INTRODUCTION

Cereals are the most important food crop of the world and it provides the world with amajesty of its food calories and about half its protein. They are staple foods in the diets of most population. According to FAO (2007), the world cereal production in the 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 accounts for 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. The contribution of cereals to national income is also large. According to available estimate, cereal production 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 staple food crops taking a significant share of areacultivated and volume of production obtained. 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. The contribution of cereals to national income is also large. According to available estimate, cereal production represents about 30% of gross domestic product (GDP). This calculation follows from 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).

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

Dendi district is one of the eighteen districts in the West Shoa Zone. The district is endowed with favorable climatic and natural resource conditions that can grow diverse annual and 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 farming agriculture 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 in agricultural output has barely kept pace with human population growth. Agricultural marketing is a very important factor in economic development and lack of well-functioning agricultural market and marketing system severely hinders the increase of social welfare, income distribution, and food security of developing countries. Moreover, markets and marketing system do not develop simultaneously with economic growth. Market and 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 decide which 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 take decisions about the economics of storage, where technically possible. Thus the marketing information 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 surplus supply at harvest is the main feature. The nature of the product on the one hand and lack of properly 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 area mainly 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 contributes to proper understanding of the challenges and assist in developing improved market development strategies for the benefit of smallholder farmers, traders, and other market participants.

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 randomly by 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 household heads 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 23 PAs, 80 HHs of Teff producers and 80 HHs of wheat producers were selected randomly. Moreover, 40 Teff and traders (farmer traders, urban assemblers, urban retailers, wholesales, 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 predetermined 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
Econometric model specification of supply function in matrix notation is the following.

\[ Y_i = \beta X + U \]  

Where:  
- \( Y_i \) = Teff and wheat supplied to the market  
- \( \beta \) = a vector of estimated coefficient of the explanatory variables  
- \( X \) = a vector of explanatory variables  
- \( U_i \) = disturbance term

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

<table>
<thead>
<tr>
<th>Traders</th>
<th>Dendi</th>
<th>Dimtu Burka</th>
<th>Cheleleka</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local collectors</td>
<td>31</td>
<td>10</td>
<td>15</td>
<td>56</td>
</tr>
<tr>
<td>Wholesalers</td>
<td>15</td>
<td>10</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>Retailers</td>
<td>75</td>
<td>17</td>
<td>21</td>
<td>113</td>
</tr>
<tr>
<td>Processors</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>126</td>
<td>37</td>
<td>6</td>
<td>204</td>
</tr>
</tbody>
</table>

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

### Table 2. Determinants of Teff quantity supplied to the market

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Robust Std. Err.</th>
<th>t</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>-381.581*</td>
<td>195.225</td>
<td>-1.95</td>
<td>0.053</td>
</tr>
<tr>
<td>Sex of HHH</td>
<td>26.038</td>
<td>18.121</td>
<td>1.44</td>
<td>0.154</td>
</tr>
<tr>
<td>Age of HHH (in years)</td>
<td>31.012</td>
<td>19.752</td>
<td>1.57</td>
<td>0.120</td>
</tr>
<tr>
<td>Education level of HHH</td>
<td>3.942*</td>
<td>1.353</td>
<td>2.93</td>
<td>0.054</td>
</tr>
<tr>
<td>Total family size of HHH</td>
<td>3.516</td>
<td>2.973</td>
<td>1.18</td>
<td>0.240</td>
</tr>
<tr>
<td>Market Access in km</td>
<td>-2.135*</td>
<td>2.119</td>
<td>-1.85</td>
<td>0.068</td>
</tr>
<tr>
<td>Teff quantity produced in quintal</td>
<td>0.979***</td>
<td>0.237</td>
<td>4.09</td>
<td>0.000</td>
</tr>
<tr>
<td>Years of experience in Teff production</td>
<td>2.980**</td>
<td>2.995</td>
<td>1.00</td>
<td>0.049</td>
</tr>
<tr>
<td>Price of Teff in 2013/14 (Birr/quintal)</td>
<td>0.735*</td>
<td>0.137</td>
<td>5.43</td>
<td>0.000</td>
</tr>
<tr>
<td>Extension access</td>
<td>38.097</td>
<td>23.673</td>
<td>1.61</td>
<td>0.111</td>
</tr>
<tr>
<td>Information access</td>
<td>14.620</td>
<td>13.114</td>
<td>1.11</td>
<td>0.268</td>
</tr>
<tr>
<td>Credit access</td>
<td>30.794</td>
<td>26.994</td>
<td>1.14</td>
<td>0.257</td>
</tr>
</tbody>
</table>

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

### Table 3. Determinants of Wheat quantity supplied

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Robust Std. Err.</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>-34.049**</td>
<td>26.479</td>
<td>-2.29</td>
<td>0.0201</td>
</tr>
<tr>
<td>Sex of HHH</td>
<td>2.724</td>
<td>2.903</td>
<td>0.94</td>
<td>0.350</td>
</tr>
<tr>
<td>Age of HHH (in years)</td>
<td>0.169</td>
<td>0.226</td>
<td>0.75</td>
<td>0.455</td>
</tr>
<tr>
<td>Education level of HHH</td>
<td>5.644**</td>
<td>4.759</td>
<td>2.03</td>
<td>0.045</td>
</tr>
<tr>
<td>Total family size of HHH</td>
<td>1.934</td>
<td>1.733</td>
<td>1.12</td>
<td>0.267</td>
</tr>
<tr>
<td>Market Access</td>
<td>0.593</td>
<td>0.440</td>
<td>1.35</td>
<td>0.181</td>
</tr>
<tr>
<td>Wheat quantity produced in quintal</td>
<td>0.816***</td>
<td>0.059</td>
<td>15.62</td>
<td>0.000</td>
</tr>
<tr>
<td>Years of experience in wheat production</td>
<td>0.075</td>
<td>0.093</td>
<td>0.8</td>
<td>0.425</td>
</tr>
<tr>
<td>Price of wheat in 2013/14 (in Birr/quintal)</td>
<td>0.014</td>
<td>0.022</td>
<td>0.63</td>
<td>0.545</td>
</tr>
<tr>
<td>Extension access</td>
<td>7.592**</td>
<td>4.244</td>
<td>2.26</td>
<td>0.026</td>
</tr>
<tr>
<td>Information access</td>
<td>4.049</td>
<td>4.195</td>
<td>0.97</td>
<td>0.337</td>
</tr>
<tr>
<td>Credit access</td>
<td>2.036</td>
<td>4.833</td>
<td>0.42</td>
<td>0.674</td>
</tr>
</tbody>
</table>

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

**Specification of errors**

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

\[ VIF(X_i) = (1 - R_i^2)^{-1} \]
Where, $R_i^2$ is the multiple correlation coefficients between explanatory variables, the larger the 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:

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

Where, CC is contingency coefficient, $x^2$ 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 heteroscedasticity is better than the others. Therefore, due to its simplicity, Kronenker-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 $u_i^2$. 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,

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

$u_i$ is obtained from this mode and then $u_i^2$ is estimated as $u_i^2 = a_0 + a_1 Y_i^2 + u_i$, where $Y_i$ are the estimated values from the original model. The null hypothesis is $a_1 = 0$. 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 the research 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 this respect, 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 the parameter estimates to be efficient, assumptions of Classical Linear Regression (CLR) model should hold true. Hence, multicollinearity and heteroscedasticity detection test were performed using appropriate test statistics as follows.

**Test for multicollinearity:** All VIF values were less than 10. This indicated absence of serious multicollinearity problem among independent continuous variables. Contingency coefficient results indicated absence of serious multicollinearity problem among the independent dummy variables. Since there is heteroscedasticity problem in the data set, the parameter estimates of the coefficients of the independent variables cannot be true. Therefore, to overcome the problem, 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 (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.

**Teff**

**Quantity of Teff produced**

As hypothesized, the multiple linear regression result revealed that marketed surplus was significant at 1% level. The positive coefficient indicated that a unit increase in quantity of Teff produced will increase the marketable supply of farmers. The result also implied that, a unit increase in the quantity of 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 total sales. 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 the quantity 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 to decline.

**Price of Teff:** The coefficient of price of Teff showed a positive relation to the quantity of Teff sold or supplied to market. Producers checked the price of Teff for their benefit and this might have directed the determinant to be significant at 10% level. The positive and significant relationship between the variables indicated that as the price of Teff at market rises, the quantity of Teff sold at the market also rises, which in turn increases quantity of Teff sold per household per year. The coefficient of the variable also confirms that a unit price increase in the Teff directed the household to increase yearly Teff sales by 0.735 qt.

**Education level of HH:** Education showed positive effect on the quantity of Teff sold or supplied to market. Producers checked the price of Teff for their benefit and this might have directed the determinant to be significant at 10% level. The positive and significant relationship between the variables indicated that as the price of Teff at market rises, the quantity of Teff sold at the market also rises, which in turn increases quantity of Teff sold per household per year. The coefficient of the variable also confirms that a unit price increase in the Teff directed the household to increase yearly Teff sales by 0.735 qt.

**Experience:** The result showed significant effect at 5% significant level for Teff with positive sign. The result implied...
that, as farmer’s experience increased by one year, 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 the market has increased in Fogera district, South Gonder.

**Wheat**

**Quantity of wheat produced:** The result was as hypothesized which indicated that households who had produced more amount of wheat had also supplied more amount of wheat to market than those who had produced less amount of wheat due to insignificant consumption of wheat at home. The value of the coefficient for production of wheat implied that an increase in production of wheat by one unit per hectare resulted in an increase in farm level marketable 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 level of sales that affect the marketable surplus.

**Extension access:** The other significant variable was extension contact, which affected positively the market supply of wheat. On average, if a wheat producer gets extension contact the amount of wheat supplied to the market increased by 7.595 quintals. Therefore it could be concluded that access to extension service and information regarding technology improved production that affects the marketable surplus. However, all the other remaining variables such as: age of the household head, sex, total family size, extension access, credit access, and market information access did not significantly influence the market supply of Teff in the study area as they expected. While sex, age, family number, years of experience, extension, information, market, and credit accesses were not significantly influenced the market supply of wheat in the study areas 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 under limited plots of land by nature without using improved technologies and agricultural inputs. Teff and Wheat producers in Dendi district used little 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 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 and place 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 link them to government’s program.

**REFERENCES**


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