

# Supply and Performance of Wheat Markets in Digelu-Tijo District of Oromia Region, Ethiopia

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**Abstract:** Analyzing the supply and performance of wheat markets for smallholder farmers need to improve their marketed surplus and initiate them for commercialization. The objective of this paper is to analyze the marketed surplus of wheat by smallholders farmers and to identify its underlying determinants. Two- stage sampling technique was used and a total of 123 smallholder farmers from five kebeles were randomly and proportionately sampled to collect both secondary and primary sources. The model results showed that six explanatory variables significantly affected the volume of wheat marketed by smallholder wheat producers. Family size, access to credit, off- farm income and livestock holding were negatively and significantly affecting supply. Oxen ownership and perception of farmers towards wheat market price were positively and significantly influence market supply. Based on the study policy interventions like family planning, awareness to farmers to supply wheat to the market when price is fair for them, awareness to farmers on rearing livestock besides farming agricultural crops, encouraging farmers to involve them self in both off-farming and farming activities to improve their livelihood.

**Keywords:** Digelu-Tijo, Market Performance, Market Supply, Smallholders, Tobit, Wheat

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## 1. Introduction

Background and justification: Ethiopia has adopted commercialization of smallholder agriculture as a strategy for its economic transformation. The agricultural services of extension, credit, and input supply are expanding significantly to support commercial transformation, although the dominant player in these services remains to be the public sector. The expansion of the agricultural services had significant impact on the intensity of input use, agricultural productivity, and market participation of Ethiopian smallholders. [1]

The production of wheat in the country is insufficient to meet the increasing demand for food for the ever-increasing population that is Ethiopia's wheat production self-sufficiency is only 75 percent and the remaining 25 percent wheat is imported commercially and through food aid. [2]

The study area, Digelu-Tijo district is the major cereals producing area in which wheat is the dominant one among all cereals by majority of households. This district is endowed with available resources that offer high potential for development and have the capacity to grow different annual crops. Even though the districts are more favorable for legume crops production in particular, due to several socioeconomic problems, the supply and performance of the market faced challenges.

## 2. Methodology

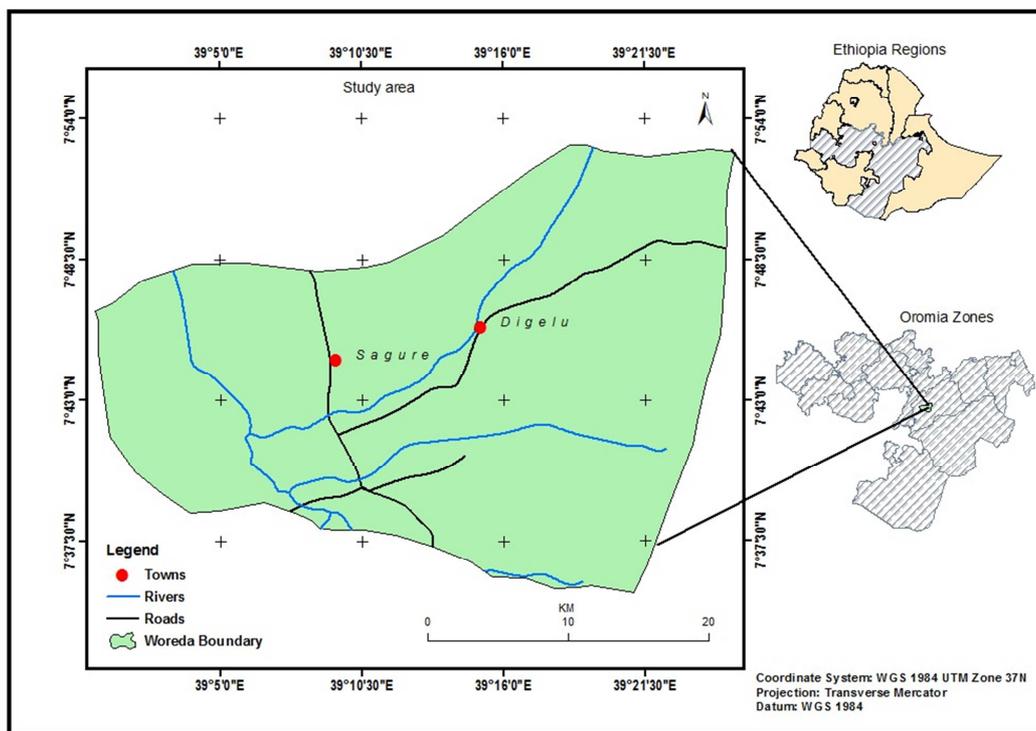
Digelu-Tijo district in which the study was conducted is located 198 km southeastern of Addis Ababa and 23 km southeastern of the capital city of Arsi zone Assella. The main asphalt road running from Addis Ababa to Bale Robe also crosses the district. The district is geographically located 07°45' N latitude and 39°09' E longitude. It found west of

Munesa, north of Tiyo, south of Lemu-Bilbilo, east of Tana, northeast of Hetose and southeast of Shirka district of Arsi zone. The major district town in Digelu -Tijo is Sagure. There are 23 peasants and 5 urban associations in the district. [3]

The district total population and households are estimated to be 140413 and 18712 respectively. Out of these, 69471 are men and 70942 are women. [4] The district consist two major climatic zones based on altitudes, rainfall and temperature. These are 78% highlands and 22% midlands. The attitude ranges from 2000-3600 meters above sea level. Its minimum annual temperature ranges between 15° c and 22° c. The mean annual rainfall of the district ranges from about 1000 mms to 1500 mms. The district has a uni-modal rainfall. The main rainy season is from June to September. However, a considerable higher of the rain falls in July and August. [5] It

was considers a surplus production area mainly depending on rain-fed agriculture.

Digelu-Tijo district is known for its high potential for cereals crops, pulses and livestock's. The major grains grown in the area are wheat, barely, maize, beans, peas, linseed for own-consumption as well as for the market. Moreover, the area is one of the foremost surplus producing parts of Ethiopia especially on wheat, by supplying to the regional and the national markets. This is the key factor underpinning for the selection of the District for this research to see. Farmers in the district are growing different types of local wheat variety. The commonly produced types of local wheat varieties in the district are *danda'a*, *digelu'*, *madda walabu*, *sofumer* and *kubsa*. [6]



Source: Adopted and manipulated from Ethiopian map

Figure 1. Location map of the study area.

2.1. Sampling Techniques and Sample Size Determination

A Digelu-Tijo district as study area was selected purposively for the district is a predominant grower of cereal crops in Oromia region of Ethiopia where the environment is particularly suitable to produce wheat crops.

Two- stage sampling technique was used to select sample respondents for the interview. In the first stage, five kebeles in the district were selected randomly. In the second stage, proportional sampling method was employed to draw representative samples from the sample kebeles (Table 1). A simplified formula suggested by [7] was used to determine sample size at 0.09% level of precision.

$$n = \frac{N}{1 + N(e)^2} \cdot \frac{18712}{1 + 18712(0.09)^2} = 123$$

Where, n= is the sample size for the research use, N= is the household size in the district.

e = is the level of precision (=0.09)

Table 1. Distribution of sample households across kebeles.

Sample kebeles	Number of wheat producers	Number of sampled households Proportional (%)
Fite katar	744	27
Lole katar	709	25
Qacema Murqica	695	25
Sagure Mole	659	23
Mankula Nagele	652	23
Total	3459	123

Source: District rural and agriculture office.

## 2.2. Data Types, Sources and Method of Collection

In order to collect primary data structural questionnaire was prepared. The situation of the marketing system from the producer up to the end consumer assessed through rapid market appraisal. Questionnaire was used as a primary instrument to collect primary data from the selected samples households from five kebeles. An open and close-ended type of question were prepared for the sample respondents. The questionnaires consisted different types, which related to the variables hypothesized, topic of research and objectives of the study. Before embarking into data collection questionnaire was pre-tested to its appropriateness for gathering the required information based on feedback obtained from advisor. Enumerators were trained regarding the contents of the questionnaire and data collection procedures. Trained enumerators were interviewed the sample respondents under the continuous supervision of the researcher. Interview was used because of its flexibility and makes clear any time when there is ambiguity. The interview was conducted from district Agriculture and Rural Development Office, district trade and market development office and different market actors.

Secondary data was collected from district agriculture and rural development offices, central statistics agency reports, published and unpublished materials. Besides, websites was consulted to generate relevant secondary data to the study.

## 2.3. Method of Data Analysis

Two types of analysis, namely descriptive analysis and econometric methods were employed to meet the objective of the study.

Specification of the Tobit model for volume of wheat marketed: The market supply data was censored that means there were households that produce wheat and do not supply to the market. Tobit model was selected to identify factors determining the supply of wheat by smallholder farmers. There are several occasions where the variables to be modeled is limited in its range. Because of the restrictions put on the values taken by the regress and, such models can be called limited dependent variable regression models. [8] Hence, a Tobit model answers both factors influencing the probability of selling and factors determining the magnitude of sale.

Statistically, we can express the Tobit model as

$$Y_i = \beta_0 + \beta_i x_i + u_i \text{ if } RHS > 0$$

$$Y_i = 0$$

Where RHS = right-hand side. Additional  $X$  variables can be easily added to the model.

Where  $Y_i$  = Volume of wheat marketed (dependent variable).

$\beta_0$  = An intercept.

$\beta_i$  = Coefficients of  $i^{\text{th}}$  independent variable.

$x_i$  = Independent variable and  $u_i$  = Unobserved disturbance term or error term.

## 2.4. Definitions and Hypothesis of Variables

### Dependent variable

Volume of Wheat Marketed (VWM): It is continuous dependent variable and measured in quintals (log-normalized). It represents the log of the actual volume of wheat marketed by farmer households.

### Independent (explanatory) variables

Perception of farmers towards price of wheat (price): If the farmer considers that the price of wheat is attractive, there would be an increase in volume of marketed surplus and if farmers had a view that the price was not attractive, he/she would be forced to decreases or even stops to supply wheat to the market and might choose alternative options like storing. The market price (ETB) is expected to affect the volume of wheat marketed positively because it stimulates the suppliers to supply to the market if the price of the wheat is better. When the price of the product is promising, farmers are motivated to take their produce to the market. The study of [9] on determinants market supply of rice found a significant positive relationship between rice sold and market price.

Distance to the nearest market (DNM): Distance to the nearest market is continuous variables measured in kilometers from household residence to the market centers. The closer the residence of households to the nearest market center that reduces cost of transportation so the more volume of wheat marketed. The assumption here is that the closer a household to the market, the more household was increased volume of the wheat marketed. Therefore these variables was expected to have an inverse relationship with volume wheat marketed [10].

Sex of the households (SHH): this is dummy variable, which takes a value of one if the household head is male and zero if female. This variable was expected to have indeterminate effect on volume wheat marketed because if the household head is male, he has enough time compared to female headed to get more information about wheat market price. Being male headed household has positive relationship with marketed surplus than female headed one. The study of [11] on patterns and determinants of livestock farmers' choice of marketing channels who found that sex of the household head has statistically significant effect on whether or not a farmer participates in the livestock market.

Family size (FS): It is a continuous variable measured in terms of adult equivalent. Families with more household members tend to have more active labour in Production and marketing. [12] Found family size having positive effect on the households' gross income from groundnut production. However, large family size requires large amount of consumption that reduce marketed surplus. The study of [13] on analysis of rice profitability and marketing chain found as family number increases supply of rice to the market decreases. Therefore, family size can affect the volume of wheat marketed either positively or negatively. Here, the sign for this variable was indeterminate.

Access to credit (ACD): Access to credit was measured as

a dummy variable taking value of one if the farmer had access to credit and zero otherwise. According to [14] credit makes traditional agriculture more productive through purchase of farm equipment and other agriculture inputs and technological developments. Credit can also use as an instrument for market supply. Therefore, this variable was expected to have indeterminate effect on volume of wheat marketed on the assumption that access to credit improves the financial capacity of farmers to buy modern inputs, thereby increasing production, which is reflected on marketed surplus. The study of Amare [15] found that access to credit affected the marketed surplus of pepper negatively.

Level of education (LED): This variable was measured as continuous variable that is expected to affect the volume of wheat marketed positively. This is because a farmer with good knowledge can adopt better practices than illiterates that would help to increase the volume of wheat marketed. [16] Argued that education had positive significant effect on quantity of milk marketed in Ethiopia highlands.

Frequency of extension contact (FEXC): Refers to the number of contacts per year that the household head made with development agents during production season. Extension visits help to reinforce the message and enhance the accuracy of implementation of technology packages [17]. Extension contact assists the dissemination of new technologies to farmers as a way of increasing agricultural productivity, thus speeding up the adoption or use of new technologies and practices was expected to have a positive effect on volume wheat marketed.

Land allocated to wheat (LAW): This variable is a continuous variable measured in hectares that households allocated for wheat production during 2015/16 production season. Farmers with larger area of cultivated land have the capacity to use compatible technologies that could increase the production and productivity. According to [18] large farms were providing large yield than small size farms. Hence, it was hypothesized that cultivated land size would have a positive effect on volume of wheat marketed.

Number of Oxen Owned (NOO): This continuous variable is measured with the number of oxen owned by the household and expected to affect volume of wheat marketed positively. This is because producers who own more oxen are more likely to till in time than producers who own no oxen. Thus, they produce more wheat that can be reflected on volume of wheat marketed. The study of [19] on determinants of agricultural commodity market supply reported that the larger the numbers of oxen owned by a farmer, the greater households supply of their produce to the market.

Livestock holding (LH): This continuous variable is measured the total number of livestock owned by a household in terms of tropical livestock unit (TLU). Farmer could sell more wheat when he/she produces more. On the other hand, when the household has less production, it must either borrow money or sell his livestock to meet household needs. Farmers who have low production need to specialize in livestock production. Therefore, it is expected to have

negative relationship with volume of wheat marketed. [20] found a significant negative relationship between total livestock and quantity of pepper supply.

Off-farm income (OFI): It is a continuous variable measured in amount of Birr the farmer earned (log-normalized) other than farming. A household with better income from off-farming is assumed to have low volume of wheat marketed. [21] reported that caution is needed if we want to increase involvement of agricultural households' with off-farm employment comparative advantage in market-oriented production. Thus for those farmers that do have other work activities besides farming it is expected to correlate negatively with papaya market participation and volume marketed. Farmers engaged in off-farm income were expected to generate more income. [22] who found that if pepper producer have off-farm income, the amount of pepper supplied to the market decreases. Therefore, it was hypothesized that farmers who engage in off-farm income were expected to have a negatively effect on volume of wheat marketed.

Farming experience (FE): It is a continuous variable that indicate the farming experience of the household head in years. Experience would improve the farmer's skill on the use of modern agricultural inputs like selected seed, fertilizer, chemicals that help them to enhance their productivity and increase amount sold. More experienced farmers apply more fertilizer on their farmland to increase the production and productivity that increase amount of market supply. A study conducted by [23] indicates that farmers with longer farming experience are expected to be more knowledgeable and skillful and are more successful in their production. Thus, farming experience is expected to have positive relation with volume of wheat marketed in the study areas.

Quantity of fertilizer used (QFU): It is continuous variable measured in quintals. Amount of fertilizer farmers used for raising production, yield and income of farm households. [24] studied fertilizer use as one factor affecting agriculture. A study conducted by [25] indicates fertilizer use had positive effect on their study on smallholder market participation under transactions costs maize supply and fertilizer demand in Kenya. Thus, Quantity of fertilizer used was expected to have positive relation with volume of wheat marketed in the study areas.

Use of improved wheat variety (UIWF): It was dummy variable taking value of one if the farmer used improved wheat variety and zero if not used. Different improved wheat variety is mostly assist farmers for increment of yield. A study conducted by [26] in North Carolina on Wheat Variety Performance indicates different wheat variety had positive impact on increment of yield. Thus, use of improved wheat variety was expected to have indeterminate relation with volume of wheat marketed in the study areas.

### 3. Result and Discussion

Characteristics of sample households: result of the survey revealed that the t- test shows that there was statistically

significant difference between the two groups with regards to wheat supply by the households. This shows significance difference between the two groups was at significance level of 1%. An average volume of wheat sold by market participants was 19.95 quintals per household. Of the 123 sample, respondents 84 percent reported that they were supply wheat to the market, where as the remaining 16 percent of respondents reported that they were not supply wheat to the market in the survey year. The average number of family members was about 5.36 persons per household for participant farmers, while it was about 6.74 for non-participant farmers the two-tailed test was statistically significant at 5% means that family size between the market participants and non-market participants were different.

The age structure of the sample households shows that the average age of the participant and non-participant farmers was 46.74 and 40.35 years respectively. On the other hand, the age of wheat market participants was greater by 6.39 years than non-participants. According to the survey result, age was found at a range of 23 to 83, this implies that both participant and non-participant farmers had different age. This shows significance difference between the two groups was at significance level of 5%. The mean years of farming experience in the production of wheat for participants and

non-participants were 23.99 and 16.8 years, which is statistically different between two groups at significance level of 1%. Production cost was greater for households who participate in wheat market than non-participant that is statistically different between two groups at significance level 1%. The average land covered by wheat was 2.73 and 1.65 hectares for participant and non-participant households of wheat market which was statistically different between two groups at significance level of 1%. As survey report showed that average yield of 31.62 quintals per hectare of wheat was reported in the study area in 2015/16 production season which is larger than the national average yield of 25.43 q/ha and the regional average yield of 28.21q/ha. This depicts that average yield of wheat for the study areas were greater than the national yield levels. This shows that the district being a potential for wheat production at national level. With regard to the frequency of extension contact among the total respondents, 19.9 percent had once contact per week, 63 percent had twice contact per month, 17.1 percent twice contact in a month. On average households who participate in wheat markets had 1.43 times contact with development agents while non-participant had 1.45 times contact. Statistical tests indicate that no difference among participants and non-participants households.

**Table 2.** Characteristics of sample households by wheat market participation.

Variables	Mean/Proportion			t-/z-/ $\chi^2$ statistic
	Participant	Non-participant	Both	
Wheat supply by the household	19.95	0	16.70	3.71***
Sex of the household head (%)	0.95	0.85	0.90	1.68**
Family size of household	5.36	6.74	6.05	-1.99**
Literacy status of household head	1.29	1.25	1.27	0.17
Age of household head	46.74	40.35	43.55	2.14**
Wheat farming experience	23.99	16.8	20.39	2.53***
Access to credit (%)	0.55	0.85	0.70	-2.48***
Distance to the nearest market	3.17	2.90	3.04	0.51
Quantity of fertilizer used	2.42	1.43	1.93	3.31***
Use of improved wheat variety (%)	0.99	1	0.99	-0.44
Land covered by wheat	2.73	1.65	2.19	3.53***
Frequency of extension contact	1.43	1.45	1.43	-0.18
Income from wheat (log)	9.49	0	9.31	5.27***
Off-farm income (log)	7.60	8.29	7.92	-1.66**
Wheat price (log)	6.68	0	6.68	2.22**
Production cost	9.29	9.02	9.25	3.58***

Note: \*\*\* and \*\* statistically significant at less than 1% and 5% significance level.

Source: Survey result, 2016.

Volume of wheat marketed: 14 hypothesized explanatory variables (11 continuous and 3 dummy) were included in the model to identify factors affecting the volume of wheat marketed. Out of these variables, six were found significantly influence volume of wheat marketed at 1 and 5 percent of significance levels. These variables include perception of farmers toward wheat market price, family size, access to credit, livestock holding (TLU), off-farm income and oxen ownership.

**Table 3.** Tobit model output results of determinants of volume of wheat marketed.

Variables	Coefficients		Marginal effects	
	Coefficient	Standard error	Intensity of sales	Probability of sales
Distance to the nearest market	0.02	0.04	0.02	0.0008
Sex of household head	0.16	0.37	0.15	0.01
Family size	-0.08	0.03	-0.07**	-0.003
Access to credit	-0.91	0.19	-0.84***	-0.04
Level of education	0.02	0.09	0.02	0.001

Variables	Coefficients		Marginal effects	
	Coefficient	Standard error	Intensity of sales	Probability of sales
Frequency of extension contact	0.21	0.18	0.19	0.02
Land allocated to wheat	-0.15	0.35	-0.14	-0.01
Off- farm income	-0.07	0.03	-0.06**	-0.003
Tropical livestock unit	-0.09	0.02	-0.08***	-0.04
Farming experience	-0.002	0.008	-0.008	-0.00007
Oxen ownership	0.34	0.11	0.31***	0.01
Perception of wheat market price	7.96	3.83	7.26**	0.34
Quantity of fertilizer used	0.46	0.35	0.42	0.02
Use of improved wheat variety	-1.07	1.01	-1.04	-0.01
_cons	-49.99	25.76		
LR chi <sup>2</sup> (14)				
Pseudo R <sup>2</sup>				
Left-censored observations				
Uncensored observations				

Source: Model output, \*\*\*, \*\* represents 1% and 5% level of significance respectively.

**Family size:** The total family size counted in the households converted in to adult equivalent. The coefficients of family size for volume of wheat marketed was negative signs and significant at 5 percent significance level. As the result of marginal effects of intensity shows that one number increment of family size in the households decrease amount of volume of wheat marketed by 7%. This means that large amount of wheat is required for consumption rather than sold when number of family member in the household increases. The result of marginal of effect indicates how likely family size has chance to sell wheat. The result indicates that one number increment of family size in the households decrease probability of selling by 0.3%. This is in line with the study by [27] as family number increases supply of rice to the market decreases. The study conducted by [28] also indicates that large family size has an effect in decreasing the supply of malt barley in Amhara Region. Furthermore, study by [29] showed that household size has significant negative effect on quantity of maize marketed.

**Access to credit (CREDIT):** As expect access to credit was found to have negative and significant impact on volume of wheat marketed at 1 percent significance level. The marginal effect result indicates that households who had access to credit decreased the volume of wheat marketed by 84% compared to the households who did not have access to credit. Households who had access to credit were not increase selling of wheat in order to cover their expenditure. Instead, they use for home consumption rather than marketing compared to households who had not access to credit; households who had access to credit had probability to decrease wheat market participation by 4%. These argue that if farmers access to credit they improve their financial capacity from credit they obtain that help them to decrease amount of wheat marketed. This result is in line with [30] that access to credit affected the marketed surplus of pepper negatively. The result was contrary with the study by [31] who pointed out that if wheat and *tef* producers have access to credit, the amount to be supplied to the market would increase.

**Tropical livestock unit:** The coefficient of number of livestock ownership measured by tropical livestock unit with

volume of wheat marketed was negative and statistically significant at 1 percent significance level. The marginal effect result revealed an increase in one unit of topical livestock unit decrease intensity of volume of wheat marketed by 8 percent. This was due to households who rich in livestock were allocated their land for grazing also beside of farm that decrease productivity and amount of marketed. The marginal effect of probability indicate that the households who rich in livestock decrease probability of selling wheat by 0.4%. The result was in line to [32] where total livestock unit influence quantity of pepper supply negatively.

**Off-farm income:** The coefficient of off-farm income for volume of wheat marketed is negative and statistically significant at 5 percent significance level. The marginal effect result indicates that households who generate income from off- farm decrease volume of wheat marketed by 6%. This is due to households who had off-farm generate their income from off-farm rather than selling wheat product. The marginal effect of probability shows that household who had off-farm income decrease probability of selling wheat by 0.3%. The result was in line with [33] who found that if pepper producer have off-farm income, the amount of pepper supplied to the market decreased. Similar studies also identified that access to other income negatively related to sales volume of banana market in Uganda [34].

**Oxen ownership** Coefficient of Oxen ownership was found to have positive and significant impact on volume of wheat marketed at 1 percent significance level. The marginal effect of intensity indicates that an increase an oxen owned by one unit households increasing intensity of volume of wheat marketed by 31%. These is due to households who had more oxen used for plowing large size of land and repeatedly plow his land in order to increase productivity that had impact on volume of wheat marketed. Almost all sample households are subsistence producers who use oxen power to cultivate their plots. [35] reported similar findings that the larger the numbers of oxen owned by a farmer, the greater households supply their production to the market.

**Perception of farmers toward wheat market price:** The estimated coefficients of perception of wheat market price for

volume of wheat marketed was positive signs and significant at 5 percent significance level. This is in line with the hypothesis made. The marginal effect of result indicates that perception of households towards wheat market price shows that for one percent increment of wheat market price causes to an increase intensity of volume wheat marketed by 7.26 quintals. Marginal effect of probability indicates households had chance to sell their wheat produced at market price they want by 34%. The study is in line with the study of [36] on determinants market supply of rice, he found a significant positive relationship between rice sold and market price.

## 4. Conclusion

Wheat does not constitute only the food crops for the majority of the households in the district but also as source of income at household level. Therefore, the study focused on the amount of wheat sold to the market by smallholder farmers as well as identified the factors determining the supply of wheat by smallholder farmers'.

## 5. Recommendation

Possible recommendations that could be given based on the study to be considered in the future intervention strategies that are amid at the promotion of wheat supply and marketing of the study area are as follows:

The result shows that family size decreases volume of wheat marketed which indicates that large family members in households used wheat for home consumption rather than supply to market. Therefore, intervention should be provided on teaching households on family planning to rural community. It is obvious that most farmers were not balance their family size with their income from their activities. These situations aggravated the country's food insecurity problems. Therefore, strengthening family planning is required from the government side.

Households who had access to credit decrease volume of wheat marketed relatively to these households who had not access to credit because they prefer to purchase inputs by credit they obtain rather than supplying wheat to the market. Without access to financial resources, the farmers who had not access to credit sell wheat immediately after harvest, when a price is at lowest point. In order to make farmers profitable from their product government and non-governmental lending institution should be beside of farmers to solve their financial problems they faced and make awareness to them to supply wheat when market price is fair for them. In addition, with limited access to credit, traders are often unable to purchase sufficient quantities of product to meet local supply need. Government lending institution and Non- governmental organization should support improving access to credit for farmers and traders highly.

Number of livestock unit in the study area was influence volume of wheat marketed negatively. These were due to households who rich in livestock sale livestock and their products in order to cover their expenditure instead of sale

wheat. Specialization on livestock production in majority is not appropriate for smallholder farmers to make linkage them self in commercialization of agricultural marketing activities. Therefore, extension agents should do awareness to farmers on farming agricultural products more than rearing livestock.

The off-farm income the households were involved influence volume of wheat marketed negatively. These were mainly due to households who had off-farm generate their income from off-farm in order to cover expenditure they incurred rather than supplying wheat to the market. Therefore, government should encourage farmers to involve them self in both activities to improve their live.

Furthermore, price of wheat found to be positively related to marketed surplus. There should be a system for which suppliers could not fix price below some threshold limit. As farmers are the pro-poor groups who need to be prioritized in any intervention, legal tactics and conditions (for instance prevailing price ceiling and price floor) under which such practices of offering unfair price would not likely to prevail should be implemented. Government and other NGOs must stand besides farmers to safeguard them by offering fair price.

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