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RESEARCH ARTICLE

DETERMINANTS OF TEFF AND WHEAT MARKET SUPPLY IN DENDI DISTRICT, WEST SHOA ZONE, ETHIOPIA

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ABSTRACT

In Ethiopia, Cereal production and marketing are the means of livelihood for millions of small holder households and it constitutes the single largest sub-sector in economy. Out of the total grain crop area, 79.69% (8.7 million hectares) was covered by cereals. Teff and wheat covered up 23.42% (about 2.6 million hectares) and 13.01% (1.4 million hectares) of grain crops area respectively. Agricultural production and productivity is very low and the growth inagricultural output has barely kept pace with human population growth. Supply of agricultural crop in the study area is subjected to seasonal variation where surplus supply at harvest is the main feature. There is lack of sufficient studies which tries to look into the determinants of their supply in Dendi district. This study helps in the understanding of determinants of teff and wheat supply in the district. For the purpose of this study, Dendi district was selected purposively. In the second stage, out of the 48 rural PAs of Dendi district , 4 PAs each for teff and wheat were selected randomly by using simple random sampling technique. From the available 23 Teff producing PAs, three were selected randomly. From these 23PAs, 80 HHs of Teff producers and 80 HHs of wheat producers were selected randomly. Data were collected: Two types of analysis, namely descriptive and econometric analysis are used for analyzing the data collected from farmers and traders in the study area. Eleven explanatory variables were hypothesized to determine the household level marketable supply of Teff and Wheat. Among these variables, only five variables namely (quantity produced, age and market access, experience and price) were found to be significant while (education, quantity produced and extension access) were found significant for Wheat. The quantity of Teff and Wheat produced at the farm level affected marketable supply of Teff and Wheat positively and significantly. Introduction of improved varieties, application of chemical fertilizers, using of modern technologies, controlling disease and pest practices should be promoted to increase production. Education has improved the producing household's ability to acquire new idea in relation to market information and improved production, which in turn enhanced productivity and thereby increased marketable supply of Teff and Wheat. Therefore, there is a great need to make information available to farmers at the right time.

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INTRODUCTION

Cereals are the most important food crop of the world and it provides the world with amajority of its food calories and about half its protein. They are staple foods in the diets ofmost population. According to FAO (2007), the world cereal production inthe year 2007 was increased by 4.8% from previous year production. In the same year Africa's contribution to the world output was 6.35% (about 133.1 million tons). In Ethiopia, Cereal production and marketing are the means of livelihood for millions of smallholder households and it constitutes the single largest sub-sector in economy. Cereal accountsfor roughly 60% of rural employment, 80% of total cultivated land, more than 40% of atypical household's food expenditure, and more than 60% of total caloric intake. Thecontribution of cereals to national income is also large. According to available estimate, cerealproduction represents about 30% of gross domestic product (GDP). This calculation followsfrom the fact that agriculture is 48% of the nation's GDP (World Bank, 2007), and that cereals' contribute to agricultural GDP is 65 % (Diao *et al*., 2007).

In the country, cereals are also the major stable food crops taking a significant share of areacultivated and volume of production obtained. Out of the total grain crop area, 79.69% (8.7million hectares) was covered by cereals. Teff and wheat covered up 23.42% (about 2.6million hectares) and 13.01% (1.4 million hectares) of grain crops area

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respectively. Cerealsalso contributed to 85.11% (about 137.1 million quintals) of the total grain production. The contribution of teff and wheat was 18.57% (29.9 million quintals) and 14.36% (23.1 millionquintals) of the total Summer cereals produced in the same order (CSA, 2007).

Maize, teff, wheat, sorghum and barley are the leading cereals crops grown inthe Oromia. Based on the report of Bureau of Oromia Agriculture and Rrural Development, 2007, West Shoa and East Shoa are the major cereal producingareas in the region. Although the region has ample production potential and market access, it has never reaped theopportunity as it would supposed to exploit (Muhammed, 2011).

Dendi district is one of the eighteen districts in the West Shoa Zone. The district isendowed with favorable climatic and natural resource conditions that can grow diverse annualand perennial crops required for household consumption and the market. Despite the fact that, rain-fed agriculture is predominant in the district, according to the report of Office of Agriculture and Rural Development of the District (2004/5), the major cereals crops grown in the district include maize, teff, wheat, sorghum, and oats.

In Ethiopia, small-scale subsistence farmers dependent on low input, rain-fed mixed farmingagriculture dominated with traditional technologies accounts for about 95% of the output (Pender *et al*., 2004). Agricultural production and productivity is very low and the growth inagricultural output has barely kept pace with human population growth. Agricultural marketing is a very important factor in economic development and lack of awell-functioning agricultural market and marketing system severely hinders the increase ofsocial welfare, income distribution, and food security of developing countries. Moreovermarkets and marketing system do not develop simultaneously with economic growth. Marketsand marketing system should be organized deliberately to enable economic development (Wolday, 1994).

Improved information and marketing facility enables farmers to plan their production more inline with market demand, to schedule their harvest at the most profitable time, to decidewhich market to sell their produce to and negotiate on a more even footing with traders and it also enables traders to move their produce profitably from a surplus to deficit market and tomake decisions about the economics of storage, where technically possible. Thus the marketinformation is critical to the law of one price and to the price discovery process (Khols and Uhl, 2002). Supply of agricultural crop in the study area is subjected to seasonal variation where surplussupply at harvest is the main feature. The nature of the product on the one hand and lack ofproperly functioning marketing system on the other, often resulted in lower producers' price. Maize, teff, wheat and Faba bean are the major cash crops grown in the study areamainly for market. However, marketing aspects of teff and wheat, which have potential production volume and marketability, are unresolved.

Yet there is lack of sufficient studies which tries to look into the determinants of their supply in Dendi district. This study helps in the understanding of determinants of teff and wheat supply in the district. This study is designed to address the prevailing information gap on the subject and contributeto proper understanding of the challenges and assist in developing improved marketdevelopment strategies for the benefit of smallholder farmers, traders, and other marketparticipants.

Research methodology

For the purpose of this study, Dendi district was selected purposively. In the second stage, out of the 48 rural PAs of Dendi district , 4 PAs each for teff and wheat were selected randomlyby using simple random sampling technique. From the available 23 Teff producing PAs, three were selected randomly. Then by employing Probability Proportional to Size (PPS) the number of farmers to be taken from each PAs was determined at the third stage. Finally based on the sampling frame collected from each PAs, Systematic Random Sampling was used at the fourth stage to select the sample of Teff producing farmers. Before selecting the householdheads to be included in the sample, teff and growing household heads of each rural PA was identified in consultation with experts in the department of grain production and protection of Dendi district, PA leaders, key informants and development agents of the respective rural PA. From these 23PAs, 80 HHs of Teff producers and 80 HHs of wheat producers were selected randomly. Moreover, 40Teff and traders (farmer traders, urban assemblers, urban retailers, whole salers, regional retailers) from different Dendi district markets were selected randomly to capture all possible representative and comprehensive data.

Enumerators who have college diploma and working as development agents were recruited and trained for data collection. Before data collection, the interview schedule was pre-tested on five farmers and three traders to evaluate the appropriateness of the design, clarity and interpretation of the questions, relevance of the questions and time taken for an interview. Hence, appropriate modifications and corrections were made on the interview schedule. Data were collected under continuous supervision of the researcher. Focus group discussions were held with three groups based on pre-determined checklists and a total of 20 key informants were interviewed from 6 different organizations and institutions. The time allotted for each discussion was 2 to 4 hours; but extended in some locations. Suitably, the data generated at various levels were supported by field observations and triangulated with other data.Two types of analysis, namely descriptive and econometric analysis are used for analyzing the data collected from farmers and traders in the study area.

Econometric model specification

Following Green (2003), the multiple linear regression models is specified as

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

Where Y_i= quantity of Teff and wheat supplied to market
X_1= Sex of HH
X_2= Age of HH
X_3= Education level of HH
X_4= Family size
X_5= Market access
X_6= Experience of the HH
X_7= Price of Teff and wheat in 2013/14
X_8= Extension access

X_9= Information access
X_{10}= Credit access
X_{11}= Size of output
Econometric model specification of supply function in matrix notation is the following.

$$Y_i = \beta X + U \quad \text{.....(1)}$$

Where: Y_i = Teff and wheat supplied to the market
β = a vector of estimated coefficient of the explanatory variables
X = a vector of explanatory variables
U_i = disturbance term

discrete variables, which seriously affects the parameter estimates. 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 relationship 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).

Table 1. Sample distribution of traders of wheat and Teff

	Dendi		Dimtu Burka		Cheleleka		Total	
Traders	Popn.	Sample	Popn.	Sample	Popn.	Sample	Popn.	Sample
Local collectors	31	12	10	3	15	5	**56**	**20**
Wholesalers	15	4	10	2	5	3	**30**	**9**
Retailers	75	7	17	1	21	0	**113**	**8**
Processors	5	3	0	0	0	0	**5**	**3**
Total	**126**	**26**	**37**	**6**	**41**	**8**	**204**	**40**

Source: District Agri. & RD Office and PA administrations, 2010 and own computation

Table 2. Determinants of Teff quantity supplied to the market

Variables	Coefficients	Robust Std. Err.	t	P-value
(Constant)	-381.581*	195.225	-1.95	0.053
Sex of HHH	26.038	18.121	1.44	0.154
Age of HHH (in years)	31.012	19.752	1.57	0.120
Education level of HHH	3.942*	1.353	1.95	0.054
Total family size of HHH	3.516	2.973	1.18	0.240
Market Access in km	-2.135*	2.119	-1.85	0.068
Teff quantity produced in quintal	0.979***	0.237	3.97	0.000
Years of experience in Teff production	2.980**	2.995	2.00	0.049
Price of Teff in 2013/14 (Birr/quintal)	0.735*	0.137	1.81	0.073
Extension access	38.097	23.673	1.61	0.111
Information access	14.620	13.114	1.11	0.268
Credit access	30.794	26.994	1.14	0.257

Note: Dependent variable - Teff quantity supplied to the market, *** Significant at 1 percent
** Significant at 5 percent * Significant at 10 percent, N=120 $R^2 = 0.876$, $\bar{R}^2 = 0.858$

Table 3. Determinants of Wheat quantity supplied

Variables	Coefficient	Robust Std. Err.	t	p-value
(Constants)	-34.049**	26.479	-2.29	0.0201
Sex of HHH	2.724	2.903	0.94	0.350
Age of HHH in years	0.169	0.226	0.75	0.455
Education level of HHH	5.644**	4.759	2.03	0.045
Total family size of HHH	1.934	1.733	1.12	0.267
Market Access	0.593	0.440	1.35	0.181
Wheat quantity produced in quintal.	0.816***	0.059	13.62	0.000
Years of experience in wheat production	0.075	0.093	0.8	0.425
Price of wheat in 2013/14 (in Birr/quts.)	0.014	0.022	0.61	0.545
Extension access	7.595**	4.244	2.26	0.026
Information access	4.049	4.195	0.97	0.337
Credit access	2.036	4.833	0.42	0.674

Note: Dependent variable- is wheat quantity supplied to the market, N=120 R^2=0.887, $\bar{R}^2$ =0.886
*, ** and *** are significant at 10 percent, 5 percent and 1 percent, respectively Source: Survey result, 2014

Specification of errors

Before fitting important variables into the regression models for analysis, it was necessary to test multicollinearity problem among continuous variables and check associations among

A measure of multicollinearity associated with the variance inflation factors is computed as:

$$VIF(Xi) = (1 - R_i^2)^{-1}$$

Where, $R_i^2$is the multiple correlation coefficients between explanatory variables, the largerthe value of R_i^2 is, the higher the value of VIF (X_i) causing higher collinearity in the variable (X_i). Contingency coefficient is used to check multicollinearity or association between discrete variables. The value ranges between 0 and 1, with 0 indicating no association between the variables and value close to 1 indicating a high degree of association between variables. A popular measure of multicollinearity associated with the CC is defined as:

$$CC = \sqrt{\frac{x^2}{N+x^2}} \quad \text{.....(2)}$$

Where, CC is contingency coefficient, $\chi 2$ is chi-square test and N is total sample size. If the value of CC is greater than 0.75, the variables are said to be collinear. Conversely, test for heteroscedasticity had undertaken for this study. There are a number of test statistics for the detecting heteroscedasticity;

According to Guiarati (2003) there is no ground to say that one test statistics of hetroscedasticity is better than the others. Therefore, due to its simplicity, Kroenker-Bessett (KB) test of heteroscedasticity was used for this study. Similar to other test statistics of heteroscedasticity, KB test is based on the squared residuals u^2. However, instead of being regressed on one or more regressors, the squared residuals are regressed on the squared estimated values of the regressors and. Particularly, if the original model is written as,

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_1 X_{2i} + \ldots + \beta_k X_{ki} + U_i \quad \text{...(3)}$$

u_i is obtained from this mode and then u_2 isestimated as $u_i^2 = \alpha_0 + \alpha_1 Y_i^2 + u_i$where Y_i are the estimated values from the original model. The null hypothesis is α1 = zero.If this is not rejected, then, one can conclude that there is no heteroscedasticity. The null hypothesis can be tested by the usual t-test or F-test.

Determinants of Teff and Wheat Market Supply

Teff and Wheat are produced mainly for market and are important cash crops in Dendi District for the farmers in general and for the three PAs in particular. According to theresearch report, all sample households are good suppliers of the commodity to the market.Analysis of factors affecting farm level marketable supply of Teff and Wheat was found to be important to identify factors constraining Teff and Wheat supply to market. In thisrespect, 11 variables were hypothesized to affect farm level marketable supply of Teff and Wheat. Multiple linear regression models were employed to identify the factors. For theparameter estimates to be efficient, assumptions of Classical Linear Regression (CLR) modelshould hold true. Hence, multicolliniarity and heteroscedasticity detection test wereperformed using appropriate test statistics as follows.

Test for multicollinearity: All VIF values were less than 10. This indicated absence of seriousmulticollinearity problem among independent continuous variables. Contingency coefficient results indicated absence of serious multicolliniarity problem among theindependent dummy variables. Since there is heteroscedasticity problem in the data set, the parameter estimates of thecoefficients of the independent variables cannot be true. Therefore, to overcome theproblem, Robust Ordinary Least Squares analysis with heteroscedasticity consistent covariance matrix was estimated (Table 2).

Eleven explanatory variables were hypothesized to determine the household level marketable supply of Teff and Wheat. Among these variables, only five variables namely (quantityproduced, age and market access, experience and price) were found to be significantwhile (education, quantity produced and extension access) were found significant for Wheat.

Teff

Quantity of Teff produced

As hypothesized, the multiple linear regression result revealedthat marketed surplus was significant at 1% level. Thepositive coefficient indicated that a unit increase in quantity of Teff produced will increasethe marketable supply of farmers. The result also implied that, a unit increase in the quantityof Teff produced has caused an increase of 0.979 qt of marketable Teff. This is in line with the findings of Abay (2007) and Adugna (2009) who illustrated an increase of tomato and papaya production by farming households has augmented marketable supply of the commodities significantly.

Access to market: Distance to market was expected to adversely affect the volume of totalsales. As hypothesized, this variable was negatively related to marketable surplus of Teff.The result showed that access to the market affected significantly and negatively the marketable surplus at 10% level. An increase in one kilometer indicated a decrease in thequantity supplied by 2.135 quintals. This is in line with the result of Holloway *et al.* (2002) and Wolday (1994) who indicated that distance to market caused market surplus of milk and food grain todecline.

Price of Teff: The coefficient of price of Teff showed a positive relation to thequantity of Teff sold or supplied to market. Producers checked the price of Teff fortheir best benefit and this might have directed the determinant to be significant at 10% level. Thepositive and significant relationship between the variables indicated that as the price of Teff at market rises, the quantity of Teff sold at the mark*et al*so rises, which in turnincreases quantity of Teff sold per household per year. The coefficient of the variable alsoconfirmed that a unit price increase in the Teff directed the household to increaseyearly Teff sales by 0.735 qt.

Education level of HH: Education showed positive effect on Teff quantity soldwith significance level at 10%. On an average, if Teff producer gets educated, the amount of Teff supplied to the market increases by 3.942 quintal. The result further indicated that,education has improved the producing household's ability to acquire new idea in relation tomarket information and improved production, which in turn enhanced productivity andthereby increased marketable supply of Teff. This is in line with the finding of Astewel (2010) who reported that if paddy producer gets educated, the amountof paddy supplied to the market increases, which suggests that education improves level ofsales that affects the marketable surplus.

Experience: The result showed significant effect at 5% significant level for Teff withpositive sign. The result implied

that, as farmer's experience increased by oneyear, the Teff supplied to market increased by 2.980 quintals. This is in line with the result of Abay (2007) who found that as farmer's experience increased the volume of tomato supplied to themarket has increased in Fogera district, South Gonder.

Wheat

Quantity of wheat produced: The result was as hypothesized which indicated that householdswho had produced more amount of wheat had also supplied more amount of wheat tomarket than those who had produced less amount of wheat due to insignificant consumptionof wheat at home. The value of the coefficient for production of wheat implied that anincrease in production of wheat by one unit per hectare resulted in an increase in farm levelmarketable supply of wheat by 0.816 quintals.

Education level: On average, if wheat producer gets educated, the amount of wheat supplied to the market increased by 5.644 quintals. This suggests that education improves levelof sales that affect the marketable surplus.

Extension access: The other significant variable was extension contact, which affectedpositively the marketed supply of wheat. On average, if a wheat producer gets extension contact the amount of wheatsupplied to the market increased by 7.595 quintals. Therefore it could be concluded that access to extension service and information regarding technology improvedproduction that affects the marketable surplus. However, all the other remaining variables such as: age of the household head, sex, totalfamily size, extension access, credit access, and market information access did notsignificantly influenced the market supply of Teff in the study area as they expected.While sex, age, family number, years of experience, extension, information, market, andcredit accesses were not significantly influenced the market supply of wheat in the study areaas expected.

Conclusion

The quantity of Teff and Wheat produced at the farm level affected marketable supply of Teff and Wheat positively and significantly. However, farmers are working underlimited plots of land by nature without using improvedtechnologies and agricultural inputs. Teff and Wheat producers in Dendi district usedlittle inputs. Hence, increasing production and productivity of Teff and Wheat per unit area of land is better alternative to increase marketable supply of Teff and wheat. Introduction of improved varieties, application of chemical fertilizers, using of modern technologies, controlling disease and pest practices should be promoted to increase production.Education has improved the producing household's ability to acquire new idea in relation tomarket information and improved production, which in turn enhanced productivity andthereby increased marketable supply of Teff and Wheat. Therefore, there is a great need to make information available to farmers at the right time andplace in response to this challenge; it is also good to develop an integrated agricultural marketing information system that will be linked to district information center, and to linkthem to government's program.

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