Determinants of Smallholder Farmers Teff Market Supply, in Jimma Arjo District, Western Oromia Regional State, Ethiopia: A Two Stage Least Square Approach

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Abstract
This study attempted to analyze teff value chain in Jimma Arjo district of Eastern Wollega zone with the objectives of analyzing the determinants volume of teff supplied to the market. Two stages random sampling technique was employed. First 3 kebeles were selected from 12 teff producers randomly and second 122 teff producers were selected randomly at 9% precision level. Primary data were collected from 122 farmers using structured and semi-structured questionnaire for both quantitative and qualitative datas. Descriptive statistics and 2SLS model were used to analyze the collected data. The result of 2SLS indicated that size of landholding, quantity of teff produced, credit service, and distance from the nearest market influenced amount of teff supplied to market at 5%, 1%, 10% and 5% significantly respectively. Recommendation drawn from the study findings include the need to improve the land productivity by utilizing land, increasing productivity of teff per acre of land by providing essential inputs, providing credit service for producers and constructing social infrastructure to solve the problem of distance from the market, strengthening the linkage/interaction among teff traders, training producers how to produce for surplus and strengthening supportive institutions.
Keywords: *Teff*, Market supply, Two Stage Least Square, Jimma Arjo District
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1. Introduction

1.1 Background

According to the world cereal production in the year 2007 was increased by 4.8 percent from previous year production. In the same year, Africa's contribution to the world output was 6.35 percent (about 133.1 million tons). Cereal crops are the most important food crop of the world. They are staple foods in the diets of most population. In the year 2007, 2029 million metric tons of cereals were produced globally from 658.5 million hectares of land with an average productivity of 30.83 quintals per hectares (FAO, 2007). The majority of Ethiopia's population earns its livelihood primarily from agriculture. The agricultural sector, which is stunned by subsistence smallholder farmers, is the primary source of livelihood for the majority of the population and the basis of the national economy. Agriculture accounts for 42.9 percent of GDP (MoFED, 2014), it contributes to nearly 80 percent of export earnings, provides employment to 73 percent of the population (EATA, 2014).

The scientific name of *teff* is *Eragrostistef (Zucc.)* and is believed to have originated in Ethiopia (Vavilov, 1951). *Teff* is a tiny, round, khaki-colored grain closely resembling millet. "*Teffa*", the Amharic word for "lost", is so named because of *teff* small size. It is the smallest grain in the world and often is lost in the harvesting and threshing process because of its size. From *teff* the preferred staple diet made in the Ethiopian and Eritrean is *injera* (pronounced *en-ger-a*, and sometimes spelled *injera*), a flat sour-like fermented pancake that is used with "*wot*", a stew made with spices, meats and pulses, such as lentils, beans and split peas (Piccinin, 2002).

Teff is grown mainly in Amhara and Oromia, which together accounted for 84 and 86 percent of the total cultivated area and production in 2011. East and West Gojjam of Amhara and East and West Shoa and Eastern Wollega of Oromiya are particularly known *teff* producing areas in the country. Among cereals, *teff* accounts for the largest share of the cultivated area (28.5 percent in 2011), followed by maize (with 20.3 percent). Even though *teff* production is expanded by 72 percent between 2004/05 and 2010/11 (CSA, 2012), it is second (to maize) in terms of quantity of production. Similarly, with only 1.3 tons per hectare, *teff* yield is the lowest among cereal crops.

In Ethiopia land used for *teff* production during 2017 production year were estimated 3.02 million hectars and

50.2 million *quintals* was produced with productivity of 16.64 *quintal* per hectar of land. In Oromia regional state 441,029.78 hectars of land was allocated for *teff* production and 24.74 million *quintals* of *teff* was produced with productivity of 17.17 quintals per hectars of land. And also in Eastern Wollega Zone 77,455.03 hectars of land used for *teff* production and 1.4 million *quintals* of *teff* will produced with productivity of 18.02 *quintals* per hectar of land. In Jimma Arjo district there are 11,995 farms household and among those 7,512 households (6,783 and 729 male and female household headed) are *teff* producer. Land allocated for *teff* production during the year (2017) is 4630 hectar (16.54 percent of total land holdings) from 27,991 total hectar of land. In the district 56,717 *quintals* of *teff* was produced during current production year and productivity of *teff* were 12.25 *quintals* per hectar of land which was below national standard (BoDARD, 2017).

According to Wolday (1994), Agricultural marketing is a very important factor in economic development and lack of a well-functioning agricultural market and marketing system severely hinders the increase of social welfare, income distribution, and food security of developing countries. Moreover, markets and marketing system and value chains do not develop simultaneously with economic growth. Development policy of Ethiopia has placed emphasis on increasing agricultural production to serve as a base for rural development. Even though there has been an increase in agricultural production, there were drawbacks with regards to many households limited participation in the markets. According to Best *et al*. (2005), the limited market participation of many agricultural households face is considered to be a major constraint to eradicate poverty. This shows that an efficient, integrated and responsive market that is marked with good performance is of crucial importance for optimal allocation of scarced resources and stimulating households to increase produce (FAO, 2003).

Bezabih (2010) indicated that, agriculture continues to face a number of constraints and obstacles in Ethiopia. The major ones are adverse climatic conditions; lack of appropriate land use system resulting in soil and other natural resources degradation; limited use of improved agricultural technologies; the predominance of subsistence agriculture and lack and/or absence of business oriented agricultural production system; limited or no access to market facilities resulting in low participation of the smallholder farmers in value chain. In comparison to this, the study by Jifara and Amsalu (2017) indicates that, Agricultural marketing is a very important factor in economic development and lack of a well market and marketing system severely hinders developing countries. In Ethiopia there is a great market fluctuation from time to time, however, production increased from year 2009 to 2016. Price and standard of *teff* in the study areas is entirely determined by *teff* traders. *Teff* farmers' production and marketing constraints were shortage of fertilizer and seed supply, price setting and access to credit whereas that of *teff* traders were double taxation, absence of infrastructure, capital shortage, inadequate of credit service, farmer reluctance to sell, lack of demand, absence of storage facility and absence of government support(Efa ,2016).

The study area is known by production of cereal crops such as Wheat, Maize*, teff*, and Sorghum mainly for market and family consumption. However market aspects of those crops were not undertaken in this district and undertaken in an other areas by different authors such as Efa *et al*. (2016) the case of Dawo and Bacho District of Oromia Region, Mohammad (2011) the case of Halaba District of SNNP region, Tadele *et al.,* (2016) and Birara (2017). To examine factors affecting market supply previous researchers was used OLS, but the way they tested is not correct that means concept endogeneity was not checked and re runned by 2SLS. This study is designed to address the prevailing information gap on the way variables of study are defined, measured, and hypothesized, model employed for data analysis and contribute to proper understanding of the determinants of *teff* supply, market outlet selection and stake holders of *teff* value chain for the benefit of smallholder farmers, traders, supporters in study area and contributions of the researchers knowledge. The objective of the study is to examine determinants of volume of teff supplied to the market in Jimma Arjo District of Eastern Wollega zone, Oromia regional state of Ethiopia.

2. Methods
2.1 Description of the Study Area
The major part of the study area can be described as rolling and undulating topography with dendrite drainage pattern. The elevation of the study area ranges from 1500-2600m a.s.l. The common physiographic features are mountains ridges plateaus and basins. The total study area is highly vegetated and type of vegetation cover depends on the physiographic and climatic condition. It is mainly covered by large trees, grass and bushes. Jimma Arjo is found in East Wollega zone of Oromia region and is 379 Km to West of Finfinne/Addis Ababa. It is bordered on the southwest by the Didessa river which separate it from the Bunno Beddele zone, on the North West by Diga lake, on the north east by Guto Wayu, and on the south east by Nunu Kumba district.

According to the agro-climatic classification of Ethiopia, the relief/land form of the study area can be grouped into three major physiographic units based on their elevation. The lowlands with <1500m a.s.l which is suitable for maize, sorghum, sesame, nouge and Daguja production, mid altitude with 1500-2300m a.s.l which is suitable for all types of crop production, and highlands with >2300m a.s.l which is strongly suitable for *teff*, wheat, bean, pea, with 30%,58% and 12% coverage respectively. According to the annual rainfall mapping the study area gets annual rainfall up to 2800mm. Types of crops produced in the study area are *teff*, wheat, maize, sorghum, nouge,

sesame, pea, bean, lettuce, sugarcane, potato, tomato, faba bean, barley, onion, Garlic, and others horticultural products. Not only crops and also livestock's are produced includes sheep, horse around highland and mule, donkey, goat and cows are produced around lowland areas of the district. *Teff* is produced once a year because of agricultural activities of the district is rainfall based, that means no irrigation activities employed for *teff* production. In the district *teff* is only produced on high land and midlands areas.
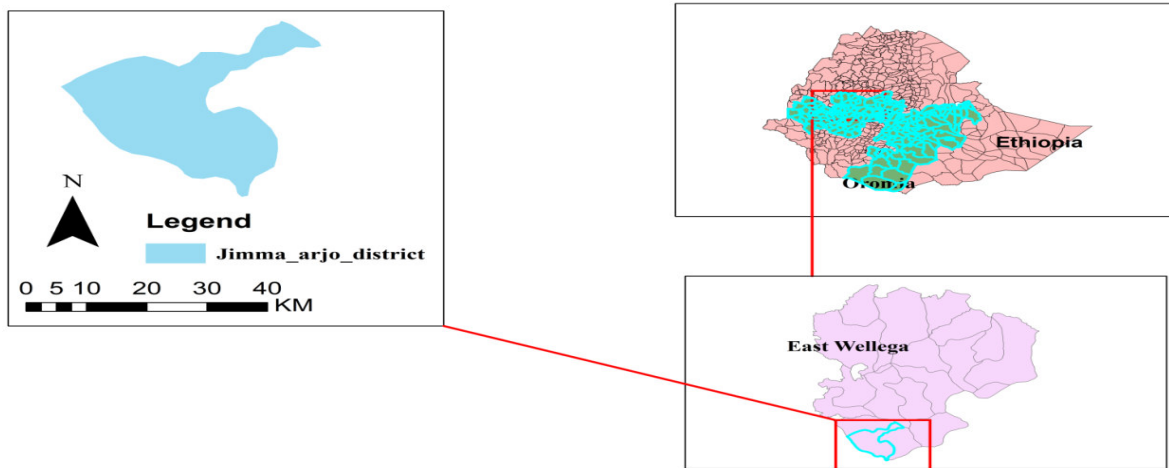

Figure 1: GIS Map of study area

2.2 Data Sources and Methods of Data Collection
2.2.1 Data types and sources
The data for this study were both qualitative and quantitative collected from primary and secondary sources. A qualitative method was used to collect the qualitative data such as data collected through focus group discussion and key informant interview. A quantitative method was used to collect information that has been transformed into numbers such as demographic, institutional, and socioeconomic factors. Primary datas were collected directly from farmers and traders while secondary datas are data which were taken from written documents of district agriculture and rural development offices, district trade and industry, internets and published articles.
2.2.2 Methods of data collection
Primary data: The data were collected formally by the method of individual interview using semi-structured interview schedule, questionnaire, focus group discussion and key informants using checklists and observations from concerned agents and model farmers.
Secondary Data: were gathered from published materials, district agriculture and rural development offices, farmers' organizations, input suppliers, marketing agencies i.e. districts industry and trade office and from different development organizations of the study area.

2.3 Sampling Procedure and Sample Size
Farmers sampling
Two stages random sampling technique was used to select sampled kebeles and respondents because of all sampled kebeles and respondents are homogeneous. There are 20 rural and 2 urban kebele administrations in the district. From 20 rural kebele administrations only 12 rural *kebeles* are *teff* producers. At first stage from those *teff* producing *kebeles* 3 *kebeles* were selected by using simple random sampling technique and at second stage appropriate numbers of sample farmers from *teff* producing *kebeles* was selected randomly in Proportional to Population Size (PPS) using Yemane (1967) formula.

$$n = \frac{N}{1 + N(e)^2} \qquad (1)$$

Where, n = sample size, N= Number of household heads that are *teff* producers in the district (7512) and e = level of precision assumed 9%. Sultan (2016) and Addisu (2016) were also used this level of precision. Accordingly, the required sample size at 91% confidence level with level of precision equal to 9% was used to obtain a sample size required which represent a true population.

$$n = \frac{7512}{1 + 7512(0.09)^2} = 122$$

Table 15: Sample distribution of producer *kebeles* (PPS)

Selected *Kebeles*	Total Households(N)	Proportion	Sample(n)
Hindhe	880	0.44	53
Tibe Caffe	506	0.25	31
Hara	626	0.31	38
Total	2012	1.00	122

Source: Survey result computation

2.4 Methods of Data Analysis

Descriptive statistics and econometric analysis was employed to analyze the data collected from all actors involved in *teff* value chain and marketing of the study area.

2.4.1 Descriptive statistics

Employed to analyze and describe mean, maximum, minimum, standard deviation, frequencies and percentages in the process of examining and describing demographic outputs were calculated.

2.4.2 Econometric models

Econometric models was employed to analyze the impact of one unit changes in explanatory variable on dependent variables i.e. factors affecting volume of *teff* supplied to the market,

Determinants of teff market supply

Multiple linear regressions employed to analyze the determinants of *teff* market supply since all *teff* producer farmers are *teff* market participants. However, when some of the assumptions of the Classical Linear Regression (CLR) model are violated, the parameter estimates of the above model may not be Best Linear Unbiased Estimator (BLUE). Thus, it is important to check the presence of hetrocedasticity, multicollinearity and endogeneity problem before fitting important variables into the regression models for analysis.

The problem of endogeneity occurs when an explanatory variable is correlated with the error term in the population data generating process which causes, the ordinary least squares estimators of the relevant model parameters to be biased and inconsistent. The source of endogeneity could be omitted variables, measurement error and simultaneity (Maddala, 2001). Both Hausman test and Durbin-Wu-Hausman (DWH) test were applied to check the presence of endogeneity. In this study, there was a potentially endogenous variable, which was quantity of *teff* produced, included in the explanatory variables that could cause endogeneity bias if OLS is applied. Therefore, in identifying the determinants of *teff* supplied, a two-stage least square (2SLS) model was used. Two-stage least square is similar to OLS except that uses two completely separate stages during the analysis phase in order to avoid problems of endogeneity (Wooldridge, 2010).Econometric model specification of supply function in matrix notation is as follows:

$$Y = \beta o + X_k'^{\beta_1} + \delta Y_1 + U \tag{2}$$

Where Y is vector of quantity of *teff* supplied to market, X' is exogenous variable that is assumed to affect market supply of *teff*, Y_1 is vector of endogenous variables which is quantity produced of *teff*, while β_0, β_1 and δ are a vector of parameters to be estimated and U a vector of disturbance term. As the name suggests 2SLS involves using OLS regression in two stages, in the first stage a reduced form of the structural equations is estimated where the endogenous variable productivity of *teff* regressed on all the exogenous variables. Reduced form is here below:

$$Y1i = \Omega 0 + \Omega 1Xi + \Omega 2Zi + v \tag{3}$$

Where Y_{1i} is endogenous variable (quantity of *teff* produced), X_i vector of explanatory variables, Z_i is a vector of excluded instrumental variables Ω is coefficients to be estimated and v is error terms and systematically surrounded around zero. Multicollinearity problem arises due to a linear relationship among explanatory variables; and becomes difficult to identify the separate effect of independent variables on the dependent variable because there exists strong relationship among them (Gujarati, 2003). Two ways to check multicollinearity, Variance Inflation Factors (VIF) is used to check for continuous variables and Contingent Coefficient for discrete variables. When value of VIF is greater than 10 ($R^2 > 0.90$), there is strong multicollinearity between continuous explanatory variables and specified as:

$$VIF(X_j)X = \frac{1}{1 - R_j^2} \tag{4}$$

Contingency coefficient (CC) was used to investigate multicollinearity problem among discrete variables and specified as;

$$CC = \sqrt{\frac{x^2}{N + x^2}} \tag{5}$$

CC= Contingent Coefficient and when its value exceeds 75 percent variables are collinear. In order to check the existence of hetrocedasticity problem in the data set, the parameter estimates of the coefficients of the independent variables cannot be BLUE. We check problem of hetrocedasticity by using STATA13 software using Breusch Pagan test.

2.5 Hypothesis and variable definition
To examine determinants of volume of *teff* supplied to the market the following variables were assumed to affect the below dependent variables.
Dependent Variables
Quantity of *teff* supplied to the market: It is a continuous dependent variable measured in Kilograms of *teff* supplied to the market during 2017/18 year.
Table 16: Description of dependent and explanatory variables used in 2SLS Models

Independent Variables	Definition	Type	Measurement	Expected Sign
NONFARIN	Non-farm income	Dummy	Yes=1, No=0	-
HHSIZE	Household size	Continuous	In adult equivalent	-
ACMKT-INF	Access to Market information	Dummy	1, if household is access to market information, 0 otherwise	+
USCRED	Using credit	Dummy	1,if household is credit user and 0 If not	+
QPRD	Quantity of *teff* produced	Continuous	In *quintal*	+
FAREX	Farm experience	Continuous	In years of start farming *teff* production	+
EDUHH	Educational level of household	Continuous	In years of schooling	+
LSIZE	Land Size	Continuous	In hectars	+
LIVH	Livestock holding	Continuous	TLU	+
EXCONT	Frequency of extension Contact	Continuous	Number of contact per month	+
DISMKT	Distance to the market	Continuous	Measured in kilometers	-

Source: Own survey computation (2018)

3. Result and Discussion
3.1 Result of descriptive Statistics
Table 3: Demographic Characteristics of sample households

Demographic Variables	N	Minimum	Maximum	Mean	Std. Deviation
Education of household in years of schooling	122	.00	12.00	3.426	3.44
Household Size in adult equivalent	122	1.00	10.00	5.80	2.13
Farming experience in years of starting *teff* production	122	3.00	45.00	22.89	10.64

Source: Own survey computation (2018)

Educational status of the household head can influence how household head accepts new idea of production and searches for efficient markets for their products. It can affect attitudes of farmers towards adoption of new technologies and ways of thinking toward the advantage of using new technology for their economic improvements. Education can also contribute to decision-making processes that alter the paths people take in life. Educational status of the sample household heads in the study area ranges from illiteracy to grade 12 completed (Table 4).

The mean household size of the total sample households was 5.83 adult equivalent ranging from 1 to 12 and this might limit them for a better participation of households in supplying large volume of *teff* to the market because of in the study area those respondents having large number of family uses more of their *teff* products for family consumption and searches to earn non-farm income for covering their expenses.

The sampled respondents have an average of 23 years of farming experience in *teff* production with a standard deviation of 10.64 years refer (Table 3). In study area those farmers having more experience are more knowledgeable on efficient market outlet selection and producing large quintals of *teff* per acre of land which helps them to increase volume of *teff* supplied for market than those less experienced farmers.

Land is the most essential fixed factor of production and measure of wealth in the study area. It is the main source of income and increases the status of people in the society. Total and mean size of land owned by respondents were 267.3 and 2.19 hectars respectively, as well as total land allocated for *teff* production during 2017 was 94.65(34.4% of total holdings) hectars. From the mean land size owned by individual respondent 0.76(34.7%) hectars of land is used for *teff* production by each respondent during this year (Table 4). In the district farmers those who have large land size participates in supplying *teff* for the market and selects efficient market outlets. All of the sample respondents indicated that they are participating in *teff* production and marketing activity.

Table 4: Land holdings and area of land allocated for *teff* production during 2017

Land (hectars)	N	Sum	Mean	Std. Deviation
Land size in hectars	122	267.31	2.19	2.36
Area of land allocated for *teff* production in hectars	122	94.65	.76	.67
Yield (Q/hectar)	122	897.86	9.49	3.71
National Standard (Q/hectar)			16.64	

Source: Own survey computation (2018)

Besides of *teff* production farmers in study area were uses part of their land for production of other major crops such as maize, sorghum, wheat, Daguja, bean, pea ,fruits, vegetables, tuber and root crops, nouge, and spice crops are produced simultaneously.

The availability of adequate financial sources for credit is crucial for farmers. Farmer's uses money they gets from credit to buy inputs such as improved seed, fertilizers, weed killers and livestock which directly contributes in increasing of *teff* products per hectars and enables farmers to raise quantity of *teff* supplied to the market. The most important services that are expected to promote production and marketing of *teff* in study area includes provision of credit services, extension service, and market information. In study area the major source of credit service is Oromia Credit and Saving Institution and others sources such as cooperatives, local money lenders and microfinance are less contributors of credit provision for farmers in study area in comparison to Oromia Credit and Saving Institutions. Among sampled household heads 41.8% of respondents are non-users and 58.2% are users of credit service from the available sources (Table 6). However, the credit provision is based on group collateral but farmers are not much interested in this way in order not to pay for defaulters in their group.

Marketing information are essential factors in promoting competitive markets and improving agricultural sector development. A well-organized market intelligence information system helps all the producers and traders freely interact with one another in arriving at prices. Existence of reliable market information help farmers sell their surpluses of *teff* and choose modes of transaction, each of which yields a different benefit. It has been postulated that farmers will choose a profitable mode of transaction if they can receive reliable market information on the prevailing market conditions. Among sampled households 24.6% of household heads are not accesses to market information while 75.4% has access to market information from neighbors, radios, and traders on prices, quality, and market demands for their *teff* products(Table:5). Most of farmers were raised problem of lack of market information regarding price of *teff* that means there is information asymmetry problem between traders and farmers. Always traders are price informed and farmers are not informed, this means according to response of farmer's *teff* is not market driven which leads price fluctuations and provides unfair price for farmers.

Provision of adequate Extension service for agriculture provides assistance for farmers in improvement of production and productivity; it also enables flow of information and transfer of knowledge and scientific findings to practice. Making contact with agricultural information services makes farmers to be aware of and get better understanding and ultimately leads to decision to take risk for improved agricultural practices. It helps in disseminating new innovations and ideas that emerges from research findings and improves better understanding of technologies that benefit farmer's production and productivity. In addition, proper contact with agricultural extension agents helps to facilitate dissemination and adoption of improved technologies and ensure the local availability of these technologies for the majority of smallholders.

Non-farm income generating activities of farmers in the study area were sheep and oxen fattening, daily labor, petty trade, brokers, were found to be some of the off/non-farm income generating activities in which sampled farmers were participating. Sampled households earns about means of non-farm income of 3206.23 birr by participating on off/non-farm income activities with standard deviation of 4517.49 (Table 5). Those farmers earns non-farm income by participating in non-farm activities supplies less amount of their *teff* products i.e. they prefers to store, expects its future price increases, and uses more of it for family consumption and prefers for efficient markets.

Livestock is the main source of household farm income in study area, that means those household owned large number of animals were earned income by selling livestock and their products which directly contributes for purchasing agricultural input and family expenses and leads farmers to produce *teff* in large amount and supply for the market in large quantity. Having large number of livestock in study area is seen as a dignity or store of value and easy for those households to prepare their own organic fertilizer from dung's of livestock which contributes to increase *teff* productivity and increases the amount of *teff* supplied to the market. From sampled households the maximum and mean of TLU owned is 21.64 and 4.91 respectively and shown in (Table 5).

The study result indicated that sample producers in the study area travels average Kilo meters with ranging from 1 to 16.5 to the market center (district market) with mean distance from district market of 8.56 Kilometers shown in (Table 6). Distance from producer's house to district market was also the factor which determines producer's *teff* supply to the market and outlet choice. The study result showed that the more the farmer is nearest to the district market the more farmer is able to select better channel outlet, they gets price and quality information and earns better price. District market is taken as market center because of almost all of sampled farmers sold their

teff product at district market due to price difference with other market center existing in the district.

Quantity of *teff* sold determines the farmer to which market outlet he/she must sell *teff* products. The study result indicates that those farmers who produce large quantity of *teff* sold their *teff* product in large quantity (the more producer is the more supplier of *teff* to the market) and has a possibility of selling *teff* at more than one market outlet. In the case of this survey those farmers who produces *teff* in large amount prefers to sell for wholesalers than consumers, retailers and for local collectors and has the possibility to sell for all market outlets (four outlets) within the district. The quantity of *teff* sold by sampled households to different actors (LC, WS,RT,and CS) are 34,545 kilograms and quantity of sold for local collectors, wholesalers, retailers and consumers were 3,735, 19,465, 1,770 and 9,900 kilograms respectively and shown in (Table 5).

The survey result shows that quantity of *teff* produced affects quantity of *teff* supplied to the market. From sampled households those who produces many quintals of *teff* searches for better market outlet and gathers information on price charged for their products and quality expected by traders from them. In the study area quantity of *teff* produced during 2017 by sample household were 578.65 with average of 4.74 *quintals*. And also the study shows that the productivity of *teff* per hectar of land in the study area was 9.49 *quintals* which is below national, regional, zone standard because of farmers are still using local seed which distributed before many years repetitively and need huge modification to equalize with the set standard. So from total quantity produced 345.45(59.9%) *quintals* of *teff* was sold to the market (Table 3).

Table 5: Institutional and socio-economic factors

Variables	N	Mean	Std. Deviation
Quantity of *teff* produced in quintal	122	4.74	4.17
Total livestock holdings in Tropical livestock unit	122	4.91	4.58
Non- farm income	122	3206.23	4519.49
Distance from the nearest market in kilo metres	122	8.56	3.31
Variables	**Frequency**	**Percent**	
Credit using			
Not credit users	51	41.8	
Credit users	71	58.2	
Not access to market information	30	24.6	
Access to market information	92	75.4	

Source: own survey Computation (2018)

3.2 Econometric Results

Determinants of Teff market Supply

Factors that affects supply of *teff* to the market was estimated by using OLS model since all respondents used for this study supplied their *teff* to the market. Eleven explanatory variables (nine independent variables and two instrumental variables those which are not correlated with both endogenous and exogenous variables) were analyzed to know their effects on quantity of *teff* supplied to the market in study area. Those hypothesized variables were: Access to market information, Frequency of extension contact, User of credit, land holding size, livestock holdings in Tropical Livestock Unit (TLU), farming experience in years of *teff* production, quantity of *teff* produced, educational level of household head in years of formal schooling, household size in adult equivalent, distance from the nearest market centre in kilometer and quantity of *teff* produced in *quintals*.

Robust regression option was used in STATA13 software to correct hetrocedasticity problem. Multicollinearity problem was also tested using VIF (Variance Inflation Factors) and the result showed that there was no multicollinearity problem since VIF value 1.66 is less than 10 and no series multicollinearity (appendix). Coefficient of multiple determinations (R^2) was used to check goodness of fit for the regression model. Hence, R^2 indicates that 85.66 % of the variation in the quantity of *teff* supplied to the market was explained by the variables included in the model as shown in (Table 6). Test of endogeneity indicated that the quantity of *teff* produced was endogenous to the model.

To overcome the problem of endogeneity we have to apply two stages least squares (2SLS) estimations method because instrumental variables are used to cut correlations between the error term and independent variables. The method involves two successive applications. The first stage is made by regressing the suspected endogenous variables over the pre-determined or pure exogenous variables to get their predicted values. Then the predicted values of the endogenous variables in the first stage are used to estimate the supply equation. Here non-farm income and education year of household head were used as instrument to quantity of *teff* produced. The instrumental variable should fulfill two requirements to be used as instrument. One of the requirements were instruments must be uncorrelated with error term and second requires the linear projection of endogenous variable onto all the exogenous variables. So for this study both instrumental variables were checked and not correlated with both endogenous and exogenous variables. Secondly there were linear projection between endogenous

variable (Quantity of *teff* produced) and exogenous variables was checked for this study.

Post estimation after indicated that Wu-Hausman Robust regression (F1, 11) = 3.146(P=0.07892) and Robust Score chi2 (1) = 3.301 (P=0.0692), First Stage Summary statistics checked shows that F (2,111)= 14.04 and P=0.000, significant at 1% significance level which shows there is no endogeneity problem of the model. The other issue tested under post estimation endogeneity was test of over identifying restriction and the result showed that the schore chi2 (1) = 0.296 ($p = 0.5681$) is insignificant and fits the model accordingly and showed no endogeneity problem (Table 6). From eleven explanatory variables including two instrumental variables four variables such as quantity of *teff* produced, land holding size, using credit and distance from the nearest market were affected volume of *teff* supplied to the market significantly.

Quantity of *teff* produced (QPRD): It is the total amount of *teff* produced in quintals in 2017 production year in the study area. It was hypothesized that quantity produced of *teff* was expected to affect quantity of *teff* supplied to the market positively and significantly. Also the study result indicated that quantity of *teff* produced affected quantity supplied to the market positively at 1% significance level. Positive sign of the coefficient indicates that quantity produced increases by 1 quintal the quantity of *teff* supplied to the market increases by 66.57 kilogram. This result indicates that farmers who produces large quantity of *teff* supplies large quantity of produce for the market. This result is in line with study by Sultan (2016) which indicates that quantity of wheat produced affects market supply positively and significantly at 1% probability level. The same study by (Azeb *et al.*, 2017) indicated that quantity of *teff* produced was significantly affected *teff* quantity sold at 1% level.

Land holding size (LSIZE): It is a continuous variable refers to the total hectar of land owned by farmers in the study area. This variable was hypothesized to affect volume of *teff* supplied to the market positively and significantly. So the study result showed that size of land holding affected volume of *teff* supplied to the market positively at 5% significance level during current year of 2017/2018. Positive coefficient shows that, the larger the total area of the land the farmer owns, the larger land is allocated for *teff* and the higher would be the output that influences large quantity of *teff* supplied to the market in study area. According to the study as land holding of the farmer household increases by 1 hectar, the quantity of *teff* supplied to the market increases by 39.64 kilograms. The study result is in line with study by Efa (2016) result which indicated that land is a scarce resource in the study area and it is more likely that those with more hectars of land can allocate to cultivation of more *teff* which lead to high *teff* production and hence supply in large volume of *teff* to market.

Using credit (USCRED): is a dummy variable which concerned with the effect of using credit on volume of *teff* supplied to the market and hypothesized as it affects quantity of *teff* supplied to the market positively. So the study result showed that using credit for *teff* production were affected volume of *teff* supplied to the market positively at 10% significance level. This indicates that those farmers who are credit users were solve their financial problem of purchasing input such as fertilizer, weed killer, and seeds which directly contributed for increasing volume of *teff* supply to the market. The coefficient showed that as farmers were being credit users, the volume of *teff* supplied to the market increase by 45.57 kilogram. This study is in line with study by Efa (2016) which indicated that access to credit positively and significantly influences farmer's participation in supplying *teff* to the market at 1% significance level. And also Muhammad (2011) has indicated in his study of market chain analysis of *teff* and wheat the case of Halaba district has found that Access to credit was influenced volume of wheat supplied to the market positively and significantly at 5% level.

Table 6: Determinants of volume of *teff* supplied to market (2SLS estimation result)

Variables	Coefficients	Robust Std. Err.	P-value
Quantity of *teff* produced (in quintal)	66.574***	9.191	0.000
Household size (in adult equivalent)	-5.739	5.201	0.270
Land holding size (in quintal)	39.638**	16.574	0.017
Farm experience in *teff* production (in year)	-1.852	1.285	0.149
Number of extension contact	-1.400	4.295	0.744
Using credit (1=Yes, 0= No)	45.571*	26.604	0.087
Livestock holding (in TLU)	3.655	4.539	0.421
Access to market information (1=yes, 0=No)	18.811	21.405	0.380
Distance from nearest market (in Kilometer)	-9.869**	4.462	0.027
Constant	25.656	65.359	0.695
Number of observation	122	Prob>chi^2	.000
Wald chi^2	375.44	R- Squared	.857

While ***, **, and * are significant at 1, 5 and 10% respectively
Source: Own survey result of 2018

Distance from the nearest market center (DISMKT): Is continuous variable hypothesized to affect volume of *teff* supplied to the market negatively and the study result showed that distance from the nearest market center

affected volume of *teff* supplied to the market negatively at 5% significance level. Negative coefficient shows that as the distance from the nearest market center increases by one kilometer the volume of *teff* supplied to the market decreases by 9.87 Kilogram. The same study by Efa (2016) indicated that, distance from the nearest market were negatively and significantly influences the intensity of marketed surplus at 10% significant level. When the household is located one Kilometer away from the market, the quantity of *teff* sold decreases by 2%. And also consistent with study by Zamasiya *et al.*, (2014) which indicated that, soybean market participation by smallholder farmers in Zimbabwe in which distance to the market negatively affected smallholder farmers' extent of market participation and quantity sold.

4. Conclusion

Generally diversifying land uses, using inputs, getting training, making extension contact with agents, using credit, improved seed and weed killers were used to increase productivity of *teff* which contributes for surplus increment and leads farmers to choose appropriate channel. The financial sector can fund the production of *teff* products whilst the government can provide subsidized inputs to the small holder farmer. This multispectral approach will definitely yield the required result of increasing income for the smallholder farmer. The government can also incorporate technology in the curriculum of institutions of higher learning.

The private sector can also contract the smallholder farmer by equipping them with the inputs and credit and thus later buy the products to distribute it for the area where this product has shortage. There is need to reduce over reliance in the importing of key production inputs such as fertilizer and weed killers. Imported inputs have meant that the domestic farmer inputs costs has risen and remained higher. There is need to reduce the cost of inputs by importing it without tariff for *teff* production and boost local production to encourage more smallholder farmers. The question that now arises and needs to be addressed in order for the productive farmers to become profitable is do they have the business idea, access to finance, infrastructural support and access to transport and market? One of the most practical solutions to this dilemma is the division of responsibilities between the private sector and Non-government Organizations. NGOs can aware farmers through capacity building activities such as farmer group strengthening and business training activities. One aspect of value chain implementation might be enhancing access to mechanization or other means of enhancing the resource that smallholders have to manage their land. The farmer needs adequate financing on the farm and marketing operations. The farmer needs a special bank to address their particular needs of through specialized concessionary interest rates to promote the expansion of production. In addition they are needed to upgrade production and consistent input supply to improve *teff*.

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