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Determinants of Smallholders' Teff Market Supply: The Case of Guji Zone, Oromia Regional State, Ethiopia

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ABSTRACT

This study aimed at identifying the determinants of smallholders' Teff market supply in the case of Guji Zone. The study was based on cross-sectional data collected from 332 randomly selected Teff producing farmers. Descriptive and econometric methods of data analysis were used to analyze the data. The multiple linear regression model results showed that the number of oxen owned by farm households, frequency of extension contact, education level, improved seed, and distance nearest to the market significantly affected the volume of Teff supplied to the market. Supporting the existing extension system through training in all aspects is very important. Moreover, an improvement of existing road facilities would reduce the time spent to reach the market and it would minimize transportation costs the government should provide an efficient extension system, updating the extension agent's knowledge and skills with improved production and marketing system.

Keywords: *Teff, Market, Multiple linear regression model*

INTRODUCTION

Famous Russian botanist, agronomist, plant geneticist, and plant breeder Ivanovich Vavilov and Nikolai, (1992) concluded that Ethiopia is the center of origin of Teff (Eragrostis Teff) after an expedition to Egypt and Somalia in 1927. This was later deep-seated by the well-known US plant geneticist Jack Harlan who named Teff "the noble crop of Ethiopia" (Andersen and Winge, 2012).

Teff is an important crop that is mainly used for agricultural income and food security for the people. On the consumption side, Teff makes the leading food crop in the consumption basket (FAO, 2012). When it is compared with other cereals, Teff is unable to tolerate adverse climate situations hence it is considered a lower risk crop and it is commonly grown at middle elevations between 1,800 and 2,200 meters above sea level and in areas where there is sufficient rainfall. Its

grain is generally used for making injera, a spongy flatbread, Ethiopia's (and Eritrea's) nationwide food (Fufa et al., 2011).

Teff is Ethiopia's valuable staple crop which is cultivated over nearly 3.02 million hectares, which accounts for 24 percent of land area under cereal farming, and the chief share of all staple grains in Ethiopia. In 2017, Teff accounts for 3,017,914 (24percent) of the grain area, followed by maize 2,135,371 (17percent), sorghum 1,881,970 (15percent) and 3.675ton/ha and 2.525ton/ha, 1.664 ton/ha produce respectively and it is the second most vital cash crop generating 464$ million per year for farmers (Hyejin, 2018).

Some of the attractive features of agricultural marketing schemes in market economies are their structure is determined by the different factors. These include economic, demographic, social, legal, and climatic factors in addition to the characteristics of the raw materials and consumer products. Effective marketing systems are formed by these impacts and tend to change as these underlying influences change. However, it is possible to get involved in the marketing process in ways that advance the functioning of the system or speed up alterations that are previously in progress (Lawrence, 2003).

Amhara and Oromia are the two major regions that account for 85.5percent of Teff's cultivation area and 87.8 percent of the Teff production. Due to the high price, the city wealthy consumers consume quite more Teff than the rural consumers. However, Teff has limitations to turning into an income-generating overall product for Ethiopian producers. Some of the limitations are low production related to other cereals, high labor-input requirements, absence of infrastructure, and an inefficient market (Hyejin, 2018).

This study was conducted in the Guji zone, Oromia Regional State, and Teff is the main crop and an income source of smallholder farmers in the study area. However, to the best of my knowledge, the studies on the factors affecting the supply of Teff to the market have not been studied yet in the study area. Hence, this study focused on the major factors affecting the Teff market supply in the case of this Woreda.

Statement of The Problem

The agricultural sector in Ethiopia remains to look at a set of limitations that constrain advanced growth. Some of these limitations can be weak markets at federal and regional levels, and public and private sector partners' lack of capacities to implement. The efforts of growing agricultural production and output require a well-performing marketing system that satisfies consumer demands with the lowest margin among producers and consumers' prices. That is, higher prices for producers can inspire farmers to accept new know-how and increase production (Wolday, 1994).

Better information and marketing empower farmers to produce their products more consistently with market demand, plan their harvest at the most profitable time, choose which market to sell their yields, support traders to transport their products from excess to shortage market and make decisions about the economics of storage, where technically possible. Therefore, the market information is critical to the price finding process (Khol and Uhl, 2002).

Provision of improved and high-yielding varieties, chemical fertilizer, pesticides, and insecticides may favor the farmers in increasing production; however, this is not an end to the aforementioned. Therefore, without a modern marketing system, together with communications, transportation, storage facilities, and financial arrangement this is not possible (Khuls and Uhl, 2002). Ethiopian agricultural product markets are characterized by a poor transport system, a limited number of traders, inadequate capital facilities, high handling costs, inadequate market information system, weak bargaining power of farmers, and underdeveloped industrial sectors (Jema, 2008).

Teff is a major crop produced by the majority of farmers in the study area. The woreda was known for the high potential in the production of Teff and 85 percent of the land was cultivated for Teff production. Though there is high production potential for this crop, its income-generating capacity is low as compared to its production potential, due to factors such as; lack of access to the market, and the lack of a properly functioning marketing system which often resulted in lower producers' price, inefficient market chain, lack of market information, lack of infrastructure (transportation, storage facilities), lack of linkages with traders, broker interference and the others in the study area. Therefore, these problems desire more work in the market approach to recognize and resolve the problem of the Teff market in the study area.

Although some related studies on Teff marketing such as Tadele, et al, (2016), (Wolday, 1994), (Yadeta and Temesgen, 2016), (Muhammed 2011), (Azebe and Tadele, 2017) and (Girma, 2015) were carried out somewhere in Ethiopia and there **are** contradicting findings. Thus, this study attempts to examine the major factors affecting Teff market supply in the study area.

RESEARCH METHODOLOGY

Description of The Study Area

Adola Rede Woreda is located in the Guji Zone, Oromia Regional State, with an estimated area covering 1401 square kilometers. It is located 475 km far away from Addis Ababa, the capital city of Ethiopia, and 142 km away South West from Hawasa, the capital city of the Sidama Region. It is bordered on the South and East by the Shakiso Woreda, on the west by Wadera Woreda, and the North by Annaa Sorraa Woreda. Topographically, this Woreda is located at an elevation of 1500 to 2500 meters above sea levels, and the Woreda is also located at a latitude and longitude of 6012'38" N and 39012'37" E respectively ARDAO (2019). The geographical location of the study area map is shown in the figure below. The Woreda consists of 3 Urban and 28 Rural Kebeles with an estimated total population of 149,735 of which 77,862 are male and 71,873female (CSA, 2015). Of the entire population, men are 52% and the remaining 48% are Females.

According to the classification used in Ethiopia, the climatic condition of the Woreda is characterized as a semi-arid climatic zone. The area receives a bimodal rainfall where the high rains are between August to October and the small rains are from February to April. However, during the main rainfall, the crops grown and planted in the area are Maize, Teff, Wheat, and Sorghum, but the Teff crop is intolerant to excessive rainfall. The best time for Teff sowing is from the beginning of September to mid-October when cultivated as a rain-fed crop. Maturity depends on the weather condition and it usually varies from 90-115days, the harvesting time is from the beginning of January to February. The Woreda has 33, 24, 30, 20, and 17 percent of arable, under cultivation, pasture, forest, and swampy land respectively. The temperature of the area ranges between 12^{o}c and 18^{o}c with an average mean annual temperature of about 20^{o}c. the mean annual rainfall is 1700mm. Lowland, Midland, and Highland agro-ecological zones characterize Woreda's climate. The soils of the area are believed to be relatively fertile and during good rains, farmers can harvest good yield even without fertilizer application (ARDAO 2019).

Research Design

Research design is necessary because, it facilitates the smooth sailing of the various research operations, thereby making research as efficient as possible yielding maximal information with minimal expenditure of effort, time, and money (Kothari, 1990). Descriptive and explanatory research designs were employed. The study used these research designs to assess the effects of the socio-economic and institutional factors on Teff market supply in the study area.

Sources and Methods of Data Collection

To collect reliable data, both primary and secondary sources of data were used. The primary data was collected from farmers (sample households of Teff producers), traders, and others who have a relationship with this focus area, using an unstructured questionnaire, personal observation, oral interview, and key informant interviews. Woreda offices information, published and unpublished documents, bulletins, and websites were visited to generate relevant secondary information focusing on the supply of Teff to the market.

Sampling Technique and Sample Size Determination

For this study, a multistage sampling procedure was applied. In the first stage, out of fourteen rural Woredas of Guji Zone, Adola Rede Woreda was selected purposively as it is one of the highest Teff producing Woredas in this zone. The Woreda has four Urban and 28 Rural Kebeles. In the second stage, from the total of 28 rural kebeles of the Woreda, three Teff producing kebeles were selected randomly because of production potential. Finally, among a total of 1,943 Teff producer household heads that exist in three kebeles namely; Gunacho, Bilu, and Orone, 332 samples of household heads were selected randomly using probability proportionate to size. The sample size was determined following a simplified formula provided by Yamane (1967). Accordingly, the required sample size at a 95% confidence level with a degree of variability of 5 percent is determined as follows:

$$n = \frac{N}{1+N(e)^2} \qquad n = \frac{1943}{1+1943(0.05)^2}$$

N=**1,943**, Then the sample size **(n) =332**

Where 'n' is the designed sample size, 'N' is the total number of Teff producer household heads and 'e' is the level of precision (margin of errors) at 5 percent.

Methods of Data Analysis

To analyze data econometrics, descriptive and inferential statistical methods were applied. Descriptive analyses such as mean, standard deviation, ratio, frequency, and percentiles were used to explain and interpret the data obtained from sampled households. To determine and predict the current qualitative findings and their effects on factors affecting the quantity of Teff supplied to the market Multiple Regression Model was applied. Accordingly, STATA version 13 was used for testing hypotheses related to the objective of the study.

Multiple linear regressions to analyze the market supply of Teff

In this study, multiple linear regression was employed. Multiple linear regressions take into account the inter-correlations among all variables listed below. This method was used to examine the effects of independent variables on the dependent variable. Since Teff is a cash crop that all farmers in this area decided to produce for selling purposes to earn cash. Therefore, all the sampled Teff farmers of the study area supply Teff to the market. Since the dependent variable is a continuous multiple linear regression model fits to survey data to identify the determinants of Teff supply to the market. Following (Greene, 2000), the econometric model specification of the multiple linear regression models in matrix notation is:

$$\gamma_i = \beta_{Xi} + \varepsilon_i$$

Where: Y_i = Teff supplied to the market and "i" = 1, 2, 3, 4…, B_i = a vector of estimated coefficient of the explanatory variables, X_i = a vector of explanatory variables, ε_i = disturbance (error) terms

Model Specification $Y_i = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12})$

➲ Therefore the equation was;

$$\boldsymbol{\gamma = \beta_0 x_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \varepsilon_i}$$

Where; Y = Quantity of Teff Supplied to the Market, X_1 = Price of other crops, X_2 = Family size X_3 = Number of Oxen owned, X_4 = Improved seed, X_5 = Distance to the nearest market, X_6, = Educational level of the house headed, X_7, = Frequency of Extension Contact, X_8, = Utilization of Credits, X_9, = Experience of Household, X_{10}, = Income from non-farm activity, X_{11}, = Price Information

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}, \beta_{11}$, *and* β_{12}, are the coefficients associated with each independent variable, which measures the change in the mean value of y, per unit change in their respective

independent variable. Regress quantity of Teff supplied to the market (as dependent variable) on the selected linear combination of independent variables using multiple regressions.

Regression Diagnostic

Multicollinearity problem among continuous variables and check associations among discrete variables, which seriously affects the parameter estimates was tested. According to Gujarati (2003), **Multicollinearity** refers to a situation where it becomes difficult to identify the separate effect of independent variables on the dependent variable because of existing strong relationships among them.

The two measures that are often suggested to test the existence of Multicollinearity are Variance Inflation Factor (VIF) and Contingency Coefficients (CC). Thus, Variance Inflation Factor (VIF) is used to check Multicollinearity among continuous variables. As a rule of thumb, if the VIF is greater than 10 (this will happen if R^2 is greater than 0.90), the variable is said to be highly collinear (Gujarati, 2003). A measure of Multicollinearity associated with the variance inflation factors is computed as:

$$VIF\ (X_i) = (1\text{-}R_i^2)^{-1}$$

Where Ri^2 is the coefficient of determination, the larger the value of Ri^2 is, the higher the value of VIF (X_i) causing higher collinearity in the variable (X_i).

The contingency coefficient is used to check Multicollinearity or association between discrete variables. The value ranges between zero and one, with zero indicating no association between the variables and a value close to one indicating a high degree of association between variables. A popular measure of Multicollinearity associated with the CC is defined as:

$$cc = \sqrt{\frac{\chi^2}{N + \chi^2}}$$

Where CC is the contingency coefficient, $\chi 2$ is the chi-square test and N is the total sample size. If the value of CC is greater than 0.75, the variables are said to be collinear. Therefore, the Multicollinearity problem among continuous variables and associations among discrete variables was checked using VIF and CC.

Heteroscedasticity was undertaken for this study. There are several test statistics for detecting Heteroscedasticities such as Park, Breusch-Pagan, Godfrey, White's testes, and Koenker Bassett (KB) test of Heteroscedasticity. However, according to Gujarati (2003), there is no ground rule to say that one test statistic of Heteroscedasticity is better than the others. Therefore, due to its simplicity, the Breusch-Pagan (BP) test of Heteroscedasticity was used for this study.

Definition of variables and Working hypothesis

Dependent variable:

Quantity of Teff Supplied to the Market (QNT-SUPPM): It was a continuous variable that represents the dependent variable and the actual supply of Teff by individual households to the market, which is measured in kilograms in the 2017/18 production year.

Independent variables:

The following explanatory variables were hypothesized to influence the marketed supply of Teff in the study area.

Price of Wheat (PR-WHEAT): Continuous variable can be measured in Birr per quintal. According to Mohammed (2011), an increase in the price of wheat produced on the farm has a negative effect on the supply of Teff. In this case, the price of Wheat was taken as a variable since it was an important potential substitute for the Teff crop in the study area. Therefore, the Price of Wheat was hypothesized to affect the household level of Teff market supply negatively.

Family Size (FMSIZE): It is a continuous variable and measured in terms of adult equivalent. A household with more number of family members was assumed to supply less amount of *Teff* to market than those households with a relatively less number of family members because of the increase in consumption. Having more household members reduces the proportion of output that goes to the market because households with large members tend to consume more of what they have produced and less is available for sales (Efa et al., 2016). Therefore, the family size was hypothesized to affect the household level of Teff market supply negatively.

Number of Oxen Owned by Households (N-OXEN): it is a continuous variable that was measured by taking into consideration the number of oxen owned by the head of the household and is expected to affect the marketable supply of Teff positively (Girma, 2015).

Improved Seed (IMP-SEED): it is a dummy variable and takes a value of one if a farmer uses improved seed and zero otherwise. Improved seeds are associated with high productivity levels and a better capacity to resist diseases (Abay, 2007). Therefore, the use of improved seed is expected to have a positive effect on Teff's market supply.

Distance to Market (DISTMARKET): It is a continuous variable and was measured in kilometers in which farmers spend time selling their products to the market. As the distance from the nearest market increases, variable transport costs increase and this discourages smallholder farmers from selling high volumes of Teff (Efa 2016). Hence, it was hypothesized that market distance affects the volume of sales negatively.

Education Level of Household Heads (EDUHH): It is a continuous variable and measured using years of formal schooling of the household head and hypothesized to affect market supply positively. It is believed that, if a farmer attained formal education of any level, there is a tendency to accept technologies that will increase production, which has a direct relationship with supply to the market. Zekarias *et al.* (2012) indicated that education positively affected the market supply of coffee. Therefore, the education level of the household head was hypothesized to affect the Teff supply at the farm household level positively.

Frequency of Extension Contact (FREQ): It is a continuous variable measured in the number of visits (in a month) by the farmer to the Development Agent (DA). Farmers that have frequent contact with DAs (development agents) have better access to information and could adopt better technology that would increase their market supply of Teff. Extension services were found to be essential in disseminating improved methods of farming which are important in increasing agricultural productivity (Njane et al., 2007). In this regard, extension is assumed to have a positive contribution to farm level market supply of Teff.

Utilization of Credit (UTCR): Utilization of credit is measured as a dummy variable taking a value of '1' if the household used credit and zero otherwise. Among other things, credit utilization is assumed to have a positive significance to the market supply of Teff, because a farmer who gets credit service can purchase inputs and improved varieties and hence increase the production and market supply of Teff and supply Teff to alternative markets at the Woreda level (Mohammed, 2011).

Farming Experience of Household (EXP-HH): it is a continuous variable measured in the number of years in Teff production. A household with a better experience in Teff farming is expected to produce more amounts of Teff than the one with only less experience and, as a result, Teff producing farmer is expected to supply more amounts of Teff to market. Therefore, experience in Teff production was expected to have a positive relationship with the farm-level market supply of Teff. Abay (2007) found that as farmers' experience increases the Agricultural product supplied to market increases in Fogera. Therefore, there is a direct relationship between experience and the supply of Teff to the market.

Income from Non-farm Activity (INCOME): It is a dummy variable measured in terms of whether the household obtained income from off and non-farming activities. It is '1' if the household is involved in non/off-farm activities and '0' otherwise. The study hypothesized that, if the earning from the non/off-farm income is higher than the Teff production, mostly the farmers shift towards the non-farm income activities. Therefore, it is hypothesized to influence the volume of Teff supply to market negatively.

Price Information (PR-INFORM): This is a dummy variable taking value 1 if farmers have price information from radio, newspaper, or information board, and zero otherwise. This is an important variable in any marketing because price information highly influences the commodity prices, and hence has a significant impact on the amount of Teff market supplied. Therefore, it is hypothesized that access to price information positively affects the amount of Teff supplied to the market because as farmers access market information, the quantity of Teff sold at the market also increases (Tadele, 2016)

RESULTS AND DISCUSSION

This paper presents the results and discussions the core findings of this study. Thus, it is organized into two sections. The first section provides descriptive analyses of the socio-demographic characteristics of sampled households. The second section is about the econometric analysis of factors affecting the Quantity of Teff supplied to the market using multiple linear regression models.

Descriptive Statistics

Demographic and Socioeconomic Characteristics of Teff Producers

The variables used to describe demographic and Socioeconomics Characteristics of sample farmers are educational level, sex, age, family size, production experiences, Off/Non-farm income, Resource Ownership, Tenure, and Others.

The survey result indicated that about 20.53 percent of the sampled household heads are illiterate. However, 56.94 and 22.22 percent attended primary, and Junior school respectively, whereas none of the respondents attended Secondary school and above in the study area. In both theoretical and practical situations, education level plays an immense role in ensuring household access to basic needs such as food, shelter, and clothing. Skills and education amplify the working efficiency resulting in more income and food security. Furthermore, education is important to manage the business as well as in decision making.

The mean family size of the total sample households was 3.89 persons. The household provides a major source of labor for crop production. The labor available for work per household is directly proportional to the family size. The respondents have an average of 21.58 years of farming experience in Teff production with a standard deviation of 6.93 years.

The land is perhaps the single most important resource/factor of production and measure of wealth in the study area. The average land owned, land rented out, Cultivated Land, and land allotted for Teff by Teff producers are 2.54, 0.00, 1.00, and 0.76 hectares respectively. Sampled Teff producing farmers reported that they have to travel an average of 9 km (approximately) with corresponding standard deviations of 3.88. The minimum and the maximum distance that sampled Teff producing respondents had to travel to the nearest market centers were 6 kilometers and 15 kilometers, respectively.

The availability of transport services is very important for the respondents. Because it allows farmers to transport their product from surplus areas to deficit areas. Moreover, to transport products from farm to home, they need the existence of quick transport. The result of this study showed that 43.18 %of the sampled respondents have transportation like a motorbike, animal back and animal pulled cart while the majority of them (56.82 %) of the sampled respondents do not have the transportation. From this, it is concluded that the lack of ownership of the transportation decreased the supply of Teff to the market in the study area.

In the study area, Trading in livestock or livestock products, Daily worker (laborer), Sales of charcoal, oxen fattening, and petty trade (small shops) are found to be some of the off/non-farm income-generating activities in which sampled farmers are participating. Of sampled households, about 18.75 percent are participating in on-off/non-farm income activities because of a shortage of land, and attractive income from off-farm activities whereas, 81.25 percent are not participating in off/non-farm income activities. From this, the researcher concluded that since the earning from the non/off-farm income is lesser, so mostly the farmers shift towards the farm income activities.

Table 1: Demographic and socioeconomic characteristics of respondents for Categorical variables

Variables		Frequency (N=332)	Percent
Educational level	Illiterate	69	20.83
	Primary	189	56.94
	Junior	74	22.22
	Others	--	--
Off-Farm Income	Yes	62	18.75
	No	270	81.25
Transportation	Yes	143	43.18
	No	189	56.82
Cooperative	No	332	100

Source: Own survey result 2019

Table 2: Demographic and socioeconomic characteristics of respondents for Continuous variables

Variables	Mean	Std. Dev.	Min	Max
Age of farm households	39.10	11.81	21	70
Experience of farm HHs	21.58	6.93	10	39
Family Size	3.88	1.98	1	9.2
Production experience(Years)	21.58333	6.93	10	39
Total owned land(ha)	2.54	0.853	1	6
Total Cultivated land(ha)	1.00	0.35	0.5	2
Total Land allotted for Teff(ha)	0.763	0.264	0.5	1.5
Nearby market(Km)	9.652778	3.881676	6	15
Woreda Market(Km)	9.652778	3.881676	6	15

Source: Own survey result 2019

Livestock Ownership with their Corresponding Value in 2019

Livestock production is an integral component of the farming system. Farmers in the study area undertake both crop and livestock production activities. Though livestock holding size varied among the sample farmers, livestock is kept for various economic like generation of cash income, food and

animal dung (as an organic fertilizer and fuel), and social reasons in the study area. Important animals kept by the sample farmers are oxen, cows, heifers, and donkeys. Oxen are the main source of farm power for plowing, harrowing, and threshing. The sample respondents on average have a pair of oxen (2.11) with a standard deviation of 2.29. The average number of sold Oxen and obtained income by the household head are 0.69 with a standard deviation of 1.25. Additionally, the sampled respondents on average have 0.812 cows with an average income of 2395.8 Birr (table 3 below).

Table 3: Livestock ownership with their corresponding value in 2019

Type of livestock	**Ave. Nº of owned**	**Ave. Nº of sold**	**Average Cash income from sold**
Cows	2.67(3.49)	0.812(1.13)	2395.8(3616.2)
Oxen	2.11(2.29)	0.69(1.25)	8363.89(15118.84)
Donkey	1.30(1.25)	--	--

Source: Own survey result, 2019

3.1.4: Production of Teff and Major Crops Produced in 2019

As presented in table 4 below, in the study area, Teff is produced with an average of 0.76 hectares. Every farmer produces Teff on his farm and supply to the market. Empirically, the sampled Teff producing farmers confirmed that in addition to Teff, they also produce other farm products like Maize (1.07 ha), Wheat (0.67 ha), and Barley (0.34ha).

Table 4: Major crops produced and marketed by sampled households in 2019

Variables	Teff	Maize	Wheat	Barely
Area cultivated(ha)	0.76(0.26)	1.07(0.28)	0.67(0.4}	0.34(0.01)
Quantity produced per ha (qt)	10.25(3.80)	13.47(3.95)	13.36(10.07)	3.25(0.80)
Quantity consumed (qt)	0.24(0.43)	9.77(3.96)	9.01(2.96)	0.24(0.43)
Quantity sold(marketed) per (qt)	4.26(2.06)	3.35(1.20)	4.35(0.97)	3.01(0.37)

Source: Own survey result in 2019 Numbers in parenthesis () indicate Std. dev.

Following Teff, the production of Maize, Wheat, and Barley are the main sources of cash for farmers in the study area. Production of all the crops in the study area is rain-fed with only once a year harvest. Table 4 above depicted that, the average land allocated(area cultivated) for the production of Teff, Maize, Wheat, and Barley by sample Teff producing respondents are 0.76, 1.07, 0.67, and 0.34 hectares respectively with a corresponding standard deviation of 0.26, 0.28, 0.4 and 0.01 hectares. The

minimum and maximum lands allocated by sample respondents to the production of Teff are 0.5 and 1.5 hectares respectively.

Main Source of Labor for *Teff* Producers

As indicated in Table 5 below, 23.61 percent of sampled respondents' main source of labor is their own family, followed by a combination of family and hired labor which is 76.39percent. Since labor is an input for the improvement of production and productivity of a crop, in our case, Teff producers used all other sources of labor in addition to their family labor.

Table 5: Main sources of labor for sample Teff producers

Source of labor	Family	Hired	family and hired	Total
N (Freq.)	78	--	254	332
Percent (percent)	23.61	--	76.39	100

Source: Survey result, 2019

Farm Inputs Utilization

Fertilizer application is one of the most important agricultural practices that are used by Teff growers in the study area. Moreover, proper application of the recommended fertilizer rate is important to obtain the required production and productivity. Farmers (Teff producing sampled respondents) in the study area used DAP fertilizer rates ranging from 50kg to 100kg per hectare, which is related to a proper application of the recommended fertilizer rate to obtain the required production and productivity. In the study area, 38.8 percent of Teff producing sample respondents are Used DAP 50 kg/ha, whereas, the rest 61.11percent are Used DAP 100 kg/ha (Table 6).

Table 6, Agricultural input used by Teff producers

Variables	N (freq.)	Percent
DAP used 50 kg/ha	129	38.89
DAP used 100 kg/ha	203	61.11
Total	332	100

Source: Survey result, 2019

Access to Institutional Service of the Farm Households

Utilization of Credit Service: Finance is the crucial element that can be used for running the production and the marketing of the product and is one way of improving smallholder farmers' ability of Teff production and productivity. Farmers with access to credit may minimize the effect of financial constraints and be able to buy the necessary inputs which improve their Teff productivity

more readily than those with no access to credit. Therefore, it is expected that using provided credit can increase the production of crops in general and Teff in particular in the study area. As depicted below in Table 7, only 47.92 percent of sampled producers had got credit in the study area and the main objective of the credit is to purchase inputs such as fertilizer, improved seeds, and Farm livestock. Additionally, the only major source of credit in the study area is Oromia Savings and Credit institutions (OSCI).

Table 7: Taking of provided credit by OSCI to sampled households

Variables		Frequency	Percent
Credit	Taken	159	47.92
	Not taken	173	52.08
	Total	332	100

Source: Survey result, 2019

Reasons for Not Taking Credit

As indicated in Table 8 below, 12.50 percent of the respondents did not take credit due to the high-interest rate, 20.14 percent due to lack of need, and 19.44 due to the availability of other alternatives. According to the sampled farm households; Landholding, membership, collateral, and personal guarantee are the preconditions to getting credit in the study area. In taking formal credit, most of the sampled respondents perceived problems such as restrictive procedures, group lending systems, and high-interest rates in the study area. Savings and Credit institutions should change especially the practice of the "Group lending system" since members in a group cannot have the same attitude and commitment as there are personal differences. Hence, this institute should allow individual lending systems. Savings and Credit institutions should also minimize the interest rates that they charge to strengthen farm household spirit and the procedures for securing loans must be simplified to support smallholder farmers.

Table 8: Reasons for not utilizing credit of Teff producers

Reasons	Frequency	Percent
High interest rate	14	12.50
No need	25	20.14
availability of other alternatives	24	19.44

Source: Own survey result, 2019

Frequency of Extension Contact and Access to Market/Price information

The frequency of extension contact is also expected to have a direct influence on the production and marketing of Teff behavior of the farmers. To give effective extension service to the farmers the region assigned Two DAs in each Kebele. The DAs are a graduate of different Universities with Qualifications in Two agricultural streams Plant Science, and animal husbandry. 20.14 percent of the sampled farmers reported that they have been receiving extension contact out of which 90.3 percent received technical advice like a seedling, transplanting, harvesting, spacing, compost preparation, post-harvest handling, storage, and input use like chemical application, fertilizer application on different types of crop.

Lastly, the government has been attempting to fill the required knowledge gap and achieve food self-sufficiency in the country by placing at least two development agents (DAs) in each Kebeles and building a Farmer Training Center (FTC). The Kebele level development agents are important means of transferring new agricultural technologies and improving the farmer's capacity for innovations. The effort to disseminate new agricultural technologies is influenced by the efficiency of communication between the development (change) agent and the farmers at the grassroots level. The survey result indicated that about 20.14 percent of the sampled farmers had access to market information from the nearby market and 79.86 percent had no access to market information. The type of information provided is output price information. The sampled respondents revealed that the major sources of market information in the study area are Other *Teff* farmers (Table 9).

Table 9: Farmers' access to price information

Variables	**Teff Growers (N=332)**
Nearby market information (Yes, percent)	67, 20.14
Nearby market information (No, percent)	265, 79.86
Sources of information	
Other *Teff* farmers	332, 100

Source: Own survey result, 2019

Econometric Result

In this study, the factors that affect the market supply of Teff to the market are analyzed. Before fitting multiple linear regressions, all the hypothesized explanatory variables are checked for the existence of Multicollinearity, omitted variable, Heteroscedasticity, and Endogeinity problem.

Test of Multicollinearity: The degrees of Multicollinearity among the explanatory variables have been tested using VIF for continuous variables and contingency coefficient for dummy variables.

The results for all VIF are ranging between 1.05 and 2.32 with a mean Variance Inflation Factor (VIF) of 1.46. Therefore, Since VIF is less than 10, Multicollinearity cannot be a problem.

Contingency Coefficient: The decision criterion is that variables with a contingency coefficient closer to one would be avoided from further consideration in the analysis. Since the contingency coefficient is less than 0.75 which is 0.0072, therefore, there is no high degree of association between the variables.

Table 10. Multi-co linearity test result for continuous and dummy variables

Variable	VIF	1/VIF
Number of Oxen Owned	2.03	0.49
Distance Nearest to Market	1.76	0.57
Frequency of Extension Contact	1.36	0.734
Price of Other crops	1.15	0.87
Nonfarm Income	1.13	0.887
Experience of HH	1.08	0.923
Family Size	1.05	0.95
Mean VIF	1.46	

Table11. Contingency coefficient of dummy variables

	Improved seed	Education Level	Utilization of Credit	Access to market information	Membership
Improved seed	1.0000				
Education Level	0.2520	1.0000			
Utilization of Credit	0.1694	0.4805	1.0000		
Access to market information	0.0333	0.1207	0.1940	1.0000	
Membership	.	.	.	.	.

Omitted variable; the problem of omitted variable is tested using the Ramsey RESET test. Since the p-value for this test is 0.9828, there is no omitted variable problem in this model.

Table12. The existence of omitted variables (checked)

Ramsey RESET test using powers of the fitted values of QSUPPLY
Ho: model has no omitted variables
F(3, 106) = 0.06
Prob > F = 0.9828

Test of Heteroscedasticity: if there is a Heteroscedasticity problem in the data set, the parameter estimates of the coefficients of the independent variables cannot be BLUE. Therefore, to overcome the problem, Robust OLS analysis with Heteroscedasticity consistent covariance matrix is estimated. The problem of Heteroscedasticity is tested using Breusch-Pagan / Cook-Weisberg test. Since the

Prob > chi2 = 0.0003, therefore, there is a Heteroscedasticity problem in this model, But to overcome this problem, Robust OLS analysis is applied.

Among a total of 11 explanatory variables (8 continuous and 3 dummy) included in the econometric model four variables namely education level of farm household, Improved seed, number of oxen owned by farm households, and frequency of extension contact are found to significantly influence the market supply of Teff positively and one variable viz; distance nearest to the market is significantly influence the market supply of Teff negatively (Table below).

Table 13: OLS results of factors affecting Teff market supply

Number of obs. = 332, F(11, 320) = 51.32, Prob. > F = 0.0000 **R-squared = 0.7795, Root MSE = 1.7691**			
Quantity Supplied	**Robust Coef.**	**Std. Err.**	**P>|t|**
1. Price of other crop	-0. 003632	0.002929	0.218
2. Family Size	0.0758964	0.0820053	0.357
3. Nº of oxen owned	0.5375476	0.1939928	0.007***
4. Improved Seed	1.222979	0.4336419	0.006***
5. Dist. Nearest to market	-0.1491997	0.0760157	0.052*
6. Education Level	1.944036	0.3401812	0.000***
7. Freq. of Extension cont.	0.4336793	0.2093301	0.041**
8. Utilization of Credit	0.297679	0.3489208	0.395
9. Experience of Farm hh	0.006199	0.0328423	0.851
10. Off-farm Income	-0.5925609	0.3596178	0.102
11. Access to price Info	-0.3597831	0.3235917	0.269
_CONS	4.175346	1.340127	0.002***

****, ** and * are statistically significant at 1%, 5% and 10% probability level, respectively*

Source: own survey data (2019)

R Squared; The overall goodness of fit of the regression model is measured by the coefficient of determination R^2 lies between 0 and 1, the closer it is to 1, the better the fit. Hence, the R squared value of 0.7795, maybe realized that 77.95 percent of the variation is explained by the given independent variables. The remaining 22.05 percent of the variance is explained by other variables not included in this study. The F test: shows the Model is the goodness of fitness because of the Prob. > F = 0.0000

Improved Seed (IMPSEED): This is a dummy variable and takes a value of one if a farmer uses improved seed and zero otherwise. It is also found to influence the volume of Teff supplied at the household level to the market positively and significantly at a 5 percent significance level. The model

result showed that a one-quintal increase in Teff yield resulted in a 1.223-quintal increase in the volume of market supply of Teff keeping other factors constant. Improved seeds are associated with high productivity levels and a better capacity to resist diseases (Abay, 2007).

Education Level of Farm Households (Edu-HH): Education has shown a positive effect on Teff quantity supplied to market with a 1 percent of the significance level. The survey results revealed that, if the education level increase by one year, the amount of Teff supplied to the market increases by 0.944 quintals, keeping other factors constant. This may be because the majority of the farmers in the study area are at a low level of education and thus enabling them to have better skills and better access to information to supply more Teff to market. Zekarias *et al.* (2012) indicated that education positively affected the market supply of coffee.

Many Oxen Owned (**OXEN**) - This variable has a positive effect on Teff supply to the market and was found to be statistically significant at a 1 percent significance level. If the number of oxen increases by one unit, the productivity of Teff increases by 0.537quintal, keeping other factors constant. Similarly, a study conducted by Girma, 2015 indicated that the number of oxen owned by the head of the household and expected to affect the marketable supply of Teff positively.

Distance Nearest to the Market: This variable has a negative effect on Teff supply to the market and was found to be statistically significant at a 10 percent significance level. The negative relationship indicates that the farther is a household from the Teff market, the more difficult and costly it would be to get involved in the Teff market. When the distance of the market (destination) is very farther from the origin of the product, the marketing costs, for example, transportation costs for their inputs and output be higher. The result shows that a one-kilometer increase in Teff market distance from the farm-gate reduces the quantity of Teff supplied to the market by 0.149 quintals, keeping other variables constant. Similarly, a study conducted by Efa 2016 indicated that, as the distance from the nearest market increases, variable transport costs increase and this discourages smallholder farmers from selling high volumes of Teff.

Frequency of Extension Contact: The result of the finding indicated that the frequency of extension contact is positively and significantly related to the volume of Teff supplied to the market at a 5 percent significance level. if the training like; technical advice, technological know-how (transferring new agricultural technologies and improving the farmer's capacity for innovations), harvesting, spacing, compost preparation, post-harvest handling, storage, and input use like chemical

application, fertilizer application on different types of crop production, given to farmers by DAs at least once a month increases, the amount of Teff supplied to the market increases by 0.434 quintals, keeping other variables constant. The result of this study goes along with the findings of many authors, for instance, Yishak (2005), and Rahmeto (2007) found that access to extension services on improved maize seed, and improved haricot bean respectively affected the marketable supply of each of the commodities significantly and positively.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The study was conducted in Adola Rede Woreda located about 485 km south of Addis Ababa. The area is known for its surplus production of agricultural commodities. However, determinants of the supply of crops in general and Teff, in particular, are not well understood. The study attempted to identify the major factors that affect the supply of Teff to the market in the study area. The selection of Teff is mainly based on its importance and marketability. Among a total of 11 explanatory variables (8 continuous and 3 dummy) included in the econometric model number of oxen owned by farm households, frequency of extension contact, education level, improved seed, and distance nearest to the market significantly affected the volume of Teff supplied to the market.

Recommendation and Policy Implication

Following the analysis made the following points are recommended. The result confirmed that education improves the readiness of the Teff producing households to accept new ideas and innovations which in turn enhances farmers' willingness to produce more and supply more to market. Therefore, government and other concerning bodies should emphasize encouraging farmers to learn adult education and provide short and intermediate practical based training, improvement of existing road facilities. Even though the Government assigned two DAs in each Kebeles, to give effective extension service to the farmers, the services they gave to farmers are much the expected level. Government should make supervision, control, and other important enforcement. Again, Efforts should be made to strengthen the linkage between Development (change) Agent and the farmers. As a result, the product and productivity of the crops will be increased. Hence, it is recommended to assign an efficient extension system, updating the extension agent's knowledge and skills with improved production and marketing system. In short, the farmer-extension-research linkages need to be strengthened.

Farmers who live far from the market without their means of transportation are unlikely to sell to private traders and cooperatives. Therefore, this study recommends that an improvement of existing road facilities will reduce the time spent to reach the market and lower transportation costs. The result of the regression analysis showed that Teff production had a significant influence on the supply of Teff. Hence, there should be a supply of improved seed at a reasonable price to improve farmers' efficiency in the production of Teff and other crops. Having more oxen by farmers is important to increase the production and productivity of Teff and other crops.

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