on market participation decision, while distance to nearest market, distance to extension service and size of land allocated for other crops had significant negative effect. Level of market participation affected positively and significantly by perception on lagged wheat price, and quantity of wheat produced, while it was affected significantly and negatively by family size. The study result indicated that, provision of training on contract farming, increasing of productivity and production of wheat, strengthening of farmers' education through adult education, rural infrastructural development and transportation system, increase in farmers training centers, and strengthening of family planning education through rural health extension as a means to enhance wheat market participation and level of participation of smallholders.

Key words: Agricultural transformation, Smallholder farmers, Market participation, Double hurdle model, Adola Rede district, Wheat.

1. INTRODUCTION

1.1. Background of the Study

Smallholder farming constitutes the livelihoods of many rural households in developing economies. Rural areas are the home of the majority in Africa and small scale agriculture is the mainstay of the rural economy serving mainly as a source of food income (Omiti *et al.*, 2007). Ethiopian economy is highly dependent on agricultural sector which account for about 38.8% of national GDP (Wondifraw *et al.*, 2016), 87% of export earnings and remains the main source of employment; generating 72.7% of total employment (UNDP, 2015).

Wheat production in Sub-Saharan Africa is at 10 to 25% of its potential and the region could easily grow more to improve food security. According to Mason *et al.*, (2012), farmers in Sub-Saharan Africa produce 44% of the wheat consumed locally and import the rest from international markets, making the region highly vulnerable to global market and supply shocks.

Ethiopia is one of the largest grain producers in Africa, and the first largest wheat producer in Sub-Saharan Africa, followed by South Africa (IFPRI, 2015). Wheat is currently grown on 1.6 million hectares in Ethiopia making wheat the fourth most widely grown crop in the country, after *teff*, maize, and sorghum. Wheat is mainly grown in the central and south eastern highlands during the main (*Meher*) rainy season (June to September) and harvested in October-November. Arsi, Bale, and parts of Shoa are considered the wheat growing belt. Among the different zone in Oromia region, Bale Zone is one of the main wheat growing areas in the South-Eastern Ethiopian highlands (CSA, 2015). Bread wheat is the major variety of wheat grown in Ethiopia. However, farmers grow durum and bread wheat (mixed together) in some parts of the country. Wheat is produced on large state-owned farms covering around 124,000 ha of land in the Arsi and Bale regions (USDA, 2012).

Recognition of the potential of market to unlock economic growth and development gave rise to market led rural development paradigm during the 1980s. Many countries and international development agencies give due concern to intensification and commercialization of smallholder farming as a means of achieving poverty reduction and thus have reflected it in

their official policies (Govereh *et al.*, 1999). Agricultural market participation has been conceived as the integration of subsistence farmers into the input and output markets of agricultural products with a view to increasing their income level and hence to reducing poverty (Mignouna *et al.*, 2015). Improved market participation is a key precondition for transformation of the agriculture sector from subsistence to commercial production (Salami *et al.*, 2010). Smallholder participation in food markets is typically characterized by constrained choice, and this choice is critically dependent upon their ability and willingness to participate in input and output markets and on the functionality of those markets that they are able to access. Smallholders are likely to increase their engagement in markets as sellers of food when well-functioning markets give them appropriate incentives, they have access to, and the ability to use assets productively, and efficient infrastructure allows them to transport their product to market at reasonable cost (Arias *et al.*, 2013).

Being cognizant of role of market participation, Ethiopia has taken agricultural transformation as a means to tackle poverty and food insecurity problems through empowering smallholder farmers and pastoralists with tools, knowledge, and support needed to transition from a traditional subsistence orientation to one that is market focused and more commercialized (ATA, 2015). In Ethiopia, on average wheat farmers produce 751 kg of wheat and sell 189 kg, so that the marketed surplus ratio is 25%. The regional breakdown shows that Amhara has more wheat farmers, but the wheat production and wheat sales per farm are larger in Oromia. As a result, Oromia accounts for about half of all marketed wheat. Amhara is the second-largest supplier of marketed wheat, followed by SNNP and Tigray (IFPRI, 2015).

Adola Rede district is characterized by mixed farming activities where crop production dominates. It has different kinds of cereals, root crops, *enset* and others. Major crops grown in the area are wheat, barley, *teff*, and maize. The district is one of the potential producers of wheat in Guji zone. Wheat production in the district is both for consumption and market purpose. In the district, more than 10,000 ha of land are suitable for wheat production. Wheat yield in the district is 29 quintal, slightly more than the national average of 26.75qt (ARANRO, 2017).

It is widely understood concept that, extent of income earning and the welfare status of smallholder farmers is determined by the extent they participate in a given market as seller.

But, in case of Adola Rede district, information on status of wheat output market participation and factors that enhance or retard smallholders' decision to participate in wheat output market and extent of market participation is not known. Therefore, study of these issues help to identify farm level factors and put forward measures for enhancing smallholders' wheat output market participation so that it will contribute to food security and poverty reduction. Thus, this study aims to reveal status of smallholder farmers' wheat output market participation and identify determinant factors of smallholder farmers' market participation decision and level of market participation in Adola Rede district in wheat output market.

1.2. Statement of the Problem

Improved access to market plays an important role in improving rural incomes of smallholder farmers in developing countries, particularly in sub-Saharan Africa. Despite this, participation of smallholder farmers in markets in most sub-Saharan African countries remains low due to a range of constraints. One of the limiting constraints faced by smallholder farmers is linked to poor market access. Poor infrastructure and weak institutions raise transaction costs that considerably alter production and market participation decisions. The majority of smallholder farmers are located in remote areas with poor transport and market infrastructures, contributing to the high transaction costs. Furthermore, the poor do not possess the level of assets required to protect themselves from market, natural, political and social shocks (Mmbando *et al.*, 2015).

In Ethiopia, even though relatively high economic growth rates registered over past years and the agriculture sector has shown steady annual growth rates for over a decade, it remains dominated by subsistence-based farming and pastoralist practices. Agricultural productivity is still at low levels and most of the food produced on the farm remains consumed by the farm household (ATA, 2015). In 2010, Ethiopia's domestic wheat production was 2,856 metric tonnes of which 101 metric tonnes were for seed requirement, 2,792 metric tonnes were for house consumption and 561 metric tonnes for sale. Likewise, country's wheat domestic production in 2015 was nearly 4,219 metric tonnes of which 2,479 metric tonnes were household consumption, and 699 metric tons was seed requirement and 877 metric tonnes were for sale (CSA, 2010; CSA, 2016). Though, there was an increment in both trend of

production and marketed surplus, the level of wheat marketed is still low and insufficient to meet the domestic consumption and needs of newly emerging food processing industries (USDA, 2015). Despite a high degree of market orientation of households in Ethiopia, the size of market (per seller) is very low (Samuel and Sharp, 2007). This indicates that the proportion of agricultural commodities supplied to the market by agricultural households is insufficient.

According to ATA (2013), a focus on increasing productivity and production alone will not help Ethiopia achieve its food security and economic growth targets. Given Ethiopia's ambition to commercialize its smallholder farmers, food security will rely increasingly on the ability of farmers to access markets for their production as well as their demand for food need. Agricultural growth will require greater attention to smallholder farmers, which contributed a lot to total agricultural production. To increase agricultural productivity of smallholders, effective expansion of the agriculture extension is important. Despite the large investment into public agricultural services, especially into extension, which has seen a rapid rise in the number of extension workers and beneficiaries served, there are capacity weaknesses which continue to inhibit the identification and dissemination of technologies to support increased productivity which in turn influence production and market participation decisions of smallholder farmers (MoA, 2015).

Likewise other part of the country, production of wheat and other agricultural crops in the study area is rain fed and its supply varies season to season. Even though, the district is known for its various agricultural production and, crop under consideration, only adaptability test of improved varieties of *teff*, and its demonstration was done on the site by Aliyi *et al.*, (2016) and, Basha and Dembi (2017), leaving market dimension of agricultural crops in general, and wheat in particular. This implies, status of wheat market participation, and contributing and retarding factors to wheat market participation by smallholder wheat farmers other than efforts to increase production and productivity level of wheat is unknown. Wheat was chosen over other crops grown in the area because of growing demand for this crop both in local and nearby markets. Also, the crop has higher yield relative to competitive crop grown along with this crop. Understanding the issue in this regard, this study was designed to analyze smallholder farmers' participation in wheat marketing in Adola Rede district of Guji zone.

1.3. Objectives of the Study

The general objective of the study is to analyze market decision and level of participation of smallholder wheat farmers in Adola Rede district with the following specific objectives:

1. To measure the degree of market participation of smallholder wheat farmers in the study area
2. To identify factors influencing smallholder wheat farmers' market participation decision and level of participation in the study area.

1.4. Research Questions

The study tries to answer the following research questions:

1. What is the degree of market participation of smallholder wheat farmers?
2. What are the factors influencing market participation decision and level of participation of smallholder's wheat farmers in the study area?

1.5. Significance of the Study

Agricultural market participation could be the main weapon against hunger to lift millions of poor farmers out of poverty traps. It is becoming crucial to motivate the farmers in increasing their farms' output, hence enabling them to earn more income (Mignouna *et al*, 2015). Recognizing this, the government of Ethiopia viewed agricultural transformation of smallholder farms from subsistence to more market led production as the major source of agricultural growth in the country (Geremew, 2012). But, enhanced market participation cannot be achieved without effective policies and strategies that create and sustain an enabling environment for integrating small producers into markets (Arias *et al.*, 2013).

Hence, a better understanding of the determinants participation and level of market participation of smallholder farmers is critical in designing appropriate policies and interventions that would enable the smallholders and the rural poor to benefit from markets. This study have generated information on status of market participation and factors affecting market participation decision and level of market participation that would help farmers,

government and non-governmental organizations, and policy makers interested to make a review on market participation status of smallholder farmers and its determinant factors and helps them in designing mechanisms for an improvement in smallholders market participation. The study would also helpful for academicians who want to conduct further research on similar topics and other related subjects as it serves as a reference material.

1.6. Scope and Limitations of the Study

Given time and financial resource limitations, the study was limited to four *kebeles* found in Adola Rede district. The study also analyzes smallholder farmers' market participation taking only a single commodity, which is wheat. Therefore, the study would not give a full picture of farmers' market participation status out of overall agricultural production. The study was used cross sectional data collected in 2016/17 productions and marketing year to identify factors determining market participation and level of participation in the study area. Due to this nature of data, therefore, the study would not capture market participation dynamics among household over time. It is clear that households may participate in a market either to purchase inputs or sale of outputs. This means evaluation of market participation can be possible from both input and output sides. Also, farm households can participate in output market to purchase wheat from the market. Therefore, this study would focus on output market participation as a seller that is; it does not include participation in input market and market participation as a buyer in wheat output market.

1.7. Organization of the Thesis

This thesis is organized into five chapters. In the first chapter, introductory parts of the study are displayed. Following the introductory chapter, chapter two presents review of literatures related to the research topic under consideration. Research methodological aspects and the description of the study area are presented in chapter three. In the fourth chapter, findings of the study and discussion of it along with comparison with results of previous similar studies are presented. The fifth chapter presents summary and conclusions of the findings, and recommendations made based on the study.

2. LITERATURE REVIEW

This chapter presents basic concepts and definitions, role of market participation, wheat consumption in Ethiopia from international context, an overview production and marketing of wheat in Ethiopia, and review of relevant literatures.

2.1. Basic Concepts and Definitions

Agricultural commercialization: Literatures on agricultural commercialization use both the participation in the output market as well as participation in the input market to measure the commercialization of agriculture. Accordingly, they classified commercialization system as subsistence, semi-commercial and commercial based on market orientation. The main purpose of subsistence system is to produce to maintain household food self- sufficiency. The semi-commercial system is focused towards generation of marketable surplus and maintaining household food-security. In commercial system, profit maximization is taken as the main objective that an economic agent wants to achieve. Production of cash crops in addition to staples or even exclusively is another form of commercialization. Similarly, commercialization also involves the widening and deepening of the household's market transactions relating to inputs and outputs (Pingali, 2001).

According to Moti *et al.*, (2009), the concept of smallholder commercialization goes beyond the marketing of surplus staple products. It is very broad in the sense that it comprises household input use decisions, major objectives of production, household participation in input and output markets, degree of specialization in production and dependence on markets for income and consumption. Agricultural commercialization can occur on the output side of production with increased marketed surplus, or on the input side with increased use of purchased inputs. On the output side, commercialization is measured as a ratio of the value of agricultural sales to the value of agricultural production while it is measured as a ratio of the value of inputs acquired from market to the value of agricultural production on the input side. Technically, agricultural commercialization entails a shift from subsistence production to a more complex market-based production and consumption system that leads to the strengthening of the linkages between input and output sides of a market. As a measure of degree of market participation or extent of commercialization, FAO (1989) cited in

Olowogbon and Fakayode (2013) has categorized farmers into three different groups based on the marketable surplus as a percentage of total production in the following manner.

Subsistence farmers: Marketable surplus under 25% of the total production.

Transition (Semi-commercial) farmers: Marketable surplus ranging between 25% and 50% of total production.

Commercial farmers: Marketable surplus more than 50% of the total production.

Recent studies on both market participation and commercialization set various cut-off points for classifying market participation status of farmers as low (subsistence), medium (semi-commercial), and high (commercial). For instance, Samuel and Sharp (2007) have used cut-off points for subsistence, semi-commercial, and commercial with market participation as a fraction of total production less than 30%, between 30% and 65%, and more than 65% respectively while Abdu *et al.*, (2016) have used cut-off points for low (subsistence), medium (semi-commercial) and high (commercial) with degree of participation less than 30%, between 31% and 50%, and more than 50% respectively. Osmani *et al.*, (2014) characterize households according to their degree of market participation as low (<30%), medium (30 – 75%), and high (>75%).

Market Participation: Supply side of market participation can be defined in terms of sales as a fraction of total output for the total of all agricultural crop production of household which includes annuals, perennials, etc (Ana *et al.*, 2008). According to Makhura *et al.*, (2001), market participation can be referred to as commercialization of agriculture. This means, market participation can be used as a proxy for commercialization or the two terms are basically used interchangeably. Benjamin (2013) suggests that, in measuring market participation using commercialization, one must clearly indicate which aspect of commercialization is being used as a proxy for market participation.

Market Orientation: Market orientation in agriculture can be defined as the degree of allocation of resources (land, labour and capital) to the production of agricultural produce that are meant for exchange or sale. Smallholders is said to be market oriented if its production plan follows market signals and produce commodities that are more marketable (Berhanu and Moti, 2010).

Smallholder farmers: There is no universally accepted definition of smallholder farmers. According to IFAD (2013), smallholder farmers are characterized by marginalization, in terms of accessibility, resources, information, technology, capital and assets. Salami *et al.*, (2010) defined smallholder farmers on the basis of land and livestock holding. Accordingly, smallholder farmers are an economic agent who cultivate less than two hectares land and own only a few heads of livestock.

2.2. Role of market participation

There is general consensus that deeper market integration of smallholders is considered an important means of achieving food security status and to move out of poverty (Von Braun, 1995). Cognizant of this, recent studies and policy initiatives have focused on ways to enhance smallholder's agricultural productivity, and enable them to achieve greater market participation. Greater market participation is not an end goal, rather the ultimate of market participation is to bring the needed improvement of the welfare of society and enable them to sustainably progress out of the multifaceted poverty (Gutu, 2017).

According to Gutu (2017), welfare aspects are expressed through poverty, inequality and vulnerability. He represented welfare in terms of consumption of basic food (grains), high-value foods (livestock products) and expenditure on clothes and shoes, durable goods, education and healthcare in his analysis of welfare effects of market participation. In this context, those who have enough resources to meet their food needs are usually referred to as food secure. On the other hand, those with resources to meet both food and non-food needs are referred to as non-poor households (not in poverty class) and the converse is also true. In his empirical work, he found that positive relation between market participation and poverty status indicating that market participation enhances the welfare of participating households.

According to UNCTAD (2015), importance of smallholders' participation in markets is gauged by analyzing the extent to which they interact with input and output markets. Smallholders participate in markets either to buy food, procure inputs or sell their produce. The extent of smallholders' participation in input and output markets partly determines their productivity, and hence their earnings. Better linkages with markets can induce rural populations to consider farming as a profitable, and therefore a viable, livelihood choice.

Participation in well-functioning agricultural input markets can enable farmers to increase yields, thus producing a marketable surplus, which, if sold in competitive output markets, can enable them to obtain higher prices and consequently increase their incomes. The resulting income is then used to buy consumer items that households need but cannot produce. This in turn improves their capacity to cope with risks and market instability.

Moreover, a study by Geoffrey *et al.*, (2015) showed that greater market participation significantly reduces food insecurity and poverty among households with high market participation when compared against households with low market participation. Arias *et al.*, (2013) in their report on smallholder's integration in changing food markets clearly explain that reducing poverty and enhancing food security require greater smallholder integration into markets and more inclusive value chains. They also emphasize that, adoption of new technologies and productivity growth will be limited if smallholder's integration to the market is weak. Also, the findings of Ntakyo and Berg (n.d), Mmbando (2014), and Kirimi *et al.*, (2013) clearly outline contribution of market participation to dietary diversity and per capita consumption expenditure, reduced risk of being in the chronically food poor, and transition households out of food poverty.

2.3. Ethiopian Wheat Consumption in International Context

In the international context, Ethiopian wheat consumption is higher than that of many countries in sub-Saharan Africa, such as Nigeria, Ghana, and Uganda, but about half the world average of 65 kg per capita. The Africa-wide average wheat consumption is about 50 kg per capita, boosted by the high levels of wheat consumption in South Africa and the North African countries. Globally, wheat consumption is declining gradually over time, as middle-income countries diversify their diets away from staple grains toward fruits, vegetables, meat, fish, and dairy products. However, within sub-Saharan Africa, several countries are experiencing rising wheat consumption as more consumers are able to afford bread and wheat flour, which is convenient but more costly than locally-produced maize, sorghum, and cassava. Uganda, Ghana, Kenya, and Nigeria have all seen increasing wheat consumption over the last decade. Wheat consumption in Ethiopia has been higher but more stable than in these countries. Since

2000, Ethiopian wheat consumption has remained in the range of 31-36 kg per capita (IFPRI, 2015).

In Ethiopia, wheat demand continues to outpace domestic production capacity as evidenced by the need to import. Wheat consumption is continued to increase. This increase in consumption is fueled by rising consumer income, urbanization, and changing diets (USDA, 2017). Domestically, wheat is consumed as bread, porridge (*genfo*), local beer (*tela*), roasted grain (*Kolo*) boiled grain (*nifro*), pasta, and different confectionary products (USDA, 2015).

2.4. An Overview of Wheat Production and Marketing in Ethiopia

2.4.1. Wheat production

Ethiopia accounts for 4.5 million tons of wheat production in 2016, making it the largest wheat producer in sub-Saharan Africa by a considerable margin (CSA, 2017). The second-largest producer is South Africa with 1.7 million tons, followed by Kenya with just 0.5 million tons. On the other hand, Ethiopian production is relatively small by global standards. Its production is surpassed by two North African countries, Egypt and Morocco, with more than 7 million tons each, and 27 other countries (FAO, 2015).

Wheat is mainly grown in the central and south eastern highlands during the main (*Meher*) rainy season (June to September) and harvested in October-November. The short rains (*belg*), starting in March, are less reliable in most parts of Ethiopia; however, in the south east of the country (Bale zone of Oromia Region), rainfall distribution is bimodal. Arsi, Bale, and parts of Shoa are considered the wheat growing belt. Bread wheat is the major variety of wheat grown in Ethiopia. However, farmers grow durum and bread wheat (mixed together) in some parts of the country. Wheat is produced on large state-owned farms covering around 124,000 ha of land in the Arsi and Bale regions. The total area of production of both durum (*Triticum turgidum*) and bread wheat (*Triticum aestivum*) is about 1,696,082.59 hectares. Although small-scale farmers dominate Ethiopian wheat production (and Ethiopian agriculture in general), there are some large-scale commercial farms growing wheat. Large-scale commercial wheat production covers about 50-80 thousand hectares of land and produces 150-200 thousand tons of wheat. Within Ethiopia, the Oromia and Amhara regions produce 59 % and

28% of the country's wheat, respectively, with an additional ten percent coming from the Southern Nations, Nationalities, and Peoples Region (SNNPR) and 3 % from others (CSA, 2017; IFPRI, 2015).

In Ethiopia, statistical data shows that area harvested and volume of wheat produced has grown year-over-year. Increase in trends of wheat production was attributed due to different factors that include good rainfall, national and international efforts to combat wheat stem rust outbreaks, and the rising use of improved seed and fertilizer. In addition, the government's extension package continues to have a positive impact on production. The extension services among other activities provides for the distribution of improved seed and fertilizer, education on the optimal application of inputs (e.g. seed) and other agronomic techniques. Further, USAID with its partner, are working in the wheat value chain to increase productivity and quality, while reducing post-harvest losses (USDA, 2015). Currently, wheat is strategic crop in Ethiopia's agriculture included under Agricultural Commercialization Cluster (ACC) in many parts of the country (ATA, 2014). Trends of area harvested and wheat production in Ethiopia is shown in figure below.

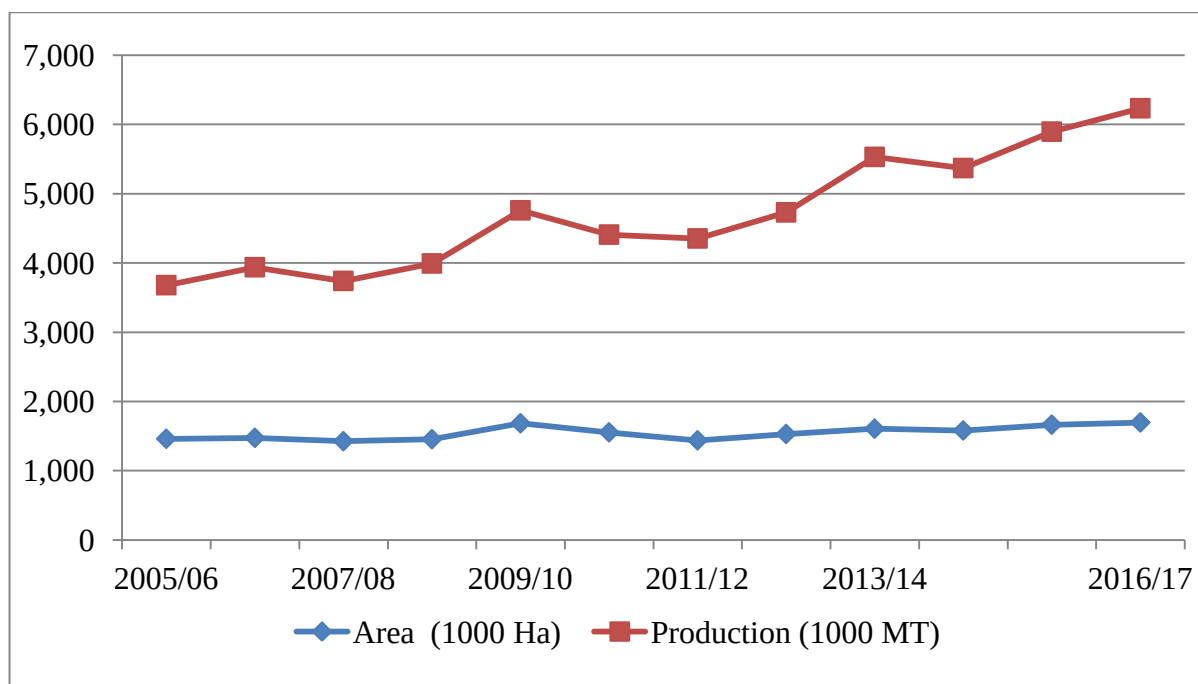


Figure 1: Trends of wheat production in Ethiopia

Source: Authors' analysis based on CSA data from 2005/06 – 2016/17

2.4.2. Wheat marketing

Regional patterns of marketed surplus of wheat indicate that, Amhara region is the second largest supplier of marketed wheat next to Oromia region which accounts for about half of all marketed wheat. Marketing patterns by farm size indicate that, those farmers with less than 0.5 hectare sold 9% of their harvest while those with more than 5 hectares sold an average of 39% of their wheat output. Farmers with 2-5 hectares of land sold 28% of their wheat output but they account for more than half (55%) of wheat marketed in Ethiopia as they are large in number. In Ethiopia, estimated proportion of marketed wheat generated by large scale commercial farmers is 15-20% (IFPRI, 2015).

Participants in wheat market in Ethiopia include smallholder and commercial producers, wholesalers, retailers, part-time farmer-traders, brokers, agents, assemblers, processors, cooperatives, the Ethiopian Grain Trade Enterprise (EGTE), and consumers. There is significant price fluctuation in wheat market. Generally, prices follow the annual pattern of relatively low post-harvest January prices followed by a period of rising prices that peak during the main rainy season (July and August) (ESPAR, 2010).

Unlike other staple grains, wheat is imported in large volumes. The percentage of domestic wheat consumption coming from imports varies between 25% and 35%, depending on the size of the harvest and other factors (IFPRI, 2015). This is due to factors such as population growth; change in consumer's income. The government of Ethiopia currently subsidizes the importation of wheat, providing it to large-scale flour mills on the condition that the flour is sold to bakeries by at controlled prices with the goal of making bread affordable to poor consumers. This is due to an intension of government to stabilize wheat prices following a significant increase in domestic food prices. Though huge volume of wheat is imported from the international markets and its distribution to millers, it has not kept the local wheat prices from increasing year on year (WFP, 2015). Volume of wheat import to Ethiopia is indicated in figure below.

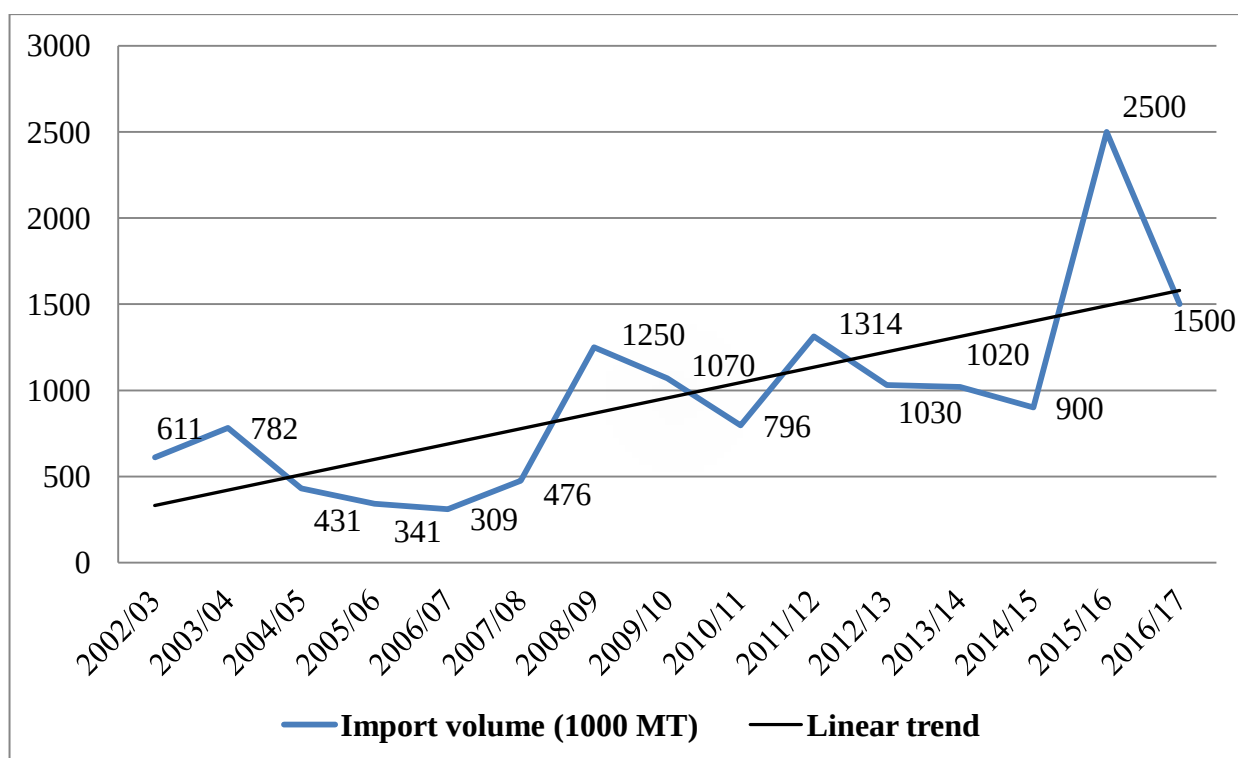


Figure 2: Trends of wheat import to Ethiopia from 2002/03 - 2016/17

Source: Author's analysis based on ATA (2014) and USDA reports of various years

2.5. Review of Empirical Evidences

2.5.1. Determinants of market participation

In agrarian economy, empirical evidence of smallholder farmers' participation in the market has been extensively considered for variety of agricultural products. Smallholders' decision to participate in larger, more lucrative national or regional markets depends on the degree of constraints they face relative to the benefits they could derive from such participation and depends on their capacity to meet minimum production requirements, both in terms of quantities and product standards; it also requires that expected profits will be large enough to encourage them to produce (Arias *et al.*, 2013).

Tollens (2006) emphasize that, while households whose food production hardly meets their consumption requirements are expected to have less degree of participation, incomes earned from marketing of produce may significantly facilitate input acquisition and hence increased

productivity and in turn improve market participation. This means, market participation is said to be depend on levels of food production. Pender *et al.*, (2006) stated as the development of input and output markets, institutions like property rights and land tenure, market regulations, cultural and social factors affecting consumption preferences, production and market opportunities and constraints, agro-climatic conditions, and production and marketing related risks and are other external factors that could affect the market participation and level of agricultural investment.

Factors that affect market participation decision and extent of market participation are in respect to broad categorization of these factors into household (farmer) characteristics, private assets, public assets/social capital and transaction cost variables (Benjamin, 2013). A number of authors have studied these factors for various crops. For instance, a study by Barrett (2008) indicate that differential asset endowments, together with differential access to those public goods and services that facilitate market participation, are identified as important factors underlying heterogeneous market participation among smallholders. Transaction costs affect market participation by increasing household's cost that could arise due to lack of transport facilities. Moreover, numerous difficulties related to smallholders' access to input markets result in transaction costs that adversely affect the profitability of their participation in output markets, hence affect decision to participate in a given market for a particular crop (Arias *et al.*, 2013). Also, the availability of market information plays an important role in their decision. Evidence on transaction cost indicates negative relationship between transaction costs and market participation (Alene *et al.*, 2008). In this regard, the findings of Solomon *et al.*, (2010) confirmed that, distance to main market variable is negatively correlated with marketed surplus because of the increased transaction costs associated with marketing of the farmers' agricultural produce. This is also related to access to improved seeds and other key agricultural inputs.

Market participation of smallholder farmers is also affected by household's age, farm/marketing experience, and education level. Benjamin (2013) using double hurdle estimation found that, likelihood of participation in maize market negatively affected by age of household head, while sex of households negatively influenced extent of maize marketed. Tadele and Ashalata (2016) found that, experience in *teff* production increases quantity of *teff*

supplied to market indicating the importance of farm experience in a market participation analysis. According to Aman *et al.*, (2014), education level of households motivate farmers market participation through improving the skill ability to utilize market information, which may in turn reduces marketing costs and make it more profitable to participate in the market. Firdisa (2016) also found as education level positively influence the likelihood of smallholder's participation decision.

Lagged price also has an effect on altering households' production decision which in turn affects market participation decision and level of participation. Mebrahatom (2014) found that average annual selling price from previous year had positive effect on extent of *teff* sold. Also, Tadele and Ashalatha (2016) in their analysis of determinants of *teff* and wheat market supply revealed that lagged price determines the quantity of *teff* supplied to the market. This means, extent of market participation increases positively with lagged price. Access to credit also affects market participation as evidenced by literatures. Access to credit would enhance the financial capacity of the farmers to purchase the necessary inputs that are necessary for agricultural production which in turn enhance for market participation. Abafita *et al.*, (2016) found that access to credit enhancing the probability of market participation significantly.

Asset holdings of household like oxen, land, farm implements and human capital is essential for marketable surplus production at smallholder level. Large farm size increases farmers' market participation because farmers having large farm size produce more output which increases a marketable surplus (Key *et al.*, 2000). Also, the findings by Geremew (2012) suggest that land is an important factor in influencing farmer's decision to produce any cash crop. Likewise, influence of land holding on likelihood of participation and intensity of marketed surplus clearly indicated in works by Efa *et al.*, (2016). The availability of labor in a large amount for agriculture is another determinant of market participation. According to Osmani and Hossain (2015), household labor had positive and significant effect on smallholder's decision to participate in market indicating increase in household labor increases likelihood of market participation. Conversely, Adam and Dawit (2015) found negative effect of family size measured adult equivalent unit on smallholders' decision to participate in a market and intensity of market participation. This could be associated with consumption

effect; as households with large family size retain significant portion of output for consumption.

Gebreslassie *et al.*, (2015) using Tobit estimation, they found distance to local market, lack of labor, age of household, expensive fertilizer, training on marketing, family size, farm size, outstanding debt, crop harvested in kg, off farm income and draft power as significant variables influencing intensity of crop out market participation. Moreover, Ele *et al.*, (2013) found that; total quantity of food crops produced, farming experience, access to agricultural extension service; size of land used for cultivation, membership in cooperatives and household family size are important factors determining the level of participation of smallholder farmers.

According to Tigist (2017), farm household's market participation decision and volume of crop sale are determined by access to improved inputs, farm size, output price, labor use, infrastructure facility, and livestock ownership. The land holding per household and availability of labor are the main factors of production that enable farm households to produce a surplus crop for market.

Mignouna *et al.*, (2016) using double hurdle model indicated that price and non-price constraints played significant roles in determining decisions on participation in maize and cow pea markets. Total farm size, price, and ease of transportation through access to motorized equipment were positively related to decision to participate in the maize market while volume of sale was affected by location. Age and total farm size positively related to decision to participate in the cow pea market while access to mobile phone, price and location affected volume of cow pea sold positively.

Hlomendlini (2015) using double hurdle model sorted out factors affecting decision to participate in maize market. According to his finding, gender of household head, household size, household land size, access to credit, government transfers affected likelihood of market participation positively. Intensity of maize sold was positively affected by household size, household land size, extension services, and fertilizer use. According to Moono (2015), decision to participate in rice market was positively affected by education level of household head, household size, output price, ownership of traction animal, ownership of working radio, price information, membership in farmer organization, and quantity of rice produced, while it

was negatively affected by age of household. In his two step heckman estimation result, intensity of participation in rice market was affected by age of household head, size of land owned, access to credit facility, price information, membership in farmer organization, and quantity of rice produced.

Abafita *et al.*, (2016) using heckman estimation identified factors affecting market participation decision as; value of crop produced, any ox, number of adult family members, all weather road, access to credit, fertilizer use, cooperatives in peasant association were factors affecting market participation positively and age and family size were negatively affected market participation. According to their finding, level of participation was affected by value of crop produced, any ox, land, all weather road, access to credit, fertilizer use, market orientation index positively and by age and family size negatively.

Alelign *et al.*, (2017) used heckman two step estimation procedure to identify factors affecting decisions to participate in crop output market and level of participation. Their finding reveal that, farm households' decision to participate in crop output markets were influenced by sex of household head, farming experience, livestock holding, cultivated land size, off/non-farm income, fertilizer used, on-farm income, market distance, and crop diversification. On the other hand, dependency ratio, cultivated land size, education status, chemical fertilizer, and distance to market were factors influencing farm households' intensity of crop output market participation.

Based on the above stated literatures, household (farmer) characteristics, private assets, public assets/social capital and transaction cost variables are also the focus of this study.

2.5.2. Conceptual framework

Smallholder farmers supposed to produce crops for two main purposes which are consumption and marketing purpose. Smallholder farmers could entirely consume their output, entirely market, consume a part of it and market the remaining depending on the commodity. If the smallholders entirely consume their produce, it means that they are not market-oriented and they can be said to be autarchic. That is they produce just meet what they need throughout the production season and do not need to depend on the market.

Market participation is viewed as two stage phenomenon. In the first stage households decide whether to participate or not to participate as a seller in the market for commodity under consideration and in the second stage, he/she decide over extent of market participation. Most variables that affect market participation decision also affect the extent of participation. Farmer's characteristics such as farm experience, family size, education, resource allocation behavior, and price perception affect both market participation decision and extent of participation (Benjamin, 2013).

Factors related to private assets such as size of land holding, livestock ownership, size of output, and income, etc. and public assets such as extension contact, access to credit, and membership in farmers association also affect both market participation decision and extent of participation. However, transaction cost related variables such as distance to market, access to communication assets, ownership of transport assets most likely affect market participation decision but less likely affect extent of participation; it is an identification variable that only included in the first stage of the model; affect only the market participation decision in case where Heckman sample selection is used (Asresu, 2014; Mmbando *et al.*, 2015). Conceptual framework showing how these factors are related to market participation decision and extent of participation is indicated in figure below.

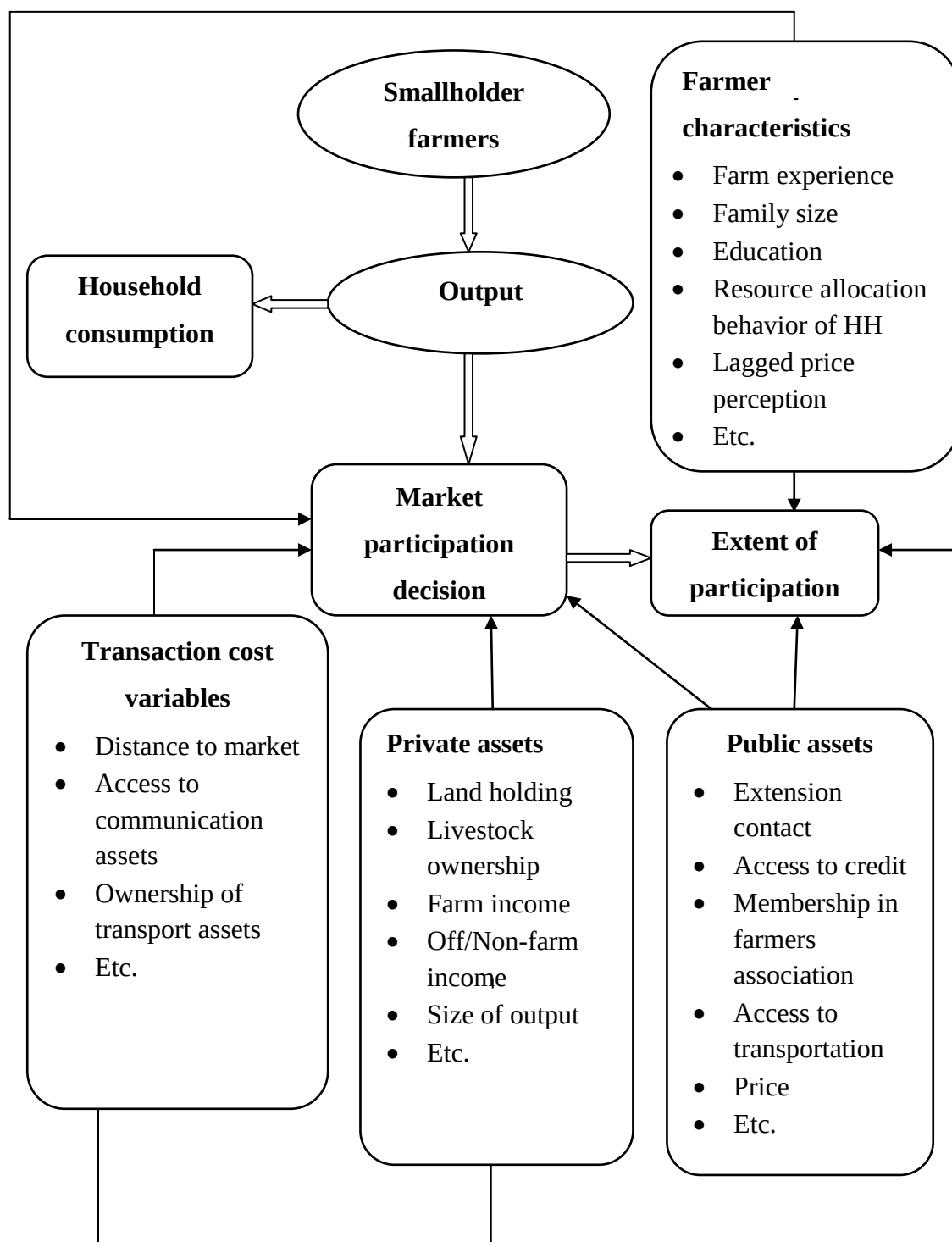


Figure 3 : Conceptual framework

Source: Adopted from Benjamin (2013)

2.5.3. Analytical framework

Different analytical models have been employed to analyze the farm household decision problem. One of the method used Tobit model to analyze determinants of market participation. Tobit model based up on the assumption that both the decision to participate in activity and the level of participation are determined by the same variables and with the same sign. This means, the decision to participate as a seller of a certain crop and the intensity of participation are jointly determined and influenced by the same parameters. This is the main weakness of the Tobit model in which it restricts the number of independent variables and coefficients in the two decisions (participation and the level of participation decisions) to the same sign (Wooldridge, 2002). In addition, Tobit models assume that zero values of participation associated with non-participation are the result of rational choice (i.e. non-participant farmers decides to sell zero in the market). This is the reason why recent empirical studies on commercialization and market participation where two separate decisions is made have shown the inadequacy of the Tobit model in cross-sectional analysis indicating the relevance of alternative approaches for analysis.

In this regard, one alternative approach is to employ the double-hurdle model. This model assumes farmers face two hurdles in any agricultural decision making processes (Cragg, 1971; Humphreys, 2010). Accordingly, the decision to participate in an activity is made first and then comes the decision regarding the level of participation in the activity. This model estimation procedure involves running a probit regression to identify factors affecting the decision to participate in the activity using all sample population in the first stage, and a truncated regression model on the participating households to analyze the extent of participation, in the second stage.

Opposed to Tobit model, in double hurdle model, there are no restrictions regarding the elements of explanatory variables in each decision stages. That means it is possible to separately analyze the determinants of market participation decision and the level of participation decisions. Due to this separation, the estimates of participation decisions can be obtained by means of probit regression and that of the level of participation decision can be analyzed by use of a truncated regression.

The other approach uses Heckman two step procedures. Sample selection model was first introduced by Heckman (1979) and its main application was in the context of estimating wage equation. This model is based on the assumption that the decision to participate and the intensity of participation may not necessarily be jointly determined as in Tobit model (Humphreys, 2010; Geoffrey *et al.*, 2013). In this case, factors that determine the market participation decision and the decision on extent of participation could be different. However, the Heckman selection model is appropriate if there is a censoring process in measuring the intensity of market participation (Humphreys, 2010). The Heckman two step procedures assume there is some potential levels in the sample population, but are not observed due to sample selection problem (selectivity bias). In general, Heckman's sample selection model is designed to account for the fact that the observed sample may be non-random. This is the importance of this model when one deals with biased (non-random) sample.

Heckman two step estimation procedures compared with double hurdle model on the basis of error terms and the assumption of dominance (potential source of zeros and how those zeros are treated). Heckman two step procedures assume that the error terms of the participation and level of participation equations are correlated, and that the participation decision dominates the level participation equation which referred to as first hurdle dominance. The model implies that observed zero level of participation are the result of participation decisions only (i.e. zero observation in the outcome equation is due to first hurdle dominance); it assumes that there are no zero observations in the second stage once the first-stage selection is passed (John, 2014). According to the Heckman two step models, only non-participants respondents can report zero intensity of market participation. The model further assumes that individuals who participate in the market do not report zero values at all. Again, Heckman two step procedures heavily basis itself on the assumption of bivariate normal distribution of error terms of selection and outcome equations which is represented by Inverse Mill's Ratio. The coefficient on the Inverse Mill's ratio will indicate if there is selection bias (Soderbom, 2011).

Conversely, double hurdle model assumes no first hurdle dominance (i.e. the double-hurdle model assumes that zero values can be reported in both decision stages.) The zeros reported in the first-stage arise from non-participation and those in the second stage come from non-sales due to the respondents' deliberate decisions or random circumstances (Efa *et al.*, 2016). John

(2014) state that double hurdle model can be thought of as a flexible version of both the Tobit and Heckman model.

Generally, before engaging in the construction of a model, we must accept that there are no true models. Indeed, models only approximate reality. The question then is to find which model would best approximate reality; given the data we have recorded (Mazerolle, n.d). To this effect, in this study, models were tested one against the other. Heckman two step estimation procedure was remained rejected due to absence of selectivity bias with the data at hand (Appendix table 8). Therefore, to address the second objectives of the study, test of Cragg's double hurdle model against the tobit model was made using the joint result from the likelihood ratio test and the Akaike's Information Criteria (Akaike, 1974).

According to Wooldridge (2002), 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. A likelihood ratio test for the tobit model against the double hurdle model comes from the estimation of the double hurdle model log likelihood that can always be written as the sum of the log likelihoods of the two separate a probit and and truncated regression model (Cragg, 1971). A simple test for the double hurdle model against tobit model can be used. To do this, the tobit model and the double hurdle model were estimated separately and a likelihood ratio test was used. The computation of the likelihood ratio is given by the following relationships (Greene, 2000).

$$\Gamma = -2[\ln L_{\text{tob}} - (\ln L_{\text{prob}} + \ln L_{\text{trunc}})] \sim \chi^2_k \quad (1)$$

Where, Γ = likelihood ratio statistic; $\ln$ = natural logarithm; L_{tob} , L_{prob} and L_{trunc} are likelihood values for tobit, probit and truncated regression models respectively, χ^2 = Chi-square distribution and k is the number of the number of explanatory variables. The null hypothesis in the equation (1) is that the tobit model provides a better fit than the double hurdle model. Null hypothesis is rejected if probability level predicted from chi-square distributed value of Γ is less than a given significance level. According to this test, tobit model was rejected at 5% (Appendix 5).

In addition to likelihood ratio test, the two competing models were compared using AIC model selection criterion. Akaike (1974) cited by Yibeltal (2014) proposed using Kullback-Leibler information for model selection. He established a relationship between the maximum likelihood, which is an estimation method used in many statistical analyses, and the Kullback Leibler information. In essence, he developed an information criterion to estimate the Kullback-Leibler information, Akaike's information criterion (AIC), which he defined as:

$$AIC = -2(\log - \text{likelihood}) + 2K \quad (2)$$

Where, K is the number of estimated parameters included in the model, the log-likelihood of the model is derived by separately estimating each competing models readily available in statistical output. The model with the lowest AIC, taken as the best model among competing models specified for the data at hand (Mazerolle, n.d). Accordingly, in this study, double hurdle model had lowest AIC indicating fitness of this model (Appendix 5).

On the other hand, it is important to test heckman maximum likelihood estimation against double hurdle model using test for non-nested maximum likelihood estimators developed by Vuong (1989). As a result of the weakness of the standard likelihood ratio test to test models of non-nested nature, Vuong (1989) proposed a modified likelihood ratio test for non-nested maximum likelihood estimators which are based on a transformed value of the log likelihood function, using a simple transformation as:

$$Wn = \left(\frac{1}{n} \right) [LR_1]^2 - \left[\left(\frac{1}{n} \right) LR_1 \right]^2 \quad (3)$$

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: $LR_1 = LL_{DH} - LL_{Heck}$ with a test statistic which has a standard normal distribution specified as:

$$\frac{LR_1}{Wn\sqrt{n}} \quad (4)$$

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. If the test statistic is smaller in absolute value than a critical value from the standard normal distribution, then the test cannot discriminate between the two models given the data at hand. Also, based on the above statistical test result (Heckman maximum likelihood estimation against double hurdle model), double hurdle model remain accepted with the data at hand (Appendix 5).

3. RESEARCH METHODOLOGY

In this chapter, the research methodology used in the study including description of the study area, data types, sources and method of data collection, sampling procedures, method of data analysis, definition of variables and hypothesis are discussed.

3.1. Description of the Study Area

3.1.1. Location

The study was conducted in Adola Rede district. Adola Rede is one of the districts which found in Guji zone of Oromia Region at a distance of 475km from Addis Ababa. Adola rede district has an area of about 1401km². Astronomically, the location of the district is between 5°44'10"N- 6°12'38"N and 38°45'10"E – 39°12'37"E. According to Oromia population projection made based on 2007 Population and Housing Census Result, the total population of Adola Rede woreda is about 149, 735 in the year 2015/16. From the total population, male accounted for 52%, while the remaining 48% were females. It shares boundary with Girja in North-East direction, Anna Sorra in North-West direction, Oddo Shakiso in Southern direction and Wadara in South-East direction (ARBoFED, 2017). Geographical location of the study is shown in figure below.

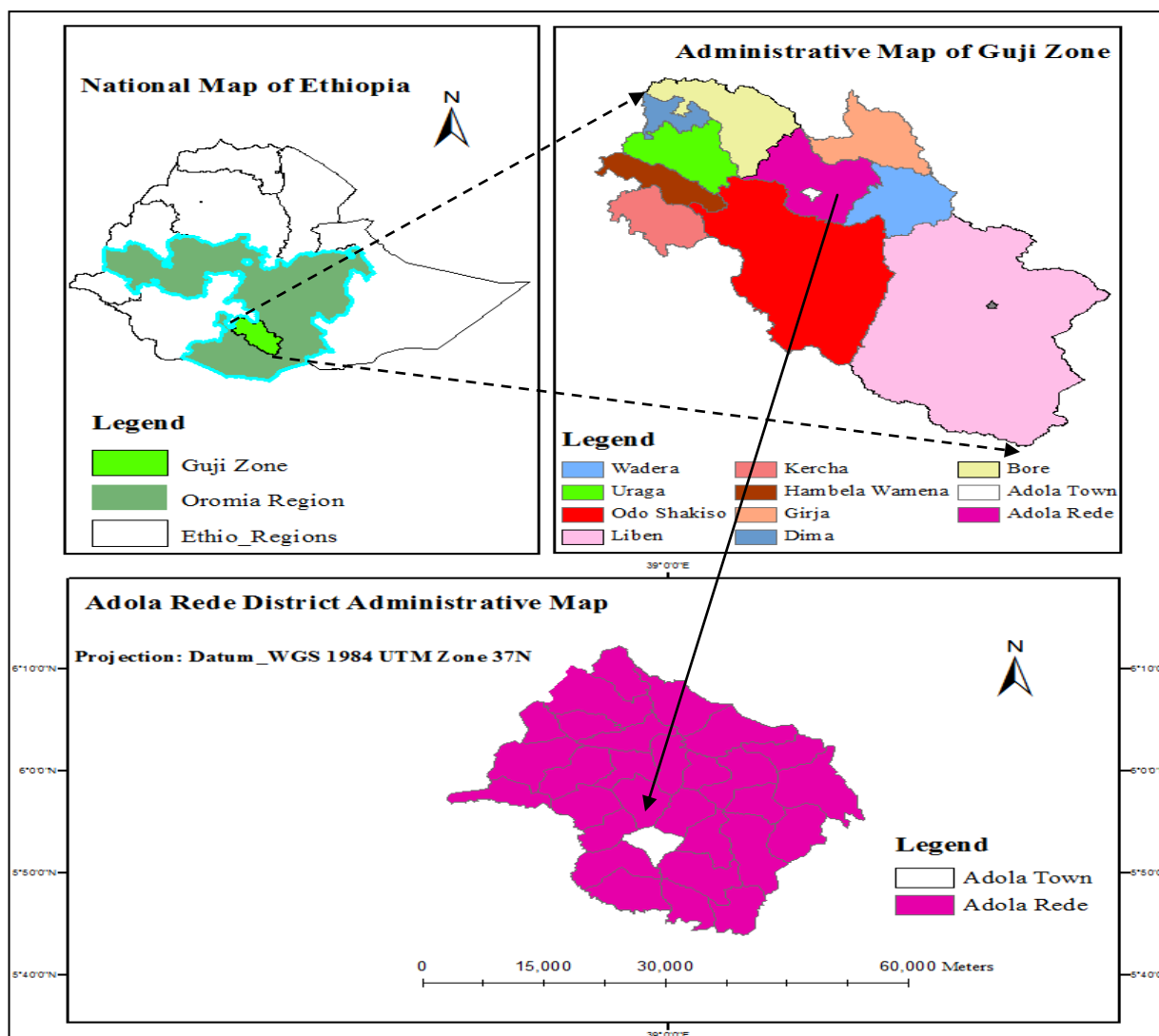


Figure 4: Geographical location of the study area

Source: Developed from Ethio-GIS (2006)

3.1.2. Farming systems and agricultural practices

Like in many parts of Ethiopia, the farming system in Adola Rede is still traditional with oxen (animal's power), and labor as the major means of production during land preparation, planting and harvesting as well as post-harvest process. Rain-fed agriculture is a common practice for many farm households in this district. However, a semi-nomadic economic activity is also practiced as a means of livelihood by some of its residents. This district has 28 rural *kebeles* and 3 urban *kebeles*. Adola Rede district is characterized by three agro-climatic zones, namely *Dega*, *Weina Dega* and *Kola*; locally known as *Bada*, *Bada Dare*, and *Gamoji*

respectively. The mean annual rain fall of the district is about 1000mm and the mean annual temperature of the district is 28C⁰. The farmers of this district produce both in *meher* and *belg* seasons. They produce cereals such as *teff*, wheat, barley and maize, pulses such as haricot bean, and others such as fruits and vegetables. They also engaged in the production of coffee and chat as means of livelihood. Overall; wheat, barley, maize and *teff* are the major crops cultivated by the farmers in the study area. Moreover, this district has a potential for livestock production which is witnessed by farmers ownership large number of livestock. Cattles, goats, sheep, horses, mules, donkey and poultry are livestock types that the district is endowed with (ARBoFED, 2017).

3.1.3. Land utilization

Out of the overall land of the district, land has been distributed according to the use pattern and resource composition. The following table displays data indicating land allocation with respect to the cultivable land, forest, grazing, and reverie, marshy, dwelling, stony and mountainous and other lands of the area. Out of the total of the district, 60,195 ha is agricultural land use coverage in the 2016/17 indicating the largest area of land in the district goes to agriculture followed by forest and grazing land which took 22, 791 ha and 21, 360 ha respectively.

Table 1: Land utilization in Adola Rede district

No.	Land coverage type	Area (ha)	Percentage (%)
1	Cultivable land	60,195	48.64
2	Forest land	22,791	18.41
3	Grazing land	21,360	17.26
4	Reverie	1,034	0.83
5	Marshy area	6,506	5.26
6	Dwelling area	6,506	5.26
7	Stony and mountainous land	3,819	3.08
8	Other	1,556	1.26
Total		123,767	100

Source: ARANRO, 2017

3.2. Data Type, Sources and Methods of Data Collection

This study used household survey data collected from Adola Rede district. Both primary and secondary data were used in this study. Before a start of actual data collection, facilitative works such as training of enumerators on interview procedures, and preliminary assessment to sampled *kebeles* was made. Primary data were collected using semi-structured questionnaire by trained enumerators. Both open and close-ended questions in line with the objective of the study were included in the questionnaire. Semi-structured questionnaire was administered on selected households to collect data on household characteristics, resource ownership, access and institutional variables relevant to meet the objective of the study. Secondary data helpful to the study were gathered from statistical abstract of Adola Rede district, journals, research findings and different reports.

3.3. Sampling Procedure

Two stages sampling technique was used to select sample households for data collection. In the first stage, in consultation with agriculture and natural resources office of the district, four *kebeles* were selected from seventeen wheat producer *kebeles* using simple random sampling technique. In the second stage, from list of wheat producer households in the sample *kebeles*, 150 sample wheat producers were selected randomly using probability proportional to size using sample size determination formula developed by Cochran's (1977) indicated in equation (5). The reason for choosing simple random sampling technique over other sampling techniques for selection of *kebeles* and sample was, because it gives equal chances for *kebeles* and households to be included within the sample frame.

$$n = \frac{Z^2 * p * q}{d^2} \quad (5)$$

Where; Z = Standard normal deviation (1.96 for 95% confidence level), p is the estimated proportion of an attribute that is present in the population, in this case proportion of wheat output market participants to wheat farmers in the district, but data on proportion of market participant at district level was unavailable. The rule for sample size determination in case where variability in p unknown is to assume p = 0.5 (Ajay and Mucuh, 2014). In this study,

due to time and financial constraint, the variability in p taken as 0.11 which is used by Efa *et al.*, (2016) based on the assumption that randomly selected sample is representative, $q = 1-P$, d = is degree of accuracy desired (0.05). Sampling frame and sample size determination is indicated in table (2).

Table 2: Sampling frame and sample size determination

Name of kebeles	Number of households (#)	Proportion of sampled households (%)	Number of sample households using PPS
Maleka	650	22	33
Gunacho	680	23	34
Hirbora Barko	516	17	26
Chembe	1130	38	57
Total	2976	100	150

Source: ARANRO (2017) and Own computation

3.4. Methods of Data Analysis

3.4.1. Descriptive analysis

Two types of analysis, namely descriptive and econometric analysis were used to meet the objectives of the study. Descriptive analytical tools such as mean, range, percentage, frequencies, and the like were used to describe households' demographic and socio-economic characteristics, and others. T-test and chi-square test were also used to compare market participants and non participants over demographic and socio-economic, and other factors. To meet first objective of the study, crop output market participation index was used. Household level degree of participation of wheat crop in the study area was estimated using the following index given as:

$$MPI_i = \frac{\text{Gross value of crop sales hh } i \text{ year } j}{\text{Gross value of crop production hh } i \text{ year } j} * 100 \quad (6)$$

The Market Participation Index (MPI) is a measure of household specific level of crop output market participation (Berhanu and Moti, 2010). In this study, the index measures the ratio of the gross value of wheat crop sales by household i in year j to the gross value of wheat crop produced by the same household i in the same year j expressed as a percentage. The index also

measures the extent to which household wheat crop production is oriented toward the market. A value of zero would signify a totally subsistence oriented household and the closer the index is to 100, the higher the degree of participation.

3.4.2. Econometric model specification

So far, empirical studies on analysis of the smallholder market participation have used various analytical models depending up on their nature of dataset. These analytical models include, Ordinary Least Squares (OLS), tobit model, heckman sample selection model, and double hurdle model. As to which type of model to use among these models depends up on the nature of dataset and underlying assumptions of the model.

Following the justifications provided in analytical framework part of the second chapter, this study have used double hurdle model to identify factors that influence smallholder wheat farmers' participation decision and intensity of wheat sales in the study area. According to Cragg (1971), double-hurdle model evaluating two separate decisions regarding decision to participation in a wheat output as seller and the level of participation (intensity of wheat sale) each of which is determined by a different set of explanatory variables can be specified as:

$$d_i^* = W_i' \beta + v_i \quad v_i \sim N(0, 1) \quad (7)$$

$$d_i = \begin{cases} 1 & \text{if } d_i^* > 0 \\ 0 & \text{if } d_i^* \leq 0 \end{cases}$$

$$y_i^* = X_i' \delta + u_i, \quad u_i \sim N(0, \sigma^2) \quad (8)$$

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \text{ and } d_i^* > 0 \\ 0 & \text{Otherwise} \end{cases}$$

Where, d_i^* is a unobservable variable describing i^{th} households' decision to participate in the wheat output market as seller (d_i), y_i^* is a latent (unobservable) variable describing i^{th} household level of participation in the wheat output market, y_i is the observed variable (actual

quantity of wheat sold by household i), W'_i and X'_i are vector of variables explaining the participation decision and level of participation decision respectively, β and δ are vectors of parameters to be estimated, v_i and u_i are respective error terms assumed to be independent and normally distributed. According to Cragg (1971), log likelihood function for the double hurdle model that nests a univariate probit model and a truncated regression model specified as follows.

$$\ln L = \sum_0 \ln \left[1 - \Phi(W'_i \beta) \left\langle \frac{X'_i \delta}{\sigma} \right\rangle \right] + \sum_+ \ln \left[\Phi(W'_i \beta) \frac{1}{\sigma} \phi \left\langle \frac{y_i - X'_i \delta}{\sigma} \right\rangle \right] \quad (9)$$

Where, Φ and ϕ represent standard normal probability and density functions respectively, W_i and X_i represent independent variables for the probit model and truncated regression model respectively, β , σ , and δ are parameters estimated from each model.

3.5. Definition of Variables and Hypothesis

Dependent variables

Market participation decision (PARTdc): It is binary dependent variable and it takes a value of 1 if the household participates in wheat output market as a seller and, 0 otherwise.

Quantity of wheat sold (Qsold): It is the quantity of wheat actually supplied to market measured in quintal and it takes positive value for those households who have supplied.

Independent (explanatory) variables

The following explanatory variables were thought to have effect on smallholders' decision to participate in output market and level of participation. They include households' demographic characteristics, human and physical capital endowment, production related factors, access to information and markets, and institutional support services. Choice of the variable was made based on review of related literature and underlying economic theory.

Family size (FAMZ): This variable is a continuous variable and refers to the total number of family members (adult equivalent) in the household. The size of economically active family members within a given farming household affects the crop production activities positively.

So, in this respect family size is expected to have positive impact on likelihood of participating in a market and sale volume. The higher the number of household members, the more they will consume their production; meaning, an increase in family size may also increase in the number of dependent family members which would in turn increase in the number of mouths to be feed and disproportionate volume of production and hence contribute to a decrease in the level of market participation (Aman *et al.*, 2014). Therefore, family size was expected to affect probability of market participation and level of participation either positively or negatively.

Education level of the Household Head (EDUC): It is a continuous variable and measured in years of schooling of the household head. Education increases the ability of farmers to get and analyze relevant market information which would improve the managerial ability of the farmers in terms of better formulation and execution of farm plans, and acquiring better information to improve their marketing performance (Aman *et al.*, 2014). Formal education is hypothesized to have positive influence on volume marketed. Enete and Igbokwe (2009) also argued that education will endow the household with better production and managerial skills which could lead to increased participation in the market. Therefore, this variable was expected to have positive effect on market decision and level of participation.

Farm experiences (EXPRS): It is a continuous variable measured in number of years the household stayed in wheat production and marketing. Household with better experience in wheat production and marketing is expected to produce more amounts of wheat and supply to the market than those with less experience. Therefore, experience in wheat production was expected to have a positive relation with market participation decision and level of participation.

Size of land allocated for wheat crop (LANDwht): The size of land used for wheat production was measured in hectare and it was expected to affect the household participation decision and level of participation positively because, for a household who allocates a large area of land under wheat production, probability of participation and level of participation is higher than a household who allocates less area of land. Mebrahatom (2014) found significant relationship between intensity of *teff* market participation and proportion of land allocated for *teff*. Efa *et al.*, (2016) have also found positive and significant relationship between extents of *teff* marketed surplus and land allocated for *teff*.

Size of land allocated to other crops (OTHERCrp): This is continuous variable measured in hectare. It measures proportion of land allocated to other crops other than wheat crop. It is assumed that the more proportion of land under other crops, the lesser land available for wheat production which in turn affect market participation. Therefore, this variable expected to affect market participation and level of participation negatively.

Total livestock holding (TLU): This variable is a continuous variable and refers to the total number of livestock household owns in terms of TLU. It is assumed that households with larger TLU would have better economic strength and financial position to purchase and use sufficient amount of fertilizer and other inputs that would help to improve his/her production (Teferi, 2003). According to Adam and Dawit (2015), crop output market participation increases with livestock possession. Therefore, this variable is expected to have a positive association with probability of market participation and level of participation.

Non-farm income (NFICOM): This is continuous variable measured in birr. Non-farm income represents the amount of income generated from activities other than crop and livestock production like labor in non-agricultural activities (small scale industrial activities, cottage industries, commercial and others). Engagement in non-farm activities better endow households with additional income. This additional income improves the households' financial position that in turn enables them to invest in purchasing the needed amount of food and farm inputs. Therefore, households who managed to earn more cash income are more likely to adopt new wheat varieties, purchase fertilizer and other agricultural technologies. Likewise, more participation of households in non-farm activities reduces agricultural production by reducing time required for management of agricultural activities that will in turn reduce marketed surplus. Yassin (2016) found negative effect of non-farm income on probability of potato market participation and level of potato sale. Therefore, this variable was expected to have indeterminate influence on probability of market participation and level of market participation.

Quantity of wheat produced (QTYprod): It is a continuous variable that measured in quintal. The amount of wheat production was expected to have positive relation to probability of market participation and quantity of wheat sold. Tadele and Ashalata (2016) found positive and significant relation between intensity of *teff* and wheat supplied and size of *teff* and wheat

production respectively in their analysis of *teff* and wheat marketing. Also, a study by Gani and Adeoti (2011) revealed that as the size of output increases the probability to sell output would also increase level of market participation. So, quantity of wheat produced expected to affect probability of market participation and level of participation positively.

Ownership of transport equipment (TranEq): Ownership of transport equipment was treated as a dummy variable taking a value of 1 if the household owns any of transport equipment and, 0 otherwise. Specifically, carts would be used to measure the availability of transportation facilities by households. According to Efa *et al.*, (2016) and Jagwe (2011), ownership of transport equipment such as donkeys and animal carts have positive impact on market participation by reducing the cost of transporting inputs from the market to the farm and output from the farm to the market. Accordingly, positive relationship was expected between probability of market participation and ownership of transport equipment.

Ownership of mobile phone (Mobile): Now days, access to information became a key input in agricultural production and marketing. According to Getaw & Shively (2013), access to information is important input for making agricultural decisions in production, marketing and finance. Farmers who want to sell their products have to search for the right price, the right buyer, the right standards and grades of the product. All these searches are costly. Farmers need to do frequent travel, repeated loading and unloading to showcase their produce to buyers and brokers. Hence, ownership of mobile phone eases the problem associated with accessing of these information. In this study, ownership of mobile phone by the household head is used as a proxy to measure market information access. It is treated as dummy variable taking 1 if the household owns mobile phone, 0 otherwise. In this regard, as compared to household head that has no mobile phone; households who own mobile phone are more likely to have better market related information access. Therefore, ownership of mobile phone was expected to have a positive effect on likelihood of market participation.

Households' perception on lagged market prices of wheat (PRICEP): This is binary variable that measure perception of households about wheat price of previous year. It will take a value of "1" if the households' perception was high and "0", if it was low. When wheat price is high in the market in the previous year, farmers would be interested to produce and supply more. Alene *et al.*, (2008) found the existence of positive relationship between the price and

the proportion of sale and confirm price to be an incentive to sell. Also, Yassin (2016) found positive and strongly significant relation between price and market participation decision. Therefore, the high household's perception on lagged price of wheat was expected to have positive relation with probability of market participation and level of participation.

Distance to extension service center (DISext): This is continuous variable which measures walking time travelled in minutes by households from home to arrive at the nearest extension service providers as a proxy for government service. Farmers who live near the extension service centre are more likely to participate in production of the considered crop (Geremew, 2012). Therefore, distance to extension service center would assume to have indirect relation with participation decision and level of participation.

Distance to the nearest market (MKTdis): Distance to the nearest market is a continuous variable measured in kilometers from the household residence to the market centers. The closer the residence of the household to the rural market center, the more farmers' awareness about the benefit of marketing and they will have adequate price information, the lesser cost of transportation that will enhance market participation. Berhanu and Moti (2010) found negative and significant effect of market distance on crop output market participation. Therefore, this variable was expected to have negative relationship with probability of market participation and level of market participation.

Access to credit (ACCRDT): This is a dummy variable which took a value of one, for those households who have access and zero, for those households who do not have access. Access to credit helps the farmers to buy different inputs for production, to fulfill their need for covering labour cost, transportation cost and different costs related to their operation (Yaynabeba, 2013). Credit can also be used as an instrument for market stability. Rural farmers can build their bargaining power by establishing storage facilities and providing transport system acquired through credit. Therefore, this variable was expected to have a positive influence on probability of market participation and level of market participation.

Membership in cooperatives (MCOOPS): This is dummy variable taking a value of "1" if the households are member of cooperatives and "0" otherwise. It is assumed that, cooperatives have a number of contributions for smallholder rural farmers in developing

countries. For example; cooperative institution provide necessary inputs, market information and buy their produce at a better prices. According to Ele *et al.*, (2013), commercialization of smallholder farmers increases with membership in cooperatives. In this study, the researcher expected that those farmers who are members of local cooperative more likely produce wheat; hence, more likely to participate in wheat output market and increase level of participation.

Table 3: Description of the model variables and hypothesis

Variables	Units of measurement	Expected effect on	
		Prob. of market participation	Level of market participation
Dependent variables			
Market participation decision	Dummy		
Quantity of wheat sold	Quintal		
Independent Variables			
Family size	Adult equivalent	+/-	+/-
Education level of household	Years of schooling	+	+
Farm experiences	Years	+	+
Size of land under wheat crop	Hectare	+	+
Land allocated to other crops	Hectare	-	-
Total livestock holding	TLU	+	+
Non-farm income	Birr	+/-	+/-
Quantity produced	Quintal	+	+
Transport equipment ownership	Dummy	+	
Mobile ownership	Dummy	+	
Perception on lagged market price	Dummy	+	+
Distance to extension service	Minutes	-	-
Distance to the nearest market	Kilometer	-	-
Access to credit	Dummy	+	+
Membership in cooperatives	Dummy	+	+

4. RESULTS AND DISCUSSION

In this chapter, the main findings of the study are presented and discussed. Under first section of this chapter, descriptive results including demographic and socio-economic characteristics of sample households, resource ownership, production and consumption, wheat market participation status, and wheat production and marketing problems in the study area are presented. In the second section, econometric results such as factors affecting smallholder's decisions to participate in a market, and the level of production marketed are presented and discussed.

4.1. Descriptive Results

4.1.1. Demographic and socio-economic characteristics of sample households

Table 4 discloses demographic and socio-economic characteristics of sample households in the study area. The study showed that, out of 150 households in the survey, 74% were market participant while the remaining 26% were non participants of market. It also showed that majority of the households (i.e. 90% of the households) were male headed and the remaining 10% were female headed households. Among market participants, male headed and female headed households constitute 96% and 4% respectively. Out of non-participants, 74% were male headed while the remaining 26% were female headed households. Chi-square test of proportional difference shows, the existence of statistically significant difference between two groups (Market participants and non-participants) at 1% significance level.

The average age of participants was 46.95 years, while for non-participants it was 48.31 years, and 47.31 years for pooled sample. The average number of household members of participants in adult equivalent was 4.80, while 5.12 among non-participants, and 4.88 for pooled sample (Appendix 1). On average, the number of years that had been spent in formal school by participants was 5.24 and for non-participants, 4.38 years, and for the total sample 5.02 years. Farm experience supposed to acquaint the households with basic production techniques. The average experience in wheat production for the whole sample was 17.11 years, while for participants and non-participants it was 17.02 years and 17.38 years respectively.

Household's perception on lagged market price of wheat is important in altering marketing decisions of households. In this study, out of the total sample, 47% of the households perceived as the lagged market price of wheat was high. Among participants, 58% of the households perceived as lagged price of wheat was high, while out of non-participants, 15% of the households were perceived lagged price of wheat as high. Statistically significant difference was observed between the participants and non-participants in terms of perception on lagged market price of wheat from chi-square test at 1% significance level.

Likewise other factors, it is important to understand access to institutional and market access factors in market participation analysis as they proxies the accessibility of production technologies, information, and transaction costs. Survey result shows that, 27% of the households had access to credit; while among participants and non-participants, 30% and 18% of households respectively had access to credit (Table 4). Out of the total survey respondents, 33% of sample households were members of cooperatives. Membership in cooperatives by groups shows that, 38% of households were members of cooperatives from participants where as 18% of households were members from non-participants. There was statistically significant difference between the two groups in membership to cooperatives at 5% significance level.

On average, the sample households travelled 32.46 minutes to arrive at extension service center. The average travel time taken among participants and non-participants to arrive at extension service in minutes was 32.47 and 32.41 respectively. The mean distance from the nearest market for the whole sample was 5.62 kilometers. The mean distance from the nearest market for market participants was 5.89 kilometers while it was 4.83 kilometers for non-participants. T-test result shows that, there was statistically significant difference between participants and non-participants in distance from the nearest at 10% significance level.

Statistically significant difference was not observed between participants and non-participants in terms of age, family size, education level, farm experiences, access to credit, and distance to extension service.

Table 4: Demographic and socio-economic characteristics of sample households

Variables	Mean/Proportions			T-value/ χ^2
	Total	Participant	Non-participant	
Number of samples	150	111	39	
Sex of household heads	0.9	0.96	0.74	14.32***
Age of household heads	47.31	46.95	48.31	0.61
Family size	4.88	4.80	5.12	0.64
Education level of household	5.02	5.24	4.38	-1.33
Farm experiences	17.11	17.02	17.38	0.47
Perception on lagged market price	0.47	0.58	0.15	21.6***
Access to credit	0.27	0.30	0.18	2.05
Membership in cooperatives	0.33	0.38	0.18	5.61**
Distance to extension service	32.46	32.47	32.41	-0.002
Distance to the nearest market	5.74	5.89	4.83	-1.87*

***, ** and * indicate significance at 1%, 5% and 10% respectively

Survey result, 2017

4.1.2. Cash income sources of sampled households

As Table 5 shows, the major cash income sources of sample households in the study area were sale of crops, livestock, and non-farm income. Cash income from livestock and its product's sale had the mean of 4260.75 Birr for the pooled sample, with participants having Birr 5369.66, while non-participants had 1104.62 Birr. There was a statistically significant difference between the participants and non-participants in terms of cash income from livestock and its product's sale at 1% significance level.

Cash income from all crop sales had the highest mean of Birr 14263.2 for the total sample households indicating that crop sale is the major income source of sample households in the study area. Market participants had the mean income from all crop sales of Birr 14769.49, while non-participants had Birr 12821.92. The cash income from wheat sale has contributed 28% to the total income from all crop sales for the whole sample. The mean annual non-farm cash income of households was Birr 1317.95. Sale of labor, and petty trade were among non-farm income sources of households. Income from all crop sales and non-farm activities was not significant between the participants and non-participants, while total average cash income was significantly different between the participants and non-participants at 5% significance

level. The total average cash income among sample households was 19866.5. The participants and non-participants had a total average cash income of Birr 21491.05 and Birr 15244.49 respectively.

Table 5: Cash income sources of sampled households

Variable	Participant	Non-participant	Total	T-value
	Mean	Mean	Mean	
Livestock & its product's sale (Birr)	5369.66	1104.62	4260.75	-3.48***
Income from all crop sale (Birr)	14769.49	12821.92	14263.2	-1.28
Wheat contribution (%)	38	-	28	-10.02***
Non-farm income (Birr)	1351.90	1317.95	1343.03	-0.06
Total average income	21491.05	15244.49	19866.5	-2.85**

***, and ** indicate significance at 1%, and 5% respectively

Survey result, 2017

4.1.3. Resource ownership, land allocation, production and consumption of wheat among sampled households

Table 6 highlights resource ownership, land allocation, and the production and consumption patterns of wheat producer households in the study area. Physical resources such as land, livestock, and others were among the resources owned by households. Livestock are another physical capital owned by households and serving for different purposes. Total livestock holding varies from 0.68 to 23.84 TLU. The mean livestock holding in TLU for participant and non-participant was 8.03 and 6.95 respectively, and 7.53 for total sample households.

Recent studies shows the impact of mobile phones on farmers' marketing decisions (spatial arbitrage, buyer's choice, frequency of selling, and size of transaction) and prices they receive based on household and village level information. To this effect, ownership of mobile phones was used as a proxy for market information. The study showed that, on average, 54% of households were owned mobile phones. Out of participants, 71% of households were owned mobile phone while 77% of households from non-participants owned mobile phone. The chi square test showed that, there was statistically significant proportional difference between participant and non-participant in terms mobile phone ownership at 5% significance level. Out of the total sample households, 27% had their own transportation equipment which includes

animal driven carts, and motor cycles. Out of market participant, 31% of households had their own transportation equipment, while out of non-market participant, 13% of household owned transportation equipment. There was a significant difference between market participant and non-participant households in terms of ownership of transport equipment.

On average, size of land allocated under wheat for market participants was 0.45 ha; while for non-participant was 0.15 ha and, for the pooled sample, size of land allocated for wheat was 0.37 ha. The T-test of variability between the groups showed that there was a statistically significant difference in terms of size of land allocated wheat between participants and non-participants at 1% significance level. Relatively large proportion of land was covered by other crops which was 1.82 ha for the total sample households. Market participants allocated 1.66 ha of land to other crops, while non-market participants allocated 1.77 ha of land. The average size of land holding of participants was 1.96 hectares, of non-participants 1.87 hectares, and 1.94 hectares for the total sample households. This land holding size in the area is higher than the average national land holding size of about 1.4 ha per household stated in CSA and WB (2013).

Production characteristics of sample households' showed that mean amount of wheat produced by participants was 1362.16 kg, and by non-participants was 374.36 kg. For the total sample households mean amount of wheat produced was 1105.33 kg. There was statistically a significant mean difference in amount of wheat produced between participants and non-participants at 1% significance level. Distribution of output among sample households shows that, on average, 491.8 kg of wheat was consumed at home for all sample households, while average wheat consumption among market participants and non-participants was 533.06 kg and 374.36 kg. Out of the total production, mean amount of wheat sold was 558.87 kg for the total sample; while for participant and non-participant it was 755.22 kg and 0, respectively. A significant mean difference was also observed in both quantity of wheat consumed and quantity of wheat sold between the two groups at 5% and 1% significance level respectively, indicating that, on average market participants consumed and sold more quantities of wheat than non-participants.

Table 6: Resource ownership, land allocation, production and consumption of wheat among sampled households.

Variable	Participant	Non-participant	Total	T-value/ χ^2
	(Mean/ Proportion)	(Mean/ Proportion)	(Mean)	
Total livestock holding (TLU)	7.73	6.96	7.53	-1.20
Mobile ownership	0.71	0.77	0.54	7.88***
Ownership of transport equipment	0.31	0.13	0.27	5.17**
Land allocated for wheat (ha)	0.45	0.15	0.37	-6.36***
Land allocated to other crops (ha)	1.66	1.77	1.82	0.36
Land holding size (ha)	1.96	1.87	1.94	-0.72
Quantity of wheat produced (kg)	1362.16	374.36	1105.33	-8.44***
Quantity of wheat consumed (kg)	533.06	374.36	491.8	-2.42**
Quantity of wheat sold (kg)	755.22	-	558.87	-7.91***

***, and ** indicate significance at 1%, and 5% respectively

Source: Survey result, 2017

4.1.4. Characterization of households by degree of market participation

A statistical summary of market participation status indicators of the sample households are displayed in table 7. Household survey result shows that households head in the study area produced on average wheat valued approximately 5,750 Birr. Sells dimension of households under study shows that, on average, households in the study area sold wheat crop worth nearly 2,910 Birr. Market participant households produced and sold wheat worth nearly 7,090 Birr and 3,930 Birr respectively, while non-participants on average produced wheat worth 1,950 Birr and sold nothing out of their production.

Value of wheat produced and sold for participants range from 1,560 Birr to 16,670 Birr and from 520 Birr to 13,010 Birr respectively while for market non-participants value of wheat produced ranged from 520 Birr to 6240 Birr. The degree of market participation for the households in the study area computed at average community level price was 39% which indicates that on average households in the study area sold 39% of their total wheat production sales ranged from 0% to 95.8%. This degree of market participation is relatively more than the national average level of market participation of 20.78 percent and level of market participation in Guji zone (32.03%) indicated in CSA (2016). Degree of market participation among participants was 52 percent.

Category of market participation status of sampled household shows that, out of the total sample, 42.67% of households had low level of market participation selling 9% of their production in monetary terms, while 40% and 17.33% of the households had moderate and high level of market participation selling 51% and 85% of their production respectively in a wheat output market.

Table 7: Sample households' degree of market participation

Degree of participation	Participant				Non-participant		
	Total (Mean)	Mean	Min.	Max.	Mean	Min.	Max.
Value of wheat produced (a)	5.75	7.09	1.56	16.67	1.95	0.52	6.24
Value of wheat sold (b)	2.91	3.93	0.52	13.01	0	0	0
Market participation level (%)	39	52.8	11.7	95.8	0	0	0
Market participation status	Freq.	%	MPI (%)	Min	Max.		
Low ($\leq 30\%$)	64	42.67	9	0	28		
Medium (30 – 75%)	60	40	51	31	75		
High ($> 75\%$)	26	17.33	85	78	95.8		

Note: 'a' and 'b' displayed values are measured in thousands Birr.

Source: Survey result, 2017

4.1.5. Wheat production and marketing problems in the study area

Table 8 discloses households' perception on production and marketing problems of wheat in the study area. As observed from the table, 95.53% of the households reported that lack of improved wheat seed as serious problem for wheat production in the study area. Statistical abstract of the district by ARBoFED (2017) also confirm that distribution of improved wheat was not made in the district. Wheat disease is another major problem in the study area according to the percentage response of the households (58%). They complain that, stem rust (locally known as *Gugufa* or *Wagi*) in particular destroying their wheat on farm thereby contributing low harvest of output.

Another binding constraint in production and marketing of wheat in the study area reported by sample households is high input cost. About 50.67% of the households responded as they are suffering from high input cost. According to their response, as volatility in market prices of fertilizer, seed and labor highly discouraging them. A relatively low market price of wheat was also among production and marketing problems reported by about 49.33% of the households.

Poor road infrastructure, inadequate means of transportation, and weather change were also identified as constraints in wheat production and marketing in the study area by 46.67%, 20.67%, and 31.33% sampled respondents respectively. According to respondents, poorly developed road infrastructure in the area made them face difficulty in transporting their output and incur significant transportation cost. In this regard, a study by Firdisa (2016) also demonstrated that poor infrastructure being one of major problems of crop production of rural areas.

Also, there is poor facility in public means of transportation. Inadequate public means of transportation could be associated with poor road infrastructure both of which force farmers sell their produce at farm gate price. Weather change was also reported as a critical problem in production of wheat in the study area. According to respondents, variability in rainfall occurring at time of sowing and harvesting was highly reducing their production potential due to deterioration of yields.

Table 8: Wheat production and marketing problems identified by sample respondents

Problems	Total (%)	Participant (%)	Non-participant (%)
Lack of improved wheat seed	95.53	94.59	97.43
Poor road infrastructure	46.67	46.84	46.15
Low price	49.33	38.74	79.48
Disease	58	59.59	64.10
Weather change	31.33	29.73	35.89
High input cost	50.67	49.55	53.84
Inadequate transportation service	20.67	21.62	17.95

Source: Survey result, 2017

4.2. Econometric Results

According to Reddy *et al.*, (2013), a commonly appearing problem in most of the econometric data is the correlated input variables or problem of multicollinearity. This problem arises due to the choice of several input variables which are having high correlation among themselves and it leads to less précised estimates and huge forecasting errors. To detect whether the data at hand exhibits multicollinearity problem or not, two tests were used: Variance Inflating Factor (VIF) and Contingency Coefficient. The Variance Inflation Factor (VIF) shows how the variance of an estimator is inflated by the presence of multicollinearity. With increased

multicollinearity, the VIF approaches infinity and in the absence of multicollinearity, VIF will be equal to 1. Variance Inflating Factor for each explanatory variable (X_i) can be calculated as stated in Reddy *et al.*, (2013) and Gujarati (2004):

$$VIF(X_i) = \frac{1}{1 - R^2} \quad (9)$$

Where, R^2 is the coefficient of correlation derived when one of explanatory variable regressed over all the other explanatory variables. As an alternative, the inverse of VIF ($1/VIF$) called Tolerance (TOL) can be used as a measure of multicollinearity. The closer is TOL of one explanatory variable (X_i) to zero, would signify the greater the degree of collinearity of that variable with the other explanatory variable. On the other hand, the closer TOL of X_i is to 1, the greater the evidence that X_i is not collinear with the other explanatory variables (Gujarati, 2004).

To detect the degree of association between dummy variables, Contingency Coefficient (CC) was used. Contingency coefficient values, which ranges between 0 to 1, measures the degree of correlation between discrete variables based on chi-square measure of association. Contingency coefficient value with 0.75 or more shows a strong degree of association between discrete variables; CC value close to zero indicates absence of series association between discrete variables (Healy, 1984; Befikadu and Yeboah, 2016). It can be calculated as:

$$CC = \sqrt{\frac{\chi^2}{n + \chi^2}} \quad (10)$$

Where, CC- is contingency coefficient n- is sample size and χ^2 is chi-square value.

In this study, the mean VIF of continuous explanatory was 1.86, and for all dummy variables included in the model, the contingency coefficient was below 0.75 indicating that there was no serious problem of multicollinearity (Appendix 3).

Endogeneity is another estimation problem in econometrics where the regressor is correlated with the error term. Estimates derived whenever endogenous regressors present in the model results in inconsistent estimation (Hansen, 2017). In this study, quantity of wheat produced

was suspected of being endogenous regressor in the model. According to Reyes *et al.*, (2012), quantity harvested is endogenous to the decision of whether to participate in the market as a seller and on the decision of how much to sell. For instance, if a farmer produces a crop with the intention of selling his surplus, whether he participates in the market will depend on how much he harvests (i.e. if the quantity harvested is small, he might decide to keep his production for his own consumption). Furthermore, market conditions will influence the amount a farmer produces because if the farmer perceives that he could sell in the market, he may decide to produce more for this purpose. Because of all these, there may be correlation between the error term in a reduced equation of quantity harvested and quantity sold; thus, making quantity produced an endogenous covariate.

To test whether quantity produced is potentially endogenous variable or not, an OLS regression was estimated on the quantity produced and then, the residuals from this OLS regression were retrieved and included in level of participation equation as an additional explanatory variable. The coefficient of residual was found statistically insignificant (p-value = 0.145) indicating absence of endogeneity problem. Finally, to account for heteroskedasticity, robust standard error was estimated.

4.2.1. Factors affecting the decision to participate in wheat market in the study area

The results for the factors affecting market participation decisions (First hurdle) are displayed in Table 9. Out of the fifteen variables fitted into first hurdle of double hurdle model, seven variables affected market participation decisions of households in the study area (Table 9). These variables are; perception on lagged wheat price, quantity of wheat produced, distance to the nearest market, distance to extension service center, land allocated for wheat, education, and land allocated to other crops. The Wald chi-square value of 59.01 for market participation decision model is statistically significant at 1% indicating that at least one of the explanatory variables included in the model jointly explain the probability of participating in wheat output market. An average household had a 73.84% predicted probabilities of market participation.

Table 9: Factors influencing farmers' market participation decision

Variables	Coefficient	Robust Std. Err.	Average Marginal Effect
Perception on lagged wheat price	1.14	0.442	0.121**
Quantity of wheat produced	0.23	0.078	0.025***
Experience in wheat production	-0.01	0.046	-0.001
Cooperative membership	-0.17	0.502	-0.018
Access to credit	-0.02	0.471	-0.002
Distance to the nearest market	-0.11	0.064	-0.011*
Ownership of transport asset	0.01	0.599	-0.005
Distance to extension service center	-0.01	0.008	-0.001*
Ownership of mobile phone	-0.52	0.514	-0.055
Non-farm income (log)	0.04	0.053	0.004
Livestock holding	0.05	0.074	0.005
Land allocated for wheat	7.68	1.858	0.815***
Family size	0.01	0.087	0.001
Education	0.18	0.068	0.01***
Land allocated to other crops	-0.56	0.328	-0.060*
Constant	-2.62	1.240	
Number of observations	150		
Pseudo R ²	0.6638		
Wald χ^2 (15), Pr > χ^2	59.01***		
Log likelihood	-28.90		
Predicted probabilities	0.7384		

***, ** and * indicate significance at 1%, 5% and 10% respectively

Source: Survey result, 2017

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¹ Three common marginal effects are available. They are Marginal Effects at Representative Values (MERs), Average Marginal Effects (AMEs), and Marginal Effects at Mean (MEMs). Generally, today; researchers recommend the use of AMEs rather than MEMs, as they take the empirical distributions of the regressors in to account (Spring, 2013; Leeper, 2017).

Households' perception on lagged price of wheat: Households' perception on lagged market price of wheat affected probability of market participation positively and statistically significant at 5% significance level. Perception of the households on lagged wheat price is important in altering production and marketing decision of households. This is because; households form their expectations based on the lagged price of wheat and allocates available resources according to their expectations. Alternatively, the higher the lagged price of wheat they perceive, the more quantity of wheat they produce and the higher the probability they participate in market as seller. Average marginal effect of this variable on probability of market participation shows that, as compared to households with low perception on lagged market price of wheat, probability of market participation for households with high perception on lagged market price of wheat increases by 12.1%. The finding was in line with priori expectation.

Quantity of wheat produced: Quantity of wheat produced positively related to probability of market participation and was significant at 1% significance level. Quantity produced is critical in semi-commercial farming system where output is firstly produced for home consumption purposes and only sell surplus. Therefore, higher output enables farmers to have more marketable surplus as indicated in Moti *et al.*, (2009). The average marginal effect was 0.025; meaning that a quintal increases in quantity of wheat produced increases the likelihood of market participation by 2.5%. This finding is in line with priori expectation and consistent with the finding of Reyes *et al.*, (2012) who found that quantity of potato produced significantly influenced the probability of market participation among smallholder farmers in the central highlands of Angola. Also, the finding of Moono (2015) shows that, likelihood of participation in rice market increases with quantity of rice produced. The finding of Gani and Adeoti (2011) also is in agreement with this finding that shows probability to participate in a market increases with size of output produced.

Distance to the nearest market: Distance to the nearest market negatively and significantly influences household's decision to participation in wheat output market at 10% significant level. Distance to the market proxies accessibility of the markets to smallholders. As Martey *et al.*, (2012) cited in Benjamin (2013), distance to market is an indicator of travel time and cost. The longer the distance of the market, it is more costly and time consuming to travel with

output forcing smallholder farmers to hold more output particularly which is common in rural areas where transportation facility is poorly developed.

Alternatively, as the distance from the nearest market increases, transport costs increase and this discourages smallholder farmers and their probability of participation in a market decreases. The size effect implies that, when the household is located one kilometer away from the nearest market, the probability of participation in wheat output market decreases by 1.1%. This result is consistent to findings of Gani and Adeoti (2011) who studied market participation and rural poverty among farmers in Northern part of Taraba State of Nigeria which found being closer to nearest market enhances probability of market participation. The finding is also in agreement with findings of Berhanu and Moti (2010), Aman *et al.*, (2014), Agwu *et al.*, (2013), Yaynabeba and Tewodros (2013), and Berhanu *et al.*, (2009).

Distance to extension service center: Proximity of agricultural extension service center is also important in studying accessibility of basic services that offered to farmers by extension service providers. According to Yalew (2016), as the farmers far away from extension service centers, farmer's frequency of contact with the agents decrease, leading them knowledge deficient on production techniques and face problem in accessing of inputs so that they couldn't produce market surplus. In line with priori hypothesis, the result showed negative and significant relationship between distance to agricultural extension service center and households' likelihood to participate in wheat output market at 10% significant level.

Average marginal effect on probability of market participation shows that, an extra minute in walking time to the extension center will decrease the probability of the household's participation in wheat market by 0.1%. The result was in agreement with the finding of Yalew (2016). The findings of Berhanu *et al.*, (2009) also showed that agricultural extension programs improve farmers' access to information and technical skills of smallholders, thus improving their resource use efficiency. They also reason out that extension programs facilitate smallholder linkages with input and output markets, and credit services thereby improving agricultural productivity through training and transferring knowledge and information to the smallholder farmers which depend on their accessibility.

Land allocated for wheat production: Another socio-economic characteristic that affects households' market participation decision is size of land allocated for wheat production. Size of land allocated for wheat production was significant at 1% significance level. Among seven variables found significant in affecting market participation decision of households, size of land allocated for wheat production has strong explanatory power over other variables. Average partial effect of this variable implies that, for a hectare increase in land allocated for wheat, probability of market participation increases by 81.5%. This is because, as the size of land allocated for wheat crop increases, the production of wheat increases which in turn increase farmers' probability of being seller in wheat output market. The findings of Chanyalew *et al.*, (2011) confirm this result.

Education level of households: Education level of households was also hypothesized to affect smallholders' market participation decision because of its capability in equipping smallholders with knowledge and skills that would help them in making decisions related to farm management, input use and information searching. As expected, education level affected probability of market participation positively and significantly at 1% significance level. One year increases in household head's education increase the probability of participation in wheat output market as seller by 1%. The result is consistent with the findings of Aman *et al.*, (2014) and Yalew (2016) that states educated household head can have better market networking and bargaining power and good managerial skill of enterprises and their tendency to accept different agricultural technologies is high, so that they can produce more surpluses for market.

Land size allocated for other crops: Lastly, size of land allocated for other crops was among important variable determining likelihood of market participation negatively and significantly at 10% significance level. This could be explained as, the land, being important in agricultural production and fixed asset, area of land allocated for a particular crop has an effect on size of area available for other crop especially when the type of the crop to be grown of a competitive nature. This means, the more the area allocated for other crops, the lesser would be the area of land for wheat production which has an impact on level of wheat produced which in turn reduce likelihood of participating in wheat market as seller. Marginal effect averaged across all sample shows that, an increase in a hectare of land allocated for other crops decrease the

probability of participation in wheat output market by 6%. This finding conforms priori expectation and consistent with the findings of Samuel *et al.*, (2016).

4.2.2. Factors affecting the level of wheat market participation in the study area

Results of level of market participation model (2nd hurdle) shows that, out of thirteen variables included in the model, three variables affected level of market participation (Table 10). These variables are; households' perception on lagged price of wheat, quantity of wheat produced, and family size. Wald chi-square value is strongly significant indicating acceptance of alternative hypothesis of at least one explanatory variable in explaining level of participation.

Table 10: Factors affecting the level of wheat market participation

Variables	Coefficient	Robust Std. Err.
Perception on lagged wheat price	1.79**	0.913
Quantity of wheat produced	0.74***	0.077
Experience in wheat production	0.05	0.090
Cooperative membership	-1.19	0.786
Access to credit	0.75	0.900
Distance to the nearest market	0.14	0.139
Distance to extension service center	-0.01	0.016
Log of non-farm income	0.11	0.111
Livestock holding	0.18	0.137
Land allocated for wheat	2.31	1.900
Family size	-0.26*	0.138
Education	-0.09	0.133
Land allocated to other crops	-0.74	0.536
Constant	-6.22***	2.292
Sigma	3.50***	0.253
Number of observations		111
Truncated observations		39
Wald χ^2 (13), $\Pr > \chi^2$		356.51***
Log likelihood		-265.31

***, ** and * indicate significance at 1%, 5% and 10% respectively

Source: Survey result, 2017

Households' perception on lagged price of wheat: Households' perception on lagged price of wheat affected level of market participation positively and significantly at 5% significance level. Coefficient of lagged wheat price perception shows that, as compared to households who perceived lagged price of wheat as low, quantity of wheat marketed by households who perceived lagged wheat price as high increases by 1.79 quintals. This is because; households who perceive lagged price as high may respond with large quantity thereby increased level of market participation. This finding is in conformity with priori expectation and the findings of Shewaye *et al.*, (2016) that shows level of participation increases as household's perception on lagged market price increases from bad to good.

Quantity of wheat produced: Quantity of wheat produced was positively and significantly associated with quantity of wheat marketed at 1% significance level. A quintal increase in quantity of wheat produced increases quantity of wheat marketed by 0.74 quintal. Positive association between quantity of wheat produced and quantity of wheat marketed implies that, the more the quantity of wheat produced, the more will be the amount of wheat marketed. This is because households decide the quantity of wheat to sell based on the total production of wheat taking in to account their family needs and consumption pattern. The more the quantity of wheat they produce, the more the marketable surplus they remain with, that could increase their level of market participation. The findings of Benjamin (2013), Adeoti *et al.*, (2014), Gebreslassie *et al.*, (2015), Tadele and Ashalatha (2016), and Abdu *et al.*, (2016) also affirm the importance of size of production in determining level of market participation.

Family size: Family size was also among the factors affecting level of market participation negatively and significantly at 10% significance level. For every increase in family size of a household, quantity of wheat marketed decreases by 0.26 quintal. This relationship is as expected, since larger family size could potentially retain a significant portion of the produce to home consumption needs so that they remain with small amount of wheat and hence, low market share as compared to smaller family size. The result confirms the results of Omiti *et al.*, (2009), Benjamin (2013), Adam and Dawit (2015), Muricho *et al.*, (2015), Gebreslassie *et al.*, (2015) and Yalew (2016) that state households with large family size need to meet their family consumption requirement first and take the surplus to the market that make them end

up with low level of participation depending up on households' consumption pattern and the nature of the crop under consideration.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary

As a means to alleviate poverty, food insecurity problems, and achieve middle income status, Ethiopia has mainstreamed different crops in its Agricultural Transformation Agenda that places great attention to smallholders under different crop initiatives of which wheat is one of priority crop targeted to increase productivity levels and link smallholders to both input and output market.

Taking these issues into consideration, this study was aimed at evaluating market participation status of smallholder farmers in wheat output market and identifying the factors affecting smallholders' market participation decisions and intensity of wheat sales. This study has used cross sectional data collected from 150 randomly selected households using probability proportional to size in Adola Rede district for 2016/17 production and marketing year.

The study has used both descriptive and inferential statistics to characterize households' market participation decisions and degree of market participation. Based on reviewed literatures and nature of the dataset at hand, double hurdle model was employed to identify factors affecting households' market participation decision and level of market participation.

Descriptive results revealed that, out of surveyed sample households, 26% of households were non-participants. The t-test of mean difference and chi-square test of proportional difference showed that existence of statistically significant difference between market participants and non-participants in terms of sex of households, perception on lagged wheat price, membership in cooperatives, distance travelled to reach nearest market, total average annual cash income, mobile ownership, ownership of transport asset, size of land allocated for wheat production, quantity of wheat produced, quantity of wheat consumed, and quantity of wheat marketed. Survey result showed that, lack of improved wheat seed, disease (stem rust), high input cost, and poorly developed road infrastructure being among major problems of wheat production and marketing in the study area.

This study also identified factors affecting smallholders' market participation decision and their level of participation in wheat output market. According to econometric result, factors

that enhance smallholders' probability of market participation are households' perception on lagged wheat price, quantity wheat produced, land size allocated for wheat production, and education level of household head, while distance to the nearest market, distance to extension service center, and size of land allocated for other crops had negative effect on likelihood of market participation. Households' level of participation was also affected positively and significantly by households' lagged price perception, and quantity of wheat produced while it was negatively and significantly affected by family size.

5.2. Conclusion and Recommendation

Now days, enhancing market participation of smallholder agriculture taken as a subject of considerable focus among policy-makers and development specialists as a means for reducing food insecurity and poverty in developing countries through different policy options that include modernization and commercialization of the smallholder agricultural sector and resolution of constraining factors that prevents smallholders from fully participating in a market. Therefore, in order to transform agrarian sector and contribute for economic development of developing country where agriculture constitute significant portion of national income, smallholders must transition from a subsistence mode to a market oriented mode, where most of the inputs and outputs are not provided and consumed internally but are purchased and sold off the farm which could happen when smallholders participate in both markets with intension of earning income from purchasing inputs and selling of outputs. This requires that concerted efforts of concerned bodies which include private sectors, government, NGOs, and other stakeholders.

Generally, in this study households' degree of market participation, and factors affecting market participation decision and level of participation of households in Adola Rede woreda were analyzed. Analysis of household market participation indicates that, the households in the study area are nearly moderately market participators in wheat output market with average sales of 39% of total production in monetary value with a maximum level of 95.8% and minimum of zero. Different factors are attributed to the deviation of this value of wheat sales by households. Majority (42.67%) of households were categorized as low participators,

whereas moderate and high participators constituted 40% and 17.33% of the total households respectively.

Double hurdle model estimation result revealed that, households' decision to participate in a market strongly and significantly affected by quantity of wheat produced, size of land allocated for wheat, and education level of household head. These factors affect probability of market participation positively at 1%. Moreover, factors such as distance to the nearest market, distance to extension service center, and size of land allocated for other crops had negative and significant effect on probability of market participation. Households' extent of market participation was affected negatively by family size, while it was positively affected by households' perception on lagged wheat price, and quantity of wheat produced. Based on the finding, the study recommends the following as a means to enhance wheat output market participation in the study area.

Households' perception on lagged price of wheat was positive and significant factor affecting both households' likelihood of market participation and level of participation. This indicates that perceiving lagged price as high increases market participation. Also, non-satisfactory lagged price might be due to the point and the time at which the crop is sold. Thus, if concerned bodies train farmers about contract farming and storage facilities of produces, they feel confident on price they receive from production of wheat and will take advantage of price fluctuation thereby increase their likelihood of participation and intensity of participation in wheat market as seller.

Quantity of wheat produced was affected both smallholders' market participation decision and their level of participation positively and significantly. Therefore, policies should aim in increasing productivity and production of wheat through making agro-inputs such as fertilizer, improved seeds, and others, and strengthen existing extension service provision. The policy should also aim at stabilizing the price of these agro-inputs to ensure their affordability to farmers.

Smallholders' decision to participate in a wheat output market was affected by size of land allocated to wheat production indicating importance of land allocation decision in enhancing smallholders' market participation. In this regard, policy should aim at ensuring efficient

utilization of land resource. In the study area, wheat has high demand, and high price as compared with competitive crops grown in the area next to *teff*. Therefore, farmers should allocate their land according to market value of the crop to enhance their likelihood of market participation.

Education level had a significant positive effect on probability of market participation of wheat farmers. This shows importance of education as it acquaints households' with basic knowledge and managerial skills and helps them in making optimal decisions. Therefore, in general, designing of policies that encourage provision of adequate and effective formal and informal education to the rural farming households and to the study area in particular enhances households' likelihood of market participation. This can be done by regional and local government through strengthening the existing education provision system including adult education, and facilitation of time for its provision as most of farmers are busy at their farm during day time and peak seasons.

Distance to nearest market and extension service center had negative and significant effect on smallholders' decision to market participation indicating their role in enhancing smallholders' market participation. Therefore, attention should be given to rural infrastructure development in general and, road in particular and sufficient transportation system as well. Since, recently, governments' provision of extension services have increased; policies that encourage development of farmers' training centers at village level along with capacity building of extension workers through training, upgrading their education and provision of incentives so that accessibility of this service more ensured will contribute to smallholders' market participation.

Size of family had negative and significant effect on households' level of participation. This is because; as size of family increases, the consumption will take most of it making size of marketable surplus small. So, in order to enhance households' market participation, rural health extension should be strengthened on promoting family planning programs by providing trainings to spouses so that they will have planned family size and will be able to secure more income from production of marketable surplus.

6. REFERENCES

- Abafita, J., Atkinson, J. and Kim, C.-S. 2016. Smallholder commercialization in Ethiopia: market orientation and participation. *International Food Research Journal*. 23(4): 1797-1807.
- Abdu Mohammed, Melkamu Baze, and Mohammed Ahmed. 2016. Smallholder commercialization and commercial farming in coffee-spice based farming system of South West Ethiopia. *International Journal of Research Studies in Agricultural Sciences (IJRSAS)*, 2(5):13-26.
- Adam Bekele and Dawit Alemu. 2015. Farm-level determinants of output commercialization: In haricot bean based farming systems. *Ethiop. J. Agric. Sci.* 25: 61-69.
- Adeoti, Adetola I., I Oluwatayo saac B., and Soliu Raheem O. 2014. Determinants of market participation among maize producers in Oyo State, Nigeria. *British Journal of Economics, Management & Trade*, 4(7): 1115-1127.
- Afewerk Hagos and Endrias Geta. 2016. Review on smallholder's agriculture commercialization in Ethiopia: What are the driving factors to focus on?: *Journal of Development and Agricultural Economics*, 8(4): 65-76.
- Agwu N.M., Anyanwu C.I. and Mendie E.I. 2013. Socio-economic determinants of commercialization among smallholder farmers in Abia State, Nigeria. A paper presented at the 4th International Conference of the African Association of Agricultural Economists, Hammamet, Tunisia.
- Ajay Singh, S, and Micah Masuku, B. 2014. Sampling techniques & determination of sample size in applied statistics research: An overview. *International Journal of Economics, Commerce and Management*, 2(11): 2348 – 0386.
- Akaike, H., 1974. A new look at the statistical model identification. *IEEE transactions on automatic control*. Tokyo. AC-19:716 – 723.
- Alealign Ademe, Belaineh Legesse, Jema Haji, Degye Goshu. 2017. Smallholder farmers' crop commercialization in the highlands of eastern Ethiopia. *Review of Agricultural and Applied Economics*, 20(2): 30 - 37.

- Alene, A. D., Manyong, V.M., Omany, G., Mignouna, H.D., Bokanga, M. and Odhiambo, G. 2008. Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. *Food Policy*, 33: 318–28.
- Aliyi Kedir, Obsa Chimdesa, Siyoum Alemu and Yeared Tesfaye. 2016. Adaptability study of *teff* varieties at mid land agro-ecologies of Guji Zone, Southern Oromia. *Journal of Natural Sciences Research*, 6(19): 2224-3186.
- Aman Tufa, Adam Bekele, and Lemma Zemedu. 2014. Determinants of smallholder commercialization of horticultural crops in Gemechis district, West Hararghe zone, Ethiopia. *African Journal of Agricultural Research*, 9(3): 310-319.
- Ana, R., William, R., Masters, A. and Shively, G. E. 2008. Linkages between market participation and productivity: results from a multi-country farm household sample. A paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Orlando.
- ARBoFED (Adola Rede Bureau of Finance and Economic Development). 2017. Socio-economic profile of Adola Rede.
- Arias, P, Hallam, D, Krivonos, E and Morrison, J. 2013. Smallholder integration in changing food markets: Food and Agriculture Organization of the United Nations, Rome.
- Asresu Yitayew. 2014. Determinants of the decision to participate in the marketing of goats by rural households in Ethiopia. MSc. Thesis submitted to Bahir Dar University, Bahir Dar.
- ATA (Agricultural Transformation Agency). 2013. Annual report on transforming agriculture in Ethiopia.
- ATA (Agricultural Transformation Agency). 2014. Wheat sector development strategy. Working document, Addis Ababa, Ethiopia.
- ATA (Agricultural Transformation Agency). 2015. Annual report on agricultural transformation agenda.
- Barrett, C. 2008. Smallholder market participation: Concepts and evidence from eastern and southern Africa. *Food Policy*, 34: 299-317.
- Basha Kebede and Dembi Korji. 2017. Demonstration of improved *teff* varieties at selected midland districts of Guji zone, Oromia regional state, Ethiopia. *Asian Journal of Agriculture and Rural Development*, 7(7): 131-135.

- Befikadu Leggese and Yeboah O.A. 2016. Landholders' choice to adopt improved watershed management in the lower Blue Nile Basin, Ethiopia, USA.
- Benjamin A. 2013. Market participation of smallholder farmers in the Upper West region of Ghana. MSc. Thesis submitted to University of Ghana, Legon.
- Berhanu Gebremedhin , Moti Jaleta , and Hoekstra D. 2009. Smallholders, institutional services, and commercial transformation in Ethiopia. *Agric. Econ.* 40(1):773-787.
- Berhanu Gebremedhin and Moti Jaleta. 2010. Commercialization of smallholders: Is market participation enough? Contributed Paper presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa.
- Chanyalew Seyoum, Tesfaye Lemma, and Ranjan S. K. 2011. Factors determining the degree of commercialization of smallholder agriculture: The case of potato growers in Kombolcha district, East Hararghe, Ethiopia. *JAD*, 2 (1).
- Cochran, W. G. 1977. Sampling Techniques, 2nd Ed., New York: John Wiley and Sons, Inc.
- Cragg, J. 1971. Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica*, (39): 829-844.
- CSA (Central Statistical Agency). 2011. Agricultural sample survey: Report on crop and livestock product utilization.
- CSA (Central Statistical Agency). 2014. Agricultural sample survey: Report on area and production of major crops.
- CSA (Central Statistical Agency). 2015. Agricultural sample survey: Report on area and production of major Crops.
- CSA (Central Statistical Agency). 2016. Agricultural sample survey: Report on crop and livestock product utilization.
- CSA (Central Statistical Agency). 2017. Agricultural sample survey: Report on area and production of major Crops.
- Central Statistical Agency and World Bank. 2013. Ethiopia rural socioeconomic survey (ERSS), survey report.
- Degye Goshu, Belay Kassa and Mengistu Ketema. 2012. Measuring smallholder commercialization decision and interactions in Ethiopia. *Journal of Economics and Sustainable Development*. 3(13): 2222-1700.

- Efa Gobena, Degye Goshu, Tinsae Demisie, and Tadesse Kenead. 2016. Determinants of market participation and intensity of marketed surplus of *teff* producers in Bacho and Dawo districts of Oromia State, Ethiopia. *Journal of Economics and Sustainable Development*, 7(1): 2222-1700.
- Ele, I. E., Omini, G. E., Adinya, B. I. 2013: Assessing the extent of commercialization of smallholding farming households in cross river state, Nigeria, *IOSR Journal of Agriculture and Veterinary Science* (IOSR-JAVS), pp. 49-55.
- Enete, A. and Igbokwe, E. 2009. Cassava market participation decisions of producing households in Africa. *Tropicultura*, 27(3): 129-136.
- EPAR (Evans School Policy Analysis and Research). 2010. Yield gap and productivity potential in Ethiopian agriculture: Staple grains & pulses prepared for the farmer productivity team of the bill & Melinda gates foundation, EPAR Brief No. 98.
- Firdisa Birru. 2016. Determinants of smallholder farmers' participation decision in *teff* production: Evidence from Horo and Jimma Geneti Woreda, Ethiopia. *Developing Country Studies*, 6(10): 2224-607.
- FAO (Food and Agricultural Organization). 1989. 'Horticultural marketing: a resource and training manual for extension officers', Rome.
- FAO (Food and Agriculture Organization). 2015. Food Balance Sheets. FAOSTAT. Rome. Available at: <http://faostat3.fao.org/download/FB/FBS/E> (Accessed on: March 22, 2017).
- Gani, B.S. & Adeoti, A. I. 2011. Analysis of market participation and rural poverty among farmers in Northern Part of Taraba State, Nigeria. *Journal of Economics*, 2(1): 23-36.
- Gebre-Ab, Newai., 2006. Commercialization of Small Holder Agriculture in Ethiopia, Note and Papers Series, pp: 3.
- Gebreslassie Hailua, Kebede Manjureb and Kiros-Meles Aymutc. 2015. Crop commercialization and smallholder farmers' livelihood in Tigray region, Ethiopia. *Journal of Development and Agricultural Economics*, 7(9): 314-322.
- Geoffrey S. Muricho, Damiano K. Manda and Fredrick O. Sule. 2015. 'Determinants of agricultural commercialization and its impacts on welfare among smallholder farmers in Kenya'. Published PhD dissertation, Nairobi, Kenya.

- Geremew Kefyalew. 2012. Analysis of smallholder farmer's participation in production and marketing of export potential crops: The case of sesame in Diga district, east Wollega zone of Oromia Regional State. An MSc Thesis presented to the Addis Ababa University, Addis Ababa, Ethiopia.
- Getaw Tadesse and Bahiigwa G. 2015. Mobile phones and farmers' marketing decisions in Ethiopia. A paper presented at International Conference of Agricultural Economists, Milan, Italy.
- Getaw Tadesse & Shively, G. 2013. Repeated transaction in rural grain markets of Ethiopia. *Journal of Development Studies*, 49(9): 1172-1187.
- Govere J, Jayne TS, Nyoro J. 1999. Smallholder commercialization, interlinked markets and food crop productivity: Cross country evidence in eastern and southern Africa.
- Greene, W. H. 2000. *Econometric Analysis* 4th ed. Englewood Cliffs, NJ, USA: Prentice Hall.
- Gujarati, D. 2004. *Basic Econometrics*, 4th ed. The McGraw Hill Companies.
- Gutu Tesso. 2017. Climate Change Challenges, Smallholder Commercialization and Progress out Poverty in Ethiopia. Working Paper No. 253, African Development Bank, Abidjan, Côte d'Ivoire.
- Hansen B. E. 2017. *Econometrics lecture notes*, University Of Wisconsin.
- Healy, F. J. 1984. *Statistics: A tool for social research*. Wads Worth Publishing Company, California.
- Heckman, J.J. 1979. Sample selection bias as a specification error. *Econometrica*. 47:153-161.
- Hlomendlini. P.H. 2015. Key factors influencing smallholder market participation in the former homelands of South Africa: Case study of the Eastern Cape. MSc. Thesis submitted to Stellenbosch University, South Africa.
- Humphreys, R.B. 2010. Dealing with zeros in economic data. University of Alberta, department of economics, Edmonton, Canada. Pp.10.: <http://www.ualberta.ca/~bhumphre/class/zeros v1.pdf> (Accessed on March 27, 2017).
- IFAD (International Fund for Agricultural Development). 2013. Smallholders, food security, and the environment.
- IFPRI (International Food Policy Research Institute). 2015. Wheat in Ethiopia: Production, marketing, and consumption. A paper prepared for the Ethiopian Agricultural Transformation Agency (ATA).

- Jagwe, N. 2011. The impact of transaction costs on the participation of smallholder farmers and intermediaries in the banana markets of Burundi, Democratic Republic of Congo and Rwanda. A thesis submitted to department of agricultural economics, extension and rural development faculty of natural and agricultural sciences, University of Pretoria.
- John, E. 2014. An application of the double hurdle model to petrol and diesel household expenditures in Ireland. Surrey Energy Economics. Discussion paper Series, School of Economics, University of Surrey, Guildford GU27XH, UK.
- Key, N., Sadoulet, E. and de Janvry, A. 2000. Transactions costs and agricultural household supply response. *American Journal of Agricultural Economics*, 82(2): 245– 59.
- Kirimi L., Gitau R., and Olunga M. 2013. Household food security and commercialization among smallholder farmers in Kenya. A paper prepared for the 4th International Conference of the African Association of Agricultural Economists, Nairobi, Kenya.
- Leeper T. J. 2017. Interpreting regression results using average marginal effects with R's margins. Available at the comprehensive R Archive Network (CRAN).
- Makhura, M.N., Kirsten, J. and Delgado, C. 2001. Transaction costs and smallholder participation in the maize market in the Northern Province of South Africa. In Seventh Eastern and Southern Africa Regional Maize Conference, Pretoria, South Africa.
- Martey, E., Al-hassan, R. M. and Kuwornu, J. K. M. 2012. Commercialization of smallholder agriculture in Ghana. A Tobit regression analysis. *African Journal of Agricultural Research*, 7(14): 2131–2141.
- Mason N. M, Jayne T.S., and Bekele Shiferaw. 2012. Wheat consumption in Sub-Saharan Africa: Trends, drivers, and policy implications. MSU International Development Working Paper 127, Michigan.
- Mazerolle M.J. n.d. Making sense out of Akaike's Information Criterion (AIC): its use and interpretation in model selection and inference from ecological data, Canada.
- Mebrahatom Medhane. 2014. Determinants of commercialization of *teff* and its factor productivity outcome. The Case of Tahtay Qoraro woreda, Northwest zone of Tigray Regional State, Ethiopia.
- Mignouna D.B, Abdoulaye T, Alene A, Akinola A.A. and Manyong V.M. 2015. Drivers of market participation decisions among small-scale farmers in yam growing areas of

- Nigeria and Ghana. A paper contributed to International Conference of Agricultural Economists, Milan, Italy.
- Mignouna B.M., Abdoulaye T., Akinola A.A., Kamara A.Y., and Olouch M. 2016. Understanding market participation choices and decisions of maize and cow pea farmers in Northern Nigeria. *Tropicultura*, 34(1): 26-29.
- Mmbando F. E. 2014. Market participation, channel choice and impacts on household welfare: The case of smallholder farmers in Tanzania. PhD dissertation submitted to University of KwaZulu-Natal, Pietermaritzburg.
- Mmbando F.E., Edilegnaw Wale and Baiyegunhi Lloyd J.S. 2015. Determinants of smallholder farmers' participation in maize and pigeon pea markets in Tanzania. *Agrekon*, 54 (1): 96–119.
- MoA (Ministry of Agriculture). 2015. Agricultural Growth Program II (AGP-II) Program design document, Addis ababa.
- Moono L. 2015. An analysis of factors influencing market participation among smallholder rice farmers in Western Province, Zambia. An MSc. thesis submitted to University of Nairobi, Nairobi.
- Moti Jaleta, Berhanu Gebremedhin, and Hoekstra D. 2009. Smallholder commercialization: Processes, determinants and impact: Improving productivity and market success (IPMS) of Ethiopian farmers project, ILRI (International Livestock Research Institute), Nairobi, Kenya. Discussion Paper No. 18, pp 55.
- Muricho G., Menale Kassie, and Obare G. 2015. Determinants of market participation regimes among smallholder maize producers in Kenya. A paper presented at International Conference of Agricultural Economists, Milan, Italy.
- Ntakyo P. R. and Berg M. V. n.d. Effect of market production on rural household food consumption: Evidence from Uganda. A publication by Development Economics group (DEG), Wageningen University, Netherlands.
- Olowogbon, S.T. and Fakayode S.B. 2013. Commercializing Agriculture in Africa: The environmental, health and safety implications and the way forward. *Proceedings of the 4th International Conference of the African Association of Agricultural Economists*, Hammamet, Tunisia.

- Omiti J, Otieno D., McCulloch E., Nyanamba T. 2007. Strategies to promote market oriented smallholder agriculture in developing countries: *AAAE Conference proceedings* 259-264, Kenya.
- Omiti J, Otieno D., McCulloch E., Nyanamba T. 2009. Factors influencing the intensity of market participation by smallholder farmers: A case study of rural and peri-urban areas of Kenya. *Afjare*, 3(1).
- Osmani G, and Hossain E. 2015. Market participation decision of smallholder farmers and its determinants in Bangladesh. *Economics of Agriculture*. UDC: 631.1.017.3:339.3 (549.3).
- Pender J, Ehui S, and Place F. 2006. Conceptual framework and hypothesis. In *Strategies for sustainable land management in the East African Highlands*. IFPRI, Washington, D.C, USA.
- Pingali, LP. 2001. Environmental consequences of agricultural commercialization in Asia. *Environment and Development Economics*, 6: 483–502.
- Reddy C, Balasubramanyam P., and Subbarayudu M. 2013. An effective approach to resolve multicollinearity in agriculture data. *International Journal of Research in Electronics and Computer Engineering*, 1(1): 2348-2281.
- Reyes, B., Donovan, C., Bernsten R. and Maredia, M. 2012. Market participation and sale of potatoes by smallholder farmers in the central highlands of Angola: A double hurdle approach. Michigan State University, USA.
- Salami, A., Kamara, A. B. and Brixiova, Z. 2010. Smallholder agriculture in East Africa: Trends, constraints and opportunities. Working Papers Series No. 105, African Development Bank, Tunis, Tunisia.
- Samuel Diro, Solomon Assefa, and Beza Erko. 2016. Trends and determinants of coffee commercialization among smallholder farmers in Southwest Ethiopia: Jimma Zone Coffee Potential Districts. *World Journal of Agricultural Sciences*, 12 (2): 138-148.
- Samuel Gebreselassie and Sharp K. 2007. Commercialization of smallholder agriculture in major *Teff*-growing areas of Ethiopia. *Proceedings of the 5th International Conference on the Ethiopian economy*, EEA, June 2007, Addis Ababa.
- Söderbom Måns. 2011. Sample Selection Bias. *Econometrics II Lecture notes*.

- Shewaye Abera, Dawit Alemu and Lemma Zemedu. 2016. Determinants of haricot bean market participation in Misrak Badawacho district, Hadiya zone, Southern Nations Nationalities and Peoples Regional State, Ethiopia. *Ethiop. J. Agric. Sci.* 26(2): 69-81.
- Solomon Asfaw, Bekele Shiferaw, Franklin S, and Mekbib Gebretsadik. 2010. Does technology adoption promote commercialization? Evidence from chickpea technologies in Ethiopia.
- Spring. 2013. Financial Econometrics: Limited dependent variables and sample selection.
- Storck, H., Bezahih Emanu, Berhanu Adnew, A. Borowiecki and Shimelis Wolde, 1991. Farming systems and farm management practices of smallholders in the Hararge highlands. Farming systems and resource Economics in the tropics. Wissenschafts, Germany.
- Tadele Melaku And Ashalatha, D. 2016. Determinants of teff and wheat market supply in Dendi district, West Shoa zone, Ethiopia. *International Journal of Current Research*, 8(10): 40716 - 40721.
- Teferi Wondale. 2003. Trends in and determinants of fertilizer use in Gozamin woreda, Amhara region. M.Sc Thesis Submitted to School of Graduate Studies of Haramaya University, Haramaya.
- Tekalign Diyana. 2014. Determinants and welfare outcomes of commercialization of smallholders' farming: The case of Anchar woreda, West Hararghe, Ethiopia. MSc thesis submitted to School of Graduate Studies of Haramaya University, Haramaya.
- Tigist Mekonnen. 2017. Agricultural intensification and market participation small-scale agriculture, Maastricht University and UNU-MERIT.
- Tollens, E. F. 2006. Market information systems in sub-Saharan Africa challenges and opportunities. Poster paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia.
- UNCTAD (United Nations Conference on Trade and Development). 2015. Smallholder farmers and sustainable commodity development. Commodities and development report, New York and Geneva.
- UNDP (United Nations Development Programme). 2015. Ethiopia: Key economic and social indicators. UNDP Ethiopia's Policy Advisory Unit, No. 2.

- USDA (United States Development Agency). 2012. Assessments of commodity and trade issues. Grain and feed annual report, Ethiopia.
- USDA (United States Development Agency). 2015. Assessments of commodity and trade issues. Grain and feed annual report, Ethiopia.
- USDA (United States Development Agency). 2017. Assessments of commodity and trade issues. Grain and feed annual report, Ethiopia.
- Von Braun, J. 1995. Agricultural commercialization: Impacts on income and nutrition and implications for policy. *Food Policy*, 20(3): 187-202.
- Vuong, Q. H. 1989. Likelihood ratio tests for model selection and non-nested hypotheses. *Econometrica*, 57(2), 307–333.
- Wooldridge, J.W. 2002. *Econometric Analysis of cross section and panel data*, Cambridge, Massachusetts: MIT Press.
- Wondifraw Zerihun, James Wakiaga, and Haile Kibret. 2016. African Economic Outlook, Ethiopia.
- WFP (World Food Program). 2015. Ethiopia monthly market watch, Ethiopia.
- Yallew Mazengia. 2016. Smallholders commercialization of maize production in Guangua district, Northwestern Ethiopia. *World Scientific News*, 58: 65-83.
- Yassin Esmael. 2016. Determinants of the participation decision of Small holder farmers in potato sales in Kofele District, Oromia National Regional State, Ethiopia. MSc. Thesis submitted to Haramaya University, Haramaya.
- Yaynabeba Abayneh and Tewodros Tefera. 2013. Factors influencing market participation decision and extent of participation of haricot bean farmers in Meskan district, Ethiopia. *International journal of management and development studies*, 2(8): 2320-0685.
- Yibeltal Belachew. 2014. The effect of cash crop production on the commercialization of traditional food crops. The case of Womberema woreda, West Gojjam zone, Amhara National Regional State. MSc. Thesis submitted to Haramaya University, Haramaya.

7. APPENDICES

Appendix I: Tables

Appendix Table 1: Conversion factors of number of family members into adult equivalent

Age Group	Male	Female
Less than 10	0.6	0.6
10 – 13	0.9	0.8
14 – 16	1	0.75
17 – 50	1	0.75
Above 50	1	0.75

Source: Samuel and Sharp (2007) cited in Tekalign (2014)

Appendix Table 2: Conversion factor used for computing tropical livestock units

Type of livestock	TLU
Ox and Cow	1
Heifer	0.75
Young Bull (Woyefen)	0.34
Calf	0.25
Sheep and Goat (Young)	0.06
Sheep and Goat (Adult)	0.13
Hen	0.013
Donkey (Young)	0.35
Donkey (Adult)	0.70
Horse and Mule	1.1

Source: Storck, *et al.* (1991) cited in Yalew (2016)

Appendix Table 3: Collinearity statistics for continuous variables used in the model

Variables	R ²	VIF	1/VIF
Quantity produced	0.6880	3.20	0.312
Land allocated for wheat	0.6632	2.97	0.336
Livestock holding	0.3333	1.50	0.667
Land allocated to other crops	0.2204	1.28	0.779
Family size	0.1915	1.24	0.808
Distance to the nearest market	0.1634	1.20	0.836
Distance to extension service center	0.1468	1.17	0.853
Education	0.1308	1.15	0.868
Log of non-farm income	0.0280	1.03	0.972
Experience in wheat production	0.0221	1.02	0.978
Mean		1.58	

Source: Computed from model result, 2017

Appendix Table 4: Collinearity statistics for dummy variables used in the model

	PRICEP	MCOOPS	ACCRDT	TranEq	Mobile
PRICEP	1.00				
MCOOPS	0.19	1.00			
ACCRDT	0.15	0.20	1.00		
TranEq	0.18	0.11	0.11	1.00	
Mobile	0.16	0.24	0.25	0.12	1.00

Source: Computed from survey result, 2017

Appendix Table 5: Model specification tests

Test type	Candidate model	Hypothesis	Test statistic
Likelihood Ratio Test	Tobit Vs Double Hurdle Model	H ₀ : Tobit best fits data H ₁ : Double Hurdle best fits data	(30.56)** Pr > χ^2 (15, 30.56) = 0.01005
Vuong's Test	Double Hurdle Vs Heckman model	Ho: No difference between Heckman model and DHM	Vuong statistic = 6.48 Z _{0.005} = 2.575
Model	AIC		
Tobit	649.00		
DHM	618.44		

Source: Based on model output, 2017

Appendix Table 6: Tobit estimation results for level of market participation

Variables	Coefficient	Robust Std. Err.
Lagged price perception	1.75***	0.619
Quantity of wheat produced	0.66***	0.066
Experience in wheat production	0.05	0.071
Cooperative membership	-0.81	0.653
Access to credit	0.68	0.681
Distance to the nearest market	0.15	0.104
Ownership of transport asset	0.18	0.689
Distance to extension service center	-0.01	0.013
Ownership of mobile phone	-0.29	0.748
Log of non-farm income	0.08	0.086
Livestock holding	0.13	0.102
Land allocated for wheat	3.34**	1.594
Family size	-0.21*	0.119
Education	0.00	0.092
Land allocated to other crops	-0.56	0.397
Constant	-5.41***	1.823
Number of observations	150	
Left censored obs.	39	
Uncensored obs.	111	
Pseudo R ²	0.2723	
LR χ^2 (15), Pr > χ^2	228.64***	
Log likelihood	-309.50	

***, ** and * indicate significance at 1%, 5% and 10% respectively

Source: Model output, 2017

Appendix Table 7: HMLE result for factors affecting probability and level of participation

Variables	1 st stage (Probit)		2 nd stage (OLS)	
	Coefficient	Std. Err.	Coefficient	Std. Err.
Lagged price perception	1.26**	0.549	1.27**	0.616
Quantity of wheat produced	0.22***	0.069	0.65***	0.065
Experience in wheat production	0.02	0.037	0.05	0.071
Cooperative membership	-0.09	0.492	-1.04	0.653
Access to credit	-0.04	0.563	0.59	0.689
Distance to the nearest market	-0.06	0.086	0.13	0.105
Ownership of transport asset	0.27	0.554		
Distance to extension service center	-0.01	0.009	0.001	0.014
Ownership of mobile phone	-0.32	0.657		
Log of non-farm income	0.01	0.035	0.12	0.085
Livestock holding	0.03	0.056	0.15	0.104
Land allocated for wheat	3.79	2.372	2.76*	1.603
Family size	-0.04	0.090	-0.18	0.116
Education	0.07	0.085	-0.03	0.096
Land allocated to other crops	-0.45	0.279	-0.55	0.399
Constant	-1.93	1.111	-4.66	1.887
Rho	1.00	5.37e ⁻¹²		
Sigma	3.10	0.264		
Number of observations		150		
Censored observations		39		
Uncensored observations		111		
Wald χ^2 (13), $\Pr > \chi^2$		342.89***		
LR test of independent eqns. χ^2 (1), $\Pr > \chi^2$		30.07***		

***, ** and * indicate significance at 1%, 5% and 10% respectively

Source: Model output, 2017

Appendix Table 8: H2SE result for factors affecting probability and level of participation

Variables	1 st stage (Probit)		2 nd stage (OLS)	
	Coefficient	Std. Err.	Coefficient	Std. Err.
Lagged price perception	1.14**	0.541	1.24*	0.667
Quantity of wheat produced	0.23***	0.086	0.64***	0.068
Experience in wheat production	-0.01	0.050	0.05	0.074
Cooperative membership	-0.16	0.569	-0.99	0.664
Access to credit	-0.02	0.616	0.69	0.701
Distance to the nearest market	-0.11	0.082	0.11	0.107
Ownership of transport asset	0.01	0.679		
Distance to extension service center	-0.01	0.011	0.00	0.014
Ownership of mobile phone	-0.52	0.615		
Log of non-farm income	0.04	0.075	0.12	0.088
Livestock holding	0.05	0.071	0.14	0.108
Land allocated for wheat	7.68***	2.380	2.36	1.621
Family size	0.01	0.098	-0.18	0.120
Education	0.18**	0.091	-0.06	0.100
Land allocated to other crops	-0.56	0.378	-0.57**	0.413
Constant	-2.62	1.448	-3.99	2.050
IMR			(1.78) ^{NS}	1.151
			P = 0.122	
Number of observations		150		
Censored observations		39		
Uncensored observations		111		
Wald χ^2 (13), Pr > χ^2		233.71***		

***, ** and * indicate significance at 1%, 5% and 10% respectively. NS shows non-significance.

Source: Model output, 2017

Appendix II: Household survey questionnaire

Analysis of Market Participation and Level of Participation of Smallholder Wheat Farmers: The Case of Adola Rede District of Guji Zone, Oromia Regional State, Ethiopia

MSc. Thesis

HOUSEHOLD SURVEY QUESTIONNAIRE

Prepared by Tariku Ayele (MSc. Student, Haramaya University)

Purpose: The purpose of this questionnaire is to collect data pertaining to Analysis of Market Participation and Level of Participation of Smallholder Wheat Farmers in Adola Rede of Guji Zone, Oromia Regional State. It provides a major input for my master's thesis and it is designed for academic purposes only. Therefore, dear respondents you are kindly requested to provide valid responses to the sets of questions included in the questionnaires. All your responses remain confidential. Thank you in advance for your cooperation.

Instructions for Enumerators

- Introduce yourself to respondent before making any interview
- Clearly explain the purpose of the study to respondents as stated above
- Consider only 2016/17 cropping season
- Fill the questionnaire as per requirement in space provided

A. General information

Kebele_____

Interviewer's name_____

Date of interview _____

Questionnaire code_____

B. Household Head Demographic Characteristics

1. Sex: 1 = Male 0 = Female

2. Age (in years)_____

3. Educational level of hh head (in years of schooling) _____

4. Number of total family members _____

5. What did the age structure of your family look like?

S.N	Participation in farm activity	Number of persons
1	HH head	
2	Spouse	
3	Adult women (Age ≥ 17)	
4	Adult men (Age ≥ 17)	
5	Young girls (10-13)	
6	Young girls (14-16)	
7	Young boys (10-13)	
8	Young boys (14-16)	

6. Total amount of hired labor for the production year (2016/17)_____

7. Cost of a unit of labor_____

C. Source of Household Income

8. From where did you get income you used to cover all family expenditures?

1 = Crop sales 2 = Livestock sales 3 = Remittances 4 = Credit 5 = Labour sale

6 = Others (please specify_____)

9. Would you list the major crops you grown last production season?

Type of crop	Area cultivated (ha)	Quantity produced (Qt)	Quantity sold (qt)	Price per quintal

10. Livestock ownership and cash income from the sale of livestock and livestock products

Type of livestock	Amount owned (number)	Amount (in number) sold	Unit price	Total value
Cows				
Oxen				
Donkeys (Young)				
Donkeys (Adult)				
Mules and Horses				
Sheep (Young)				
Sheep (Adult)				
Goats (Young)				
Goats (Adult)				
Chicken				
Heifers				
Young bull				
Others				
Milk				
Butter				
Ayib				
Hides				
Eggs				

11. Did you participate in non-farm income generating activities in 2016/17 cropping season?

1= Yes 2 = No

12. If your answer to question # 11 is “Yes”, mention off-farm /non farm income during the year 2016/17 cropping season?

Source of non-farm income	Number of family members involved			Number of days worked	Income/working days	Total annual income
	Male	Female	Total			
Petty trade (crop, livestock, etc)						
Daily laborer						
Stone mining						
Hand crafting						
Black smith						
Fire wood and/or charcoal selling						
Guard						
Others (Specify)						

D. Access to Information, Extension, Finance, markets and social capital

13. What were your major sources of market information about input and output price, demand and supply situations as well as other production and management related information?

1 = Self (from market) 2 = Mobile 3 = Radio 4 = DA 5 = Cooperative 6 = From others (neighbor, trader or buyer) 8 = Other_____ (Multiple answers are possible)

14. Do you own mobile? 1 = Yes 0 = No

15. Do you own radio? 1 = Yes 0 = No

16. Do you own TV? 1 = Yes 0 = No

17. Have you ever been visited by extension agent in 2016/17? 1 = Yes 0 = No

18. If your answer for question #18 is yes; how many times did you contact them during the year?_____

19. Traveling time from home settlement to extension services _____ (in minutes)

20. Traveling time from home to farm places _____ (in minutes)

21. Distance from home to nearby markets _____ (in km)

22. Traveling time from home to nearby rural weather road _____ (in minutes)

23. What is the nearest output market where you mainly sale your products? _____

24. What is the approximate distance between your farm and the nearest market for agricultural produce and inputs?

Market place for	Location of the nearest market in km or hour	Location of the alternate market in km or hour
Wheat sale		
Seed sale and purchase		
Fertilizer purchase		
Cattle, sheep, and goat sale and purchase		
Milk sale		

25. Were you a credit/loan recipient in 2016/17? 1 = Yes 2 = No

26. If your answer to question # 25 is “yes”, please specify the type and amount of credit obtained in 2016/2017 (Use appropriate units).

Purpose of credit	Form of credit (1= Cash 2 = Kind)	Private Organization	BoA	Farmers Association	Local money lenders	Total
1.Crop production						
2.Livestock production						
Others (Specify)						

27. 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_____

28. Are you a member of any cooperatives? 1= Yes 2=No

29. If your answer to question #28 is yes, what benefits did you gain?

1 = Fast input delivery 2 = Affordable input price 3 = Fair farm gate 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)
(Multiple answers are possible)

E. Details on Production, Input and technology use and Marketing activities of wheat

30. Did you participate in production of wheat in 2016/17 crop season? 1 = Yes 2 = No

31. For how many years you are in production of wheat? _____

32. Total land holding size (in hectare) _____

33. Land size allocated for wheat in 2016/2017 cropping season _____ (in hectare)

34. Did you involve in land renting activity in 2016/2017 production year? 1=Yes 2= No

35. If your answer to question #34 is “Yes”, are you: 1 = Rented out 2 = Rented in

36. Which means of land preparation methods you used for wheat production:-

1 = Own oxen 2 = Rented oxen 3 = Traditional instruments 4 = Rented tractors

37. Did you use irrigation for wheat production during 2016/17 cropping season

1 = Yes 0 = No

38. If yes, how much is the proportion of the irrigated land under wheat production? _____

39. Type of wheat seed used: 1 = Local 2 = Improved

40. Total seed use composition during last season of wheat production;

Wheat seed list	Seed type 1 = Local 2 = Improved	Amount of seed used (kg)		
		Own	Purchased	
			Amount	Price

41. From where did you get the seed?

1 = Own production 2 = Market 3 = Cooperatives 4 = Agricultural offices 5 = Buyer contractor 6 = Other (Specify _____)

42. Amount of wheat seed used as input per hectare _____ (quantity)

43. Did you use fertilizer for wheat production in 2016/17? 1= Yes 2 = No

44. If yes, answer questions in table below.

Item	Purchase price per kg	Amount (in kg) applied last season in 2016/17		
		Total	On cash	On credit
DAP				
UREA				

45. If your answer to question #44 is "No", what is the reason?

1 = No need 2 = Not available 3 = No potential to purchase 4 = Others
(Specify_____)

46. Did you use pesticides for wheat production? 1 = Yes 2 = No

47. If yes, specify the type and amount used in liter.

Type of pesticide used	Amount used (L)

48. Quantity of wheat produced in 2016/17 _____ (in quintal)

49. Quantity of wheat marketed _____ (in quintal)

50. Quantity of wheat consumed _____ (in quintal)

51. Quantity of wheat saved for seed _____ (in quintal)

52. Did you sell wheat at one time? 1 = Yes 2 = No

53. If your answer to question #52 is yes, what was the price of wheat per quintal? _____

54. If your answer to question #52 is No, state the time of sale and price of wheat per quintal.

Time of sale	Wheat price per quintal

55. How can you rank price of wheat in 2015/16? 1 = Low 2 = High

56. How did you sale your wheat produce?

1 = Directly to the purchaser/traders 2 = Through brokers 3 = Others

57. Where did you sell mostly your wheat produce?

1 = Local buyers (collectors) 2 = Cooperatives 3 = Traders at primary market 4 =
Others (Specify)

58. What is the price of wheat per kilogram in your local in 2016/17? _____

59. What is the price of wheat per kilogram at nearby market? _____

60. Do you have a transport access to the nearest market? 1 = Yes 2 = No

61. How did you transport your wheat produce from home to market places?

1 = Head/back loading 2 = Pack animals 3 = Vehicles 4 = Other (_____)

62. Did you own transportation asset? 1 = Yes 0 = No

63. If yes, mention type of transportation asset owned in table below.

Type of transportation asset	Number owned	Did you use to transport commodity (1 = Yes 0 = No)
Cart		
Motor cycle		
Bicycle		
Car		
Other (Specify)		

64. What are the major costs you incur in selling your wheat?

a. Transportation cost_____ (birr per quintal)

b. Packaging Cost_____ (birr per quintal)

c. Threshing and cleaning cost_____ (birr per quintal)

d. Others _____ (birr per quintal)

65. Have you ever had any marketing contracts with commercial buyers of wheat?

1 = Yes 2 = No

66. What are the major challenges you faced in production and marketing of wheat?

1. Lack of improved seed 2. Poor road infrastructure 3. Low price 4. Outbreak of diseases (Specify) 5. Weather change 6. High inputs cost 7. Inadequate means of transport 8. Of others (specify)

67. If you have any comment please list here below.