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Factors Affecting *Teff* (*Eragrostis tef*) Market Supply in Woliso and Becho Districts of South West Shoa Zone Oromia Regional State, Ethiopia

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Abstract

This study was aimed to analyze *teff* (*Eragrostis tef*) market chain in south west Shoa zone with objective of factors affecting *teff* market supply using two stage ordinary least square approaches. The majority of Ethiopia's population earns its livelihood primarily from agriculture. Cereals *teff* is the first in Ethiopia area coverage and production. *Teff* (*Eragrostis tef*) is a major staple food crop in Ethiopia. Both primary and secondary data were used in this study. Primary data was collected from 138 sampled farmers and 38 traders from both districts by using semi-structured interview. The OLS (ordinary least square) model results showed that seven explanatory variables significantly affected the quantity of *teff* supplied to the market supplied by smallholder producers. Age, education level and current market price were negatively and significantly affecting *teff* market supply. Distance to the nearest market, farm size, perception and quantity produced were positively and significantly influencing marketed supply of *teff*. Policy implications that were to take place highly recommendation those are relevant to improve *teff* marketing system in the study area which indicated production and market orientation were set based on the significant variables and raised problems by the stakeholders. To improve market supply of *teff* in the study area resolving the prevailing production problems deems a necessary condition.

Keywords

Market Supply, Ordinary Least Square, *Teff*, Woliso, Becho District

1. Introduction

The majority of Ethiopia's population earns its livelihood primarily from agri-

culture. 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 contributes about 35.8 percent to the national GDP and still about 70 percent of Ethiopian population is employed in the agriculture sector [1]. Ethiopia produces more cereal crops than other agricultural products with Cereals accounting for more than 60% of rural employment, 81% of total cultivated land, more than 42% of atypical household's food expenditure and more than 60% of total calorie intake [2].

Cereals *teff* is the first in Ethiopia area coverage and production. The scientific name of *teff* is *Eragrostis tef* [3]. In Oromia regional state, the land allocated for the production of *teff* in the year 2020 was 1,441,029.78 ha. Moreover, the regional production of *teff* in the year 2020 was 24,737,963.79 quintal with the productivity of 15.12 qu/ha which is less than the productivity of the country 16.64 qu/ha [4]. *Teff* (*Eragrostis tef*) is a major staple food crop in Ethiopia. *Teff* is grown at middle elevations between 1800 and 2200 meters above sea level and in regions that have adequate rainfall. Compared to other cereals, *teff* is considered a lower risk crop as it can withstand adverse weather conditions [5]. *Teff* is one of the most important crops for farm income and food security in Ethiopia. Its grain is mainly used for making *enjera*, a spongy flatbread, the main national dish in Ethiopia. *Teff* is also valued for its fine straw, which is used for animal feed as well as mixed with mud for building purposes.

2. Research Methodology

2.1. Description of the Study Area

The study was conducted in Woliso and Becho Districts of South West Shoa Zone of Oromia National Regional State. As indicated in **Figure 1** below, southwest Shewa zone is one of the zones of the Oromia Region in Ethiopia. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this Zone has a total population of 1,101,129, of whom 556,194 are men and 544,935 women. 149,878 or 13.61% of population are urban inhabitants.

Woliso district is far about 114 km southwest of Addis Ababa. It is located at 8˚32'23.0"N latitude and 37˚58'16.3"E longitude and altitude ranging from 1600 - 2880 meter above sea level. It receives annual rainfall ranging from 900 - 1900 mm. The mean minimum and maximum air temperature of the area is 10˚C and 35˚C, respectively. Agro ecologically, it is classified into *weinadega* (70%) and *dega* (30%) zones. Chromic and Vertisol are the dominant soil types found in the district. It is bordered by the south by Goro, on the west by Wonchi, on the east by Beco and on the north by Dawo districts of southwest Shewa zone [6].

Data and Sampling Procedure

The data used for this study was collected from primary and secondary sources. Formal sample survey methods were used to collect primary and secondary data. The formal survey was undertaken through formal interviews with randomly selected farmers and traders using a semi-structured questionnaire for

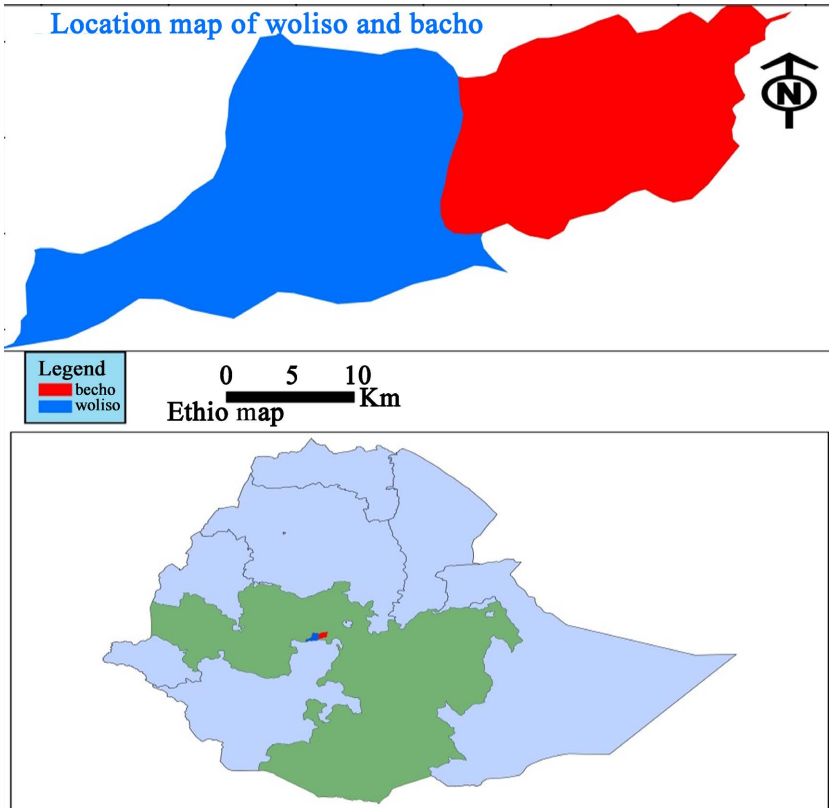

Figure 1. Location Map of Woliso and Bacho districts. Source: A geographic information system (GIS).

each group. Totally 138 sample farmers and 38 traders were selected randomly based on proportional to the population size using Cochran formula. Accordingly, the required sample size at 95% confidence level with degree of variability of 5% and level of precision equal to 9% are recommended to obtain a sample size required which represents a true population.

2.2. Data Analysis Technique

2.2.1. Factors Affect Market Supply of *Teff*

In estimating factors that affect household's levels of market participation, OLS (Ordinary Least Square) model is applicable if and only if all the households participate in the marketing of the commodity of interest. Growers supply part of their produce to the market. Therefore, for this study to achieve objective of factors that affect household's levels of market participation, multiple linear regression model was used to analyze determinants of *teff* market supply. This model is also selected for its simplicity and practical applicability.

OLS (Ordinary Least Square) can be used to estimate partial regression coefficients of multiple regression models. But, due to their simplicity and popularity, OLS methods can be used. Besides of this, OLS can be used if all households supply their produce to the market. The OLS procedure consists in so choosing the values of the unknown parameters that the residual sum of squares is as

small as possible. Following [7] the multiple linear regression model specification of supply function in matrix notation is the following.

$$Y = \beta' X + U . \quad (1)$$

where: Y = quantity of *Teff* supplied to the market

β' = a vector of estimated coefficient of the explanatory variables

X = a vector of explanatory variables

u_i = disturbance term.

2.2.2. Statistical Diagnostic Tests

After model, specification is done and before model estimation is made, it is important to test normality, multicollinearity and heteroscedasticity problems.

2.3. Definitions and Hypothesis Variables

2.3.1. Dependent Variable

Quantity of *Teff* supplied to the market: It is dependent variable that represents the amount of *Teff* actually supplied to the market by household in the year 2019/2020 that is measured in quintals or kilogram. A number of factors can influence the market supply of *Teff*. However, the importance of variables in explaining the produced amount is different depending on the crop type, area of production and degree of commercialization.

2.3.2. The Independent Variables That Influence Quantity of Market Supply of *Teff*

Age of the household head (AGHH): This is a continuous variable measured in years. The expected sign was positive. As an individual stays long, he/she has better knowledge and decides to allocate more size of land, produce more and supply more. Hence, direct relation was assumed between age and amount supplied. [8] found age of household head has positive effect on coffee supply. This implies that aged farmers supply more than younger one.

Level of Education (EDUCAT): It is a continuous variable and refers to schooling year for formal education of household heads. Education enhances information acquisition and adjustment abilities of the farmer, thereby improving the quality of decision-making [9]. Thus, education was hypothesized to have positive effect on market supply of *Teff*.

Family size (FAMSZ): It is a continuous variable, measured in adult equivalent lived under one home. Production is a function of labor, and availability of labor is assumed to have positive relation with quantity of supplied. Therefore, family size is expected to have positive impact on market supply. [10] shows that household size had significant positive effect on quantity of *teff* marketed. In this context, family size was expected to hypothesize to have a positive impact on market supply of *Teff*.

Experience of the household head (EXPHH): This is a continuous variable measured in number of years. A household with better experience of *Teff* farming is expected to produce more amount than the one with less experience and

so, he/she is expected to supply more amounts. Therefore, experience in *Teff* production have expected to a positive relation with market supply.

Market price: A farmer gets this price offer from selling his produce. It is a continuous variable measured in Birr per quintal in average and expected to influence market supply decisions positively. [11] shows that on determinants marketed supply of rice found a significant positive relationship between rice sold and selling price.

Frequency of Extension contact (EXTENS): This is a continuous variable, which is measured in terms of number of visit of the extension agent to the farmer during production season. Extension agents assist farmers in dissemination of new technologies, thus speeding up the adoption or use of new technologies and practices [12]. Farmers who have had frequent extension contact to be assumed have more production and as a result market supply.

Distance to the nearest market (DSTMKT): It is a continuous variable measured in kilometers. The closer the market the lesser the transportation charges, reduced transaction costs, and reduce other marketing cost [13]. On enhancing market orientation of smallholders on grain market supply in Ethiopia revealed negative relationship between grain market supply and distance to market. Therefore, as the market becomes far from the farm the market supply is low. According to the 2014 World Bank Poverty Assessment report indicates, poverty rates increased by 7 percent with every additional 10km distance from a market town. This is indicating that rural households who live far from towns are less likely to access farm inputs and to benefit from agricultural growth. Thus, distance to the nearest market will be hypothesized to have positive relationship with market supply of *Teff*.

Access to credit (ACCR): This is a dummy variable that represents access to both formal and informal credit for farm related purposes. It was measured as 1 if a farmer has access to credit and 0 otherwise. Access to credit is an important source of financing the agricultural activities of smallholder farmers [14]. Hence, access to credit was expected to have a direct relationship with the market supply. [15] found that access to credit affected the marketed surplus of pepper negatively.

Livestock ownership (LIVEST): This reflects the livestock ownership a farmer expressed in number of livestock. The farmer who possesses more number of livestock was expected to have more money for the purchase of agricultural inputs, and again has the chance to get oxen for draught power. Therefore, livestock ownership will hypothesized to have positive relationship with market supply of *Teff*.

Farm size (FARMS): This is a continuous variable expressed in hectare indicating the total land owned by a farmer. It was expected to take positive sign implying that the larger land size a farmer owns the more land size would be allocated for the crop of interest. Increase in size of land is assumed to directly influence market supply. [16] found expanding the area under crop increasing the

market supply of the crop.

Access to market information (ACMIF): This is a dummy variable and takes a value of 1 if a farmer has market information and 0 otherwise. Farmers marketing decisions are based on market price information, and poorly integrated markets may convey inaccurate price information, leading to inefficient product movement. Therefore, it is hypothesized that market information will expected to positively relate to market supply.

Weather condition (WC): This is a dummy variable and takes a value of 1 if weather condition favorable for production and 0 if bad for 2019/20 production season. This may be strengthened market supply of *Teff* on one side and may weaken it on the other side.

Quantity produced of *Teff*: It is the total amount of *Teff* produced in quintals in 2019/2020 production season in the study area. It was hypothesized that quantity produced of *Teff* affects marketable supply positively.

3. Result and Discussion

3.1. Econometrics Model Results

In this section factors affecting *Teff* market supply is presented and discussed.

3.2. Determinants of Market Supply

Factors that determine supply of *Teff* to the market were estimated using OLS model since all respondents used for this study supplied their *Teff* to the market. The hypothesized variables that were assumed to influence marketable supply were: age, level of education Family size, experience of household head, market price (current and lagged price), frequency of extension contact, distance to the nearest market, access to credit, livestock ownership, farm size, access to market information and Perception of households.

According to the OLS model outputs below Table 1 report indicates, seven variables (age, education level, current market price, Distance to the nearest market, farm size, weather condition and quantity produced) are statistically significant variables affecting market supply of *teff* by households. Age, Education level and current market price are factors adversely affecting market supply of *teff* while the remaining four variables positively affect market supply of *teff*. A combination of independent variables in the regression model explained 92% of the variation in the dependent variable with the remaining 8% for uncontrollable factors in the regression model.

However, interpretation of OLS model outputs is possible if and only if the basic assumptions of classical linear regression model are satisfied. There are many post-estimation tests used to check the satisfaction of the basic assumptions of multiple linear regression model. Tests for heteroscedasticity, omitted variables and multicollinearity are the most important post-estimation tests that must be reported with the OLS model outputs.

Table 1. 2SLS results for factors influencing quantity of *teff* supplied to market.

Variables	Coef.	Std. Err.	t	P > |t|
Age	−0.0362644	0.015	−2.37	0.020**
Education level	−0.159	0.091	−1.75	0.082*
Family size(adult)	0.0695	0.053	1.31	0.192
years of experience	0.015	0.0156	0.98	0.331
Market price	−0.00015	0.00026	−0.56	0.578
Frequency of extension contact	−0.083	0.065	−1.27	0.205
Distance to the market	0.1117	0.0239	4.68	0.000***
Access to credit	0.2444	0.2261	1.08	0.282
Livestock (tropical livestock)	−0.0218	0.030167	−0.72	0.471
Farm size	0.178	0.0933	1.91	0.058**
access to market information	−0.6211	0.449	−1.38	0.169
Weather condition	1.185	0.2882	4.11	0.000***
Quantity produced	0.6455	0.026	24.07	0.000***
_cons	0.814	1.609	0.51	0.614

N = 138, R^2 = 0.92, ***, ** and * significant at 1%, 5% and 10% respectively. Source: own computation from survey result.

Testes for heteroscedasticity

The test for heteroscedasticity after OLS suggests that the errors are of the same variance. The null that the errors have constant variance is accepted.

estat hettest

Breusch-Pagan/Cook-Weisberg test for heteroscedasticity

Ho: Constant variance

Variables: fitted values of Quantity sold

$chi^2(1) = 8.41$

Prob > $chi^2 = 0.0037$

Testes for omitted variables

The null that there is not omitted variable in the model is accepted suggesting that the model has no problem of omitted variable bias.

estat ovtest

Ramsey RESET test using powers of the fitted values of quantity sold

Ho: model has no omitted variables

F (3, 120) = 15.91

Prob > F = 0.0000

Tests for multicollinearity

The test for multicollinearity reported below suggests that there is no serious problem of multicollinearity among explanatory variables because the mean VIF is about 1.83.

Variables	VIF	1/VIF
Years of experience	3.51	0.28
Distance to the nearest market	2.64	0.38
Age	2.62	0.38
Quantity produced	2.27	0.44
Livestock	2.06	0.48
Total farm size	1.69	0.59
Total family size	1.59	0.62
Perception	1.57	0.64
Education level	1.40	0.71
Current market price	1.35	0.74
Lagged market price	1.31	0.76
Frequency of extension market	1.27	0.78
Access to credit	1.22	0.81
Access to Market Information	1.18	0.84
Mean VIF	1.83	

Ideally, a VIF of 1 indicates that the variable provides completely independent information or no multicollinearity. The higher the VIF, the more severe will be the effects of multicollinearity. *VIFj* = 2, for example, means that variance is twice what it would be if *x j* was not affected by multicollinearity. A *VIFj* = 10 is clear evidence that the estimation of *j* is being affected by multicollinearity.

Average of all VIFs considerably greater than 1 also indicates multicollinearity. The problems with VIF are that there is no hard and fast VIF decision rule. In practice, all VIFs are greater than 1. There is typically some degree of multicollinearity. How high is high? While there is no table of formal critical VIF values, a common rule of thumb is that if a given VIF is greater than 5, the multicollinearity is severe. VIFs are considered "bad" if they exceed 10 because 90% of the variance of *x j* is explained by the other *x*' *s*. There can still be severe multicollinearity even with small VIFs. In small samples, a VIF of about 5.0 may indicate problems. VIF is a necessary, not sufficient, test for multicollinearity.

Age: It is a continuous variable measured in years of households. It affects quantity of *teff* supplied to market negatively and significantly. As farmers age increased by one year the amount of *teff* supplied to market is decreased by 0.036quntal. This is because age of households as become older their probability of participation on market is decline when we compare with young farmers. This finding was in agreement with previous studies conducted by [17], on Market chain analysis of *Teff* in Tole districts. He finds that an increase in the age of household head by one year decreased the *teff* market supply by 0.28 quintal.

Education level: It is a continuous variable and refers to schooling year for

formal education of household heads. Education enhances information acquisition and adjustment abilities of the farmer, thereby improving the quality of decision-making [9]. It affects quantity of *teff* market supply negatively and significant at less than 10%. This indicate that education level decline market supply of *teff* by 15.5% this in reality households who have more educated prefer to sell other product rather than *teff*. This find was contradict with the finding of [17] which showed that education has positive effect on *teff* quantity sold.

Current market: The estimated coefficients of market price for quantity of *teff* market supply marketed was negative signs and significant at 5 percent significance level. This is in line with the hypothesis made. The coefficient of result indicates that for one unit increment of market price of *teff* market supply decrease by 0.0006 quintals.

Distance to the nearest market: It is a continuous variable measured in kilometers or walking hours. Accordingly distance to the nearest market affects quantity of *teff* market supply positively and significantly at 1%. This indicates that as farmers near to the market by one kilometer amount of *teff* supplied to the market increase by 11.17 present. The closer the market the lesser the transportation charges, reduced transaction costs, and reduce other marketing cost [13]. On enhancing market orientation of smallholders on grain market supply in Ethiopia revealed negative relationship between grain market supply and distance to market. Therefore, as the market becomes far from the farm the market supply was be low. This is indicating that rural households who live far from towns are less likely to access farm inputs and to benefit from agricultural growth. Thus, distances to the nearest market have positive relationship with market supply of *Teff*.

Farm size: It is a continuous variable refers to the total area of farmland a farmer owned. It is assumed that the larger the total area of the farmland 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 market. Accordingly the size of landholding affects quantity of *teff* market supply positively and significantly at 5%. As the area of landholding by farmer increased by one hectare, the quantity of *teff* supplied to market would increase by 17.8 percent. This result was in agreement with the finding of [18] implies that on average, increase in the farmers' farm size by one hectare resulted in increase the quantity of pineapples supplied to market holding other things remains constant.

Quantity produced of *Teff*: It is the total amount of *Teff* produced in quintals in 2019/2020 production season in the study area. It was hypothesized that quantity produced of *Teff* affects marketable supply positively. Accordingly, the result indicated that quantity of *Teff* produced affects market supply positively and significantly at 1% probability level. Positive sign of coefficients indicates that farmers who produce more quantity of *teff* supply increase volume of marketable supply.

4. Summary and Recommendation

The OLS model results showed that seven explanatory variables significantly affected the quantity of *teff* supplied to the market by smallholder *teff* producers. Age, education level and current market were negatively and significantly affecting *teff* market supply. Distance to the nearest market, Farm size, Perception and quantity produced were positively and significantly influencing marketed supply of *teff*. Based on the study policy interventions like.

Recommendations (policy implications) that are relevant to improve *Teff* marketing system in the study area which indicated production and market orientation were set based on the significant variables and raised problems by the stakeholders. To improve market supply of *teff* in the study area resolving the prevailing production problems deems a necessary condition. Among these increasing farmers' awareness on the importance of integrated crop management packages for increased productivity and sustainable production is one of them. In order to strengthen farmer's production potential, making available credit to farmers for input purchase also needs attention.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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