Asian Journal of Advances in Research

4(1): 1309-1320, 2021

DETERMINANTS OF MAIZE (*Zea mays*) SUPPLY TO THE MARKET in NORTHWESTERN ETHIOPIA

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Received: 22 September 2021
Accepted: 27 November 2021
Published: 01 December 2021

Original Research Article

ABSTRACT

Maize supply to the market enhances the economic growth of many smallholder farmers in Ethiopia. Despite this, farmers still produce mainly for consumption, and small amounts of maize are supplied to the market due to different factors. Therefore, this study examined the determinants of maize supply to the market in Northwestern Ethiopia. Descriptive statistics and multiple linear regression analysis were employed to analyze determinants of maize supply. The data were collected from 198 randomly selected sample maize farmers using structured questionnaire interviews. The descriptive statistics result revealed that the mean quantity supply of maize to the market was 1,369quintals. The model result showed that education, previous year price, access to market information, land allocated for maize, extension service, credit access, and maize yield were important factors significantly affecting the market supply of maize positively. However, family size and distance to the nearest market affected the market supply of maize negatively. Therefore, the study recommends the need to strengthen and promote maize yield (by using improved technology and best agronomic practice), market-oriented extension delivery (through farmers' training), improve market access (through expanding market facilities), and market infrastructure (through road construction) to improve maize supply to the market.

Keywords: Maize; market supply; multiple linear regression analysis; Alefa.

1. INTRODUCTION

Maize is Ethiopia's most important cereal commodity, both as a source of food for consumers and as a source of income for farmers. It is an important crop for food security because it provides the highest share of caloric intake, accounting for 17-20% of the total caloric intake [1].

In 2017, global maize production added up to 1.04 billion tons, of which close to 15% were traded on international markets. Over the last few years, the global stock-to-use ratio was around 25% which had a stabilizing effect on international maize prices [2]. Maize was the most widely-grown staple food crop in sub-Saharan Africa occupying more than 33 million hectares (ha) each year. The crop covers nearly 17% of the estimated 200 million ha of cultivated land in Sub-Saharan Africa, and is produced in diverse production environments and consumed by people with varying food preferences and socio-economic backgrounds.

Maize yield in Ethiopia has doubled over the last two decades, around 1.6 t/ha in 1990 to more than 3.7 t/ha in recent years. It is the highest in sub-Saharan Africa

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after South Africa [2]. In 2010, maize accounted for 28% of total cereal production, compared to 20% for teff and 22% for sorghum; which has the largest share among cereals in total production. Its yield was the highest among cereal crops and it is the only crop with significant use of commercial inputs. In 2008, about 37% of maize producers used fertilizer, compared to the national average of 17% for all cereal producers. An estimated 26% of maize producers used improved seed, which is again about twice the national average for all cereal producers [3].

Ethiopia is the third-largest producer of maize in Africa, next to South Africa and Nigeria (FAOSTAT, 2015). In 2015/16 production season, 2.11 million ha of land was covered by maize in the country from which 71.51 million quintals (qt) of output was produced by 9.55 million holders [4]. The productivity of maize has reached 34.29 qt/ha in the 2014/15 production season by achieving tremendous growth compared with a 21.87 qt/ha in the 2005/06 production season [5].

Maize is the leading cereal crop in terms of production in Ethiopia; 6.2 million tons of maize was produced in 2013 by 9.3 million smallholder farmers across 2 million hectares of land. Over half of smallholder farmers produce maize mainly as a subsistence crop (household consumption), with 75% of all maize output consumed by farming households, not producing for the market [6].

In the Central Gondar zone, the major cereal crops include; maize, teff, finger millet, barley, and wheat are produced for consumption and market. The major producers of such crops are smallholder farmers [7]. Even though smallholder farmers' market supply of maize plays an important role in improving its living standard, the farmers are still producing without market oriented system due to different factors. There was no research conducted to identify those factors affecting smallholder farmers' market supply of maize production in the study area (Alefa district).

Different studies were conducted on smallholder maize marketing in the country such as [8, 9, 10, 11] who found that quantity supply of maize has a positive relationship with the quantity produced and price of maize but the amount of supply was not enough to the market. Market supply of maize in Alefa district, the study area, is also quite low. However, in the district, maize is produced in large amounts compared to other cultivated crops even if the district produces cereals based on rain-fed only [12]. Besides, smallholder farmers could not derive the expected benefits; instead they were very disappointed in producing maize due to different factors. Therefore, this study was designed to identify the determinants of market supply of maize in the district and suggest market development strategies to the benefit of smallholder farmers, and other market participants.

2. RESEARCH METHODS

2.1 Description of the Study Area

The study was conducted in Alefa district of Central Gondar Zone (Amhara region), Ethiopia (Fig. 1). The district is bordered on the southwest by Agew Awi Zone, on the west by Qwara, on the north by Takusa, on the east by Lake Tana, and on the southeast by West Gojam Zone. The administrative center of the district is Shawra, which is located 652kilometrs from Addis Ababa (the capital city of Ethiopia), 88 kilometers from east of Bahir Dar (regional city of Amhara), and 142 kilometers north of Gondar (the zonal city of Central Gondar) [12].

The total population of the district is 170,491, of whom 86,350 are men and 84,141 are women, an increase of 20-32% over the 1994 census. The district has a population density of 86.91 per square kilometer, which is greater than the Zone average of 63.76 per square kilometer. A total of 36,072 households were counted in this district, resulting in an average of 4.73 persons per household, and 34,901 housing units. The majority of the inhabitants practiced Ethiopian Orthodox Tewahido (99.5%) and speak the Amharic language (100%) [13].

The agro-ecological condition of Alefa district is suitable for the production of maize and grain legumes. About 45% of the land area in the district lies in mid-highland (Woinadega) whereas 55% is mid-lowland (Kolla). It lies between 110 45′ and 120 30´ N latitude, and 370 10´ and 360 30´E longitudes coordinate, respectively, and at an altitude that ranges from 750 to 2250 meters above sea level. Its temperature ranges from 25-38°C. The district has mini modal rainfall distribution, which extends from June to the end of August with average annual rainfall reaching 900-1400 millimeters. The district has a larger proportion for areas with red soil whereas brown and black soils also constitute some proportions [12].

Major constraints of farming systems in the district include low soil fertility, crop pests and diseases, shortage of improved varieties, inappropriate cropping practice, and land preparation. Poor market infrastructures also affect crop production in the area.

According to the districts' OAWARD (2009) evaluation report, the main sources of the district economy are crop production (teff, maize, finger millet, barley, hot pepper, bean, and pulses). Crops are produced entirely using rain-fed and grown for both consumption and market but teff and pulses are particularly aimed at for the market whereas sheep are the most important sources of household income.

2.2 Data Types and Sources

To address the objective of the study, both qualitative and quantitative data were collected from primary and secondary sources. Qualitative data were collected from socio-demographic characteristics of the sample households and quantitative data also included the quantity supply, price, land size, income, the quantity of maize, and the number of livestock. The primary data sources were sample respondents (smallholder maize farmers). Secondary data were obtained by reviewing the relevant published and unpublished documents such as district agriculture and rural development office, office of small scale trade and industry, annual reports, international organizations (such as FAO), and statistical agency.

2.3 Sample Size and Sampling Techniques

A two-stage random sampling procedure was used for the selection of sample household heads. In the first stage, out of 25 rural kebeles (peasant associations) 5 rural kebeles (Tara kezen, Amichiho, Gamawubar, Atedemariam, and Dengelber) were selected randomly as all kebeles are producers of maize in the district. Before selecting household heads to be included in the sample, maize grower household heads of each sample rural kebele was identified in collaboration with experts of the district agriculture and rural development office, kebele leaders, key informants, and development agents of the respective rural kebele.

In the second stage, from 6,143 maize producer households, about 198 sample household heads were selected randomly from 5 selected rural kebeles; proportionally 65, 29, 45, 27, 32 sample households were drawn from Tara kezen, Amichiho, Gamawubar, Atedemariam, and Dengelber respectively.

The sample size was determined by following a simplified formula provided by Yamane [14] at a 95% confidence level with a degree of variability of 5% and in the precision level of 7% to estimate a true population (Table 1). The determined sample size (maize producers) was the following:

$$n = \frac{N}{1 + N(e)^2} = \frac{6{,}143}{1 + 6{,}143(0.07)^2} = 198$$

Where, N = total target population = 6,143 n = sample size and e = error term = 7%.

2.4 Method of Data Collection

Primary data were collected using a structured questionnaire that incorporates demographic, socioeconomic, and market characteristics of the sample households. The questionnaire was pretested on randomly selected respondents (5 in number) for the sake of clarity, interpretation, relevance, and time is taken for an interview. The questionnaire was amended according to the feedback from the pretested respondents. Then using the amended structured questionnaire, primary data was collected through personal interviews from sample farmers. In addition to this, primary data were collected informally from the non-sampled individuals (key informants), who are expected to have good knowledge (by using a checklist). Field observation was also used as a method to collect the primary/qualitative data to fill gaps observed during personal interviews. Secondary data were collected through reviewing relevant published and unpublished documents (CSA, FAO, journals, district's agricultural product reports). This was used to analyze the determinants of maize market supply in the district.

Table 1. Selected rural kebeles, total target population and number of respondents

No	Name of selected kebeles	Total number of maize producers in selected rural kebeles, 2016/17.	Number of sampled households
1	Tara kezen	2,007	65
2	Amichiho	900	29
3	Gamawubar	1,414	45
4	Atsedemariam	835	27
5	Dengelber	987	32
	Total	6,143	198

Source: Survey result, 2017

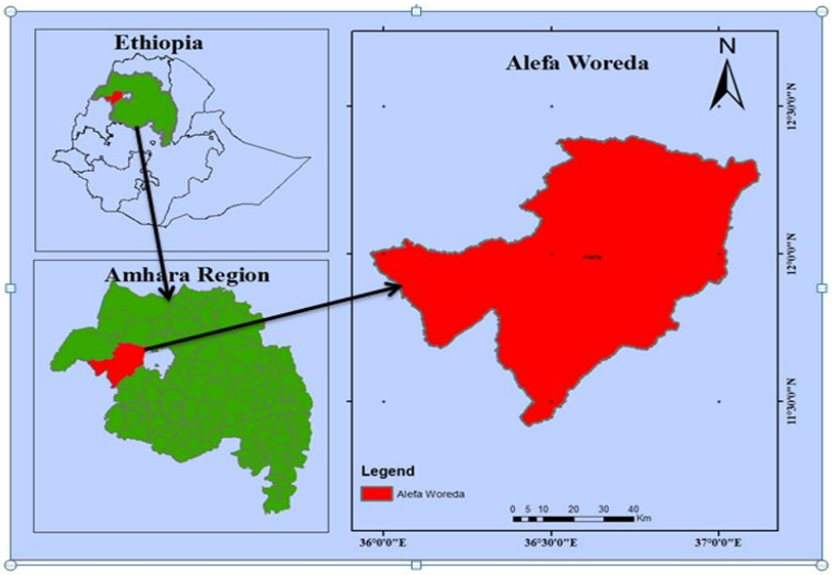

Fig. 1. Geographic map of the study area

2.5 Methods of Data Analysis

In this study, both descriptive and econometric analytical techniques were employed to analyze the data collected from sample maize producers. Descriptive statistics such as mean, percentage, minimum and maximum value, frequency, and standard deviation were used to analyze the socio-economic characteristics of smallholder maize farmers. Different econometric models were used to do this. What matters is the nature of the dependent variable to determine the type of econometric model. Since the dependent variable was the amount of maize supplied to the market in the study area which is a continuous variable and also all maize producers' participates in the market. This study used a multiple linear regression model to identify factors affecting the volume of maize marketed in the study area. This model was also selected for its simplicity and practical applicability [15].

Green [15] who indicates that the multiple linear regression models were specified as:

$$Y_i=\beta_0+\beta_1 X_{i1i}+\beta_2 X_{i2i}+\ldots\ldots \ldots + \beta_k X_{ik} + U_i$$
$$=X_i\beta+U_i \quad (1)$$

Where Y_i = quantity of maize supplied to the market (in quintal per year)
X_i = a vector of explanatory variable, and **'i'** is 1, 2, 3……k
β= coefficient of i^{th} explanatory variable
U_i= unobserved disturbance term

2.6 Hypothesis and Definitions of Variables

To analyze determinants of maize market supply actual quantity supplied to market (by individual farm households) of maize was considers as a dependent variable. It is a continuous variable which is measured in quintal (100kg). The dependent variable is affected by different factors (explanatory variables) and the study hypothesized the following factors based on previous literatures [8, 9, 16, 17, 10, 18-22] and own experience of the study area (Table 2).

3. RESULTS AND DISCUSSION

3.1 Descriptive Statistics

3.1.1 Demographic and socio-economic characteristics of sample households

Concerning the sex of household heads, out of the total sampled households, 89.39% were male while the remaining 10.61% were female household heads. Of the total respondents interviewed, 4.55% were in the range 20-30 years of age, 22.22% were in the range 31-40 years of age, 37.88% were in the range 41-50 years of age, and the rest 35.35% were above 50 years of age. Thus, smallholder farmers are in the range of 41-50 years of age category than in any other age group. Concerning the marital status of sample households, most of the household heads (97.5%) were married with only 1.5% divorced and 1% widowed household heads (Table 3). As indicated in Table 3; 59.09% of the maize producers were illiterate and 40.91% were literate. This shows the majority of maize producers were illiterate.

Table 2. Dependent and explanatory variables that would be used in the model with expected sign on maize market supply

Variables	Category	Measurement	Expected effect
Quantity Supplied	Continuous	Quintal	
	Explanatory Variables		
Yield	Continuous	Quintal/ha	Positive
Lagged market price	Continuous	ETB/Qt	Positive
Land allocated for maize	Continuous	Hectare	Positive
Household size	Continuous	Number	Negative
Extension service	Dummy	0=No 1=Yes	Positive
Access to credit	Dummy	0=No 1=Yes	Positive
Education status of HHH	Dummy	0=Illiterate 1=Literate	Positive
Experience in production	Continuous	Number of years	Positive
Male headed HH	Dummy	0=Female 1=Male	Positive
Access to market information	Dummy	0=No 1=Yes	Positive
Distance to nearest market	Continuous	Walking minutes	Negative
Livestock holding	Continuous	TLU	Positive

In both theoretical and practical situations, education level plays an immense role in ensuring households access to basic needs such as food, shelter, and clothing. Education strengthens working efficiency resulting in more income and food security. Furthermore, education is important to manage a business as well as in decision-making [23].

Access to credit is one way of improving smallholder farmers' ability of maize production and productivity. Farmer's ability to purchase inputs such as improved seed, fertilizer and pesticides is tied with access to credit. Farmers with access to credit can minimize the effect of financial constraints and be able to buy the necessary inputs which improve their maize productivity more readily than those with no access to credit [18]. Therefore, it was expected that access to credit can increase the production of agricultural crops in general and maize in particular.

Sampled maize producer farm households access credit from formal institutions (MFI, and cooperatives) and informal sources (Iqub, traders, friends, relatives, and village money lenders). As depicted in Table 3, only 26.3% of sampled producers had access to credit while the remaining majority (73.7%) of maize producing sample respondents reported that they had no access to credit that can be used to buy improved seeds, pesticides, and fertilizer.

Access to extension services is also expected to have direct influence on the production and marketing behavior of farmers. The more access to extension service a farmer has, the more likely that farmer adopt new farm technologies and innovations which leads to better product quality. Fig. 2 shows that out of the total respondents of maize producing sample households, about 92.93% of farmers reported that they had access to extension service in the 2016/17 production season. Only 7.07% of farmers reported that they had no access to extension services. The extension service providers were office of agriculture experts, development agents and innovative (model) farmers. The extension services provided were about maize production, input use, marketing of maize, harvesting, and post-harvest handling.

The mean experience of maize producers in the study area was 18.34 years with a standard deviation of 4.87. Experience of maize farming was ranging from 3 to 23 years because formally maize starts to produce during 1995 as a field crop (row sowing) in Ethiopia. Mean household size of the total sample households was 7.16 persons and standard deviation is 2.3, with a minimum and maximum of 2 and 13 persons respectively (Table 4).

Access to different marketing and agricultural services has important contributions in improving the production and productivity of farmers, thereby increasing market supply and ultimately increasing the income of smallholder farmers. Among important services that were expected to promote the production and marketing of maize in the study area include nearness to market and access to market information.

Proximity to markets: Distance to the nearest market and walking time to sell their products varies from farmer to farmer. Distance taken to travel from home to the nearest maize market place where they sold their product, sampled maize producing farmers reported that they have to travel an average of 25.66 minute with corresponding standard deviation of 15.89. The minimum and maximum distance that sampled maize producing respondents have to travel to nearest market centers were 5 and 90 minutes,

respectively. This showed that sample households walked more hours to take their products to the nearest market (Table 4). In all sample kebele administrations market is available for 2 days per week (Saturday and Thursday).

Farmer Training Center (FTC) is an important factor in making information available and helps them. Hence, from Table 4, one can observe that sample producers in the study area travel on average walking minutes of 41.48 with ranging from 1 to 180 walking minutes to access the farmer training center (development center).

As indicated in Table 4 below, the average landholding size of maize producing farmers was 2.34 hector (ha) or 9.36 ''Kada'' of land. The standard deviation was 0.84 with maximum and minimum landholding sizes of 6 ha and 0.38ha respectively. Out of these, they allocated on average 0.53ha of land for maize production with a standard deviation of 0.21, and minimum and maximum allocation of land was 0.25 ha and 1.5ha respectively. Average production, quantity supplied to the market, and yield of maize were 18.03 quintals per household, 1,369 quintals per household, and 34.37 quintals per hectare respectively.

Regarding the total number of livestock holding of the households measured in the Tropical Livestock Unit (TLU). Livestock is farmers' important source of income, food, fertilizer, draft/pack power for crop cultivation, and transportation of produces. As indicated in Table 4, the average livestock holding was 9.85 TLU using conversion factors. The standard deviation was 4.40 with maximum and minimum livestock ownership of 35.62 TLU and 2.45 TLU respectively.

Table 3. Demographic and socioeconomic characteristics of respondents (categorical variables)

Variables	Items	n	%
Sex	Female	21	10.61
	Male	177	89.39
Age	20-30	9	4.55
	31-40	44	22.22
	41-50	75	37.88
	>50	70	35.35
Education	Literate	81	40.91
	Illiterate	117	59.09
Marital status	Married	193	97.5
	Divorced	3	1.5
	Widowed	2	1.0
Credit support	Yes	52	26.3
	No	146	73.7

Source: Survey result, 2017

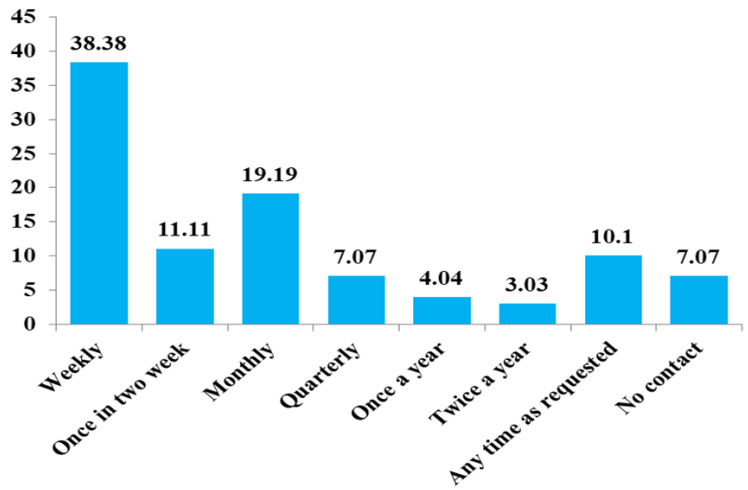

Fig. 2. Farmers' extension agent contact frequency per year (n=198)
Source: Survey result, 2017

3.1.2 Supply, demand and price information

The survey result indicates that almost all sample farmers had access to market information from different sources which were 94.4%, 96.5%, and 98% about supply, demand, and price of maize respectively before they sale their product to the nearby market but 5.6%, 3.5% and 2% of interviewed farmers do not have access to any information about supply, demand, and price of maize respectively (Table 5).

Out of 198 maize producers, 31.8% of them obtained information about maize supply from other farmers and their personal observations. Sample respondents were also revealed that 31.3% of them get information about maize market demand from maize traders and their personal observation. In the same manner, 30.3% of sampled households obtained price information from other farmers and their personal observations (Table 5).

As presented in Table 6 below, in the study area, sampled maize producing farmers confirmed that in addition to maize, they were also producing other farm products like teff (0.48ha), finger milet (0.448ha), barley (0.23ha) and wheat (0.04ha).

Table 4. Demographic and socio-economic characteristics of respondents (continuous variable)

Variables	Mean	Standard Deviation	Minimum	Maximum
Years of maize farming experience	18.34	4.873	3	23
Household size	7.16	2.303	2	13
Distance to nearest market	25.66	15.89	5	90
Distance to farmer training center	41.48	29.58	1	180
Total land holding (ha)	2.34	0.84	0.38	6
Maize land (ha)	0.53	0.21	0.25	1.5
Maize production (Qt)	18.03	10.75	3	70
Quantity supplied to market (Qt)	1,369	10.12	0.50	18
Maize yield (Qt/ha)	34.37	14.67	10	76
Livestock holding (TLU)	9.85	4.40	2.45	35.62

Source: Survey result, 2017

Table 5. Source of information about supply, demand and price, 2016/17 (n = 198)

	Information		
	Supply	**Demand**	**Price**
Source of information	%	%	%
Cooperatives	2.5	4.5	3.0
Other farmers and maize traders	5.1	4.0	5.6
Other farmers and personal observation	31.8	3.0	30.3
Other farmers	27.8	14.6	18.7
Maize traders	2.5	8.1	15.7
Personal observation	20.2	30.8	21.7
Maize traders and personal observation	4.5	31.3	3.0
No	5.6	3.5	2.0
Total	**100**	**100**	**100**

Source: Survey result, 2017

Table 6. Major crops produced by sampled households

Types of crops	Minimum	Maximum	Mean (ha)	Standard deviation
Teff	0.00	1.50	0.48	0.214
Finger millet	0.00	1.00	0.448	0.205
Barley	0.00	1.00	0.23	0.20
Wheat	0.00	0.75	0.04	0.106

Source: Survey result, 2017

Table 7. OLS results of determinants of maize market supply (log)

Variables	Coef.	Std. Err.	t-ratio	p-value
Male headed household	0.028	0.090	0.31	0.756
Education	0.227***	0.066	3.42	0.001
Family size	-0.047***	0.013	-3.64	0.000
Maize land	0.925***	0.140	6.58	0.000
Farming experience	0.007	0.005	1.31	0.193
Extension	0.229**	0.089	2.56	0.011
Credit	0.061*	0.035	1.72	0.088
Distance to nearest market	-0.012***	0.002	-5.68	0.000
Market information	0.428***	0.073	5.86	0.000
Yield of maize	0.015***	0.002	6.99	0.000
Livestock holding	0.009	0.006	1.40	0.164
Lagged price (log)	1.186***	0.212	5.57	0.000
Constant	-2.811***	0.590	-4.76	0.000
N	198			
F (12,185)		91.14		
Prob>F		0.0000***		
R-Squared		0.8553		

*Source: Survey result, 2017. Note: Dependent variable is quantity of maize supplied to the market (log), *, ** and *** denotes explanatory variables were significant at 10%, 5% and 1% respectively*

3.2 Econometric Model Results

Multiple linear regression analysis was employed to identify significant factors that affect the volume of maize supply to the market by using OLS in STATA software version 13.1. Prior to fitting multiple linear regression analysis, hypothesized explanatory variables were checked for the existence of multicollinearity, omitted variable, heteroscedasticity, and endogeneity problem using appropriate test statistics.

Education status of household head (EDU-SHH): Education has a positive effect on maize quantity supply per household per year. It was statistical significance at a 1% significance level. The model output verified that the literate farmer can supply 22.7% more maize to the market than an illiterate one. The positive and significant relationship indicated that education determines the bargaining power, readiness to accept new ideas and innovations, and ease to get supply, demand, and price information this helps farmers to produce more and increase the volume of sales. This confirmed the finding of Mazengia [9] who found that education has a positive association with the amount of maize sold in the market. Similarly, Abate, Mitiku, and Negash (2020), Abera [11] and Dibaba, [24] found that education improves the ability of farmers to analyze information and market the supply of wheat, rice, and teff respectively.

Household size (HH-SZ): It is the number of living household members. As expected, this variable in man equivalent was statistically significant at a 1% significant level and had a negative effect on the household market supply of maize. The negative and significant relationship indicates that households with more number members supply less amount of maize to market than those households with a relatively fewer number of family members because more part of maize production is allocated for household consumption. The model output shows that as the member of the household is increased by one, the volume of maize supplied to the market is decreased by 4.7%. This finding is consistent with Mazengia [9] who found that the number of family sizes increased, more parts of maize produce are allocated for household consumption. Similarly, Usman [25] Abate, Mitiku, and Negash [26] found that family size has a negative and significant association with the market participation of wheat.

Land allocated for maize (MZ-LAND): The result showed that the land size of maize had a positive and significant effect on the market supply of maize at a 1% significance level; the more the land allocated for maize, the higher the production that in turn increased market supply. It implied that as the land allocated for maize increased by one hectare, the market supply of maize also increased by 92.5% when other variables remain constant (ceteris paribus). This study is consistent with the finding of Erko and Goshu [27] Mazengia [9], Beadgie and Zemedu [10], and Abera and Halako [11] who showed that the more land allocated for maize, the higher the production that in turn increased marketed supply of maize.

Extension service (EXT-SRV): It was hypothesized that extension service has a positive effect on the market supply of maize. The result of the study also indicates extension service was positively and significantly related to the volume of maize supplied to the market at a 5% significance level. On average, households having access to extension service will be 22.9% higher in the supply of maize to the market as compared to their counterpart. This is consistent with the finding of Kusse, Kassu, and Alemayehu [18], who found that a maize producer gets extension contact the amount of maize supplied to the market increases. This is similar to the previous studies conducted by Gecho [28]; Mussema [29] and Negash [30] who found that access to extension service on improved maize seed, red pepper, and improved haricot bean respectively affected the marketable supply of each of the commodities significantly and positively.

Access to credit (CRED-ACC): The model result indicates that access to credit had a positive and significant influence on the volume of maize supply at 10% significance level. From this result, it can be stated that those farmers who have access to credit, are more probable to supply maize than those who have no access to credit. The variable's coefficient also confirmed that farmers having access to credit was 6.1% higher in the market supply of maize as compared to their counterparts. This is in line with the study of Beadgie and Zemedu [10], who found that access to credit, had a positive and significant influence on the supply of maize. Similarly, Mirie and Zemedu [17], and Abate, Mitiku, and Negash [19] argued that take to credit had direct relationships with the market supply of teff and wheat respectively.

Distance to the nearest market (DS-NMKT): The closer the marketplace to the farm gate, the lesser would be the transportation costs, transaction costs, time, and more access to market information. The result showed that for a minute increase in time taken to the nearest market, the market supply of maize decreased by 1.2%. Therefore, the time is taken to market negatively affected the quantity supplied to the market. The variable was statistically significant at a 1% significance level. The result was in line with Erko and Goshu [27], Mazengia [9] and Beadgie and Reddy [20] showed that as the distance from the nearest market increases, variable transport costs increase and this discourages smallholder farmers quantity supplied of maize. In the same way, Kyaw, Ahn, and Lee [16], Abera [21], and Sori [22] states that the remoteness of a household from markets often hindered them from selling a high volume of a product in a market due to high transport costs and market inaccessibility.

Access to market information (MKT-INFO): This is also another factor, which positively affects the quantity supply of maize at a 1% significance level. The variable's coefficient also confirmed that farmers having access to market information will be 42.8% higher in the market supply of maize as compared to their counterparts. This is in line with Musah et al. [8], Beadgie and Zemedu [10], Kusse, Kassu and Alemayehu [18] and Abera and Harko [11]indicates that the need to give emphasis to strength institutional supports to improve farmers' access to formal market information because farmers who have not accessed to market information, quantity supplied of maize at market decreases.

Yield of maize (M-YLD): This variable was hypothesized to affect the volume of farm-level market supply of maize positively. Since it is taken as a proxy variable for quantity produced, it indicates households with a high level of quantity produced had also supplied more to the market. As expected, the result shows that the volume of maize supplied to the market affected positively and significantly at a 1% significance level. The model result shows that a one quintal increase in maize yield resulted in a 1.5% increase in the volume of market supply of maize. But other variables remain constant. This confirms the finding of Kusse, Kassu, and Alemayehu [18] and Abera and Harko [11], who illustrated that an increase in a quintal of maize increased the marketed supply of maize. Likewise, Habtewold, Challa, and Latha [31] and Mirie and Zemedu [17], conducted on the determinants of smallholder farmers in teff market supply and found that the quantity produced of teff has a direct relationship with the quantity supplied of teff to the market but other things remain constant.

Lagged market price of maize (LAG-PR): This is a continuous variable measured in ETB per quintal of maize and transformed into a natural logarithm during analysis to avoid the effect of outliers. As expected one year lagged price of maize was previously expected to have a positive sign in determining the volume of maize supplied to the market. The model result also showed that the variable coefficient was positive and statistically significant at a 1% significance level. The coefficient indicates that as the previous year's price increased by 1%, the amount of maize supplied to market was increased by 118.6% next year, while all other variables remained constant. Farmers would be interested in producing and supplying more maize if the price of maize in the market was high in the previous year. This study confirmed the finding of Abera, Alemu, and Zemedu [32], Mazengia [9], and Mirie and Zemedu [17], who founds that lagged market price, affect households decision to participate in haricot bean, maize, and teff

market supply respectively. Similarly, Asfaw and Ketema [33] and Ayele et al. [34-35], confirmed that lagged price of wheat directly affects the amount of wheat supplied to the market. Therefore, the price has a direct relationship with the volume of maize sold and this, in turn, confirms the economic theory that output price is an incentive for farm households to produce a more marketable surplus.

4. CONCLUSION AND RECOMMENDATION

4.1 Conclusion

The descriptive result showed that; out of the total household heads, 89.39% were male-headed and the remaining 10.61% were female-headed. Of the total respondents interviewed, Smallholder farmers are in the range of 41-50 (37.88%) years of age category than in any other age group. The average family size was 7.16, and the overall educational status of sampled households was composed of 59.09% illiterate and 40.91% literate. The proportion of land allocated for maize was much higher as compared to other major crops. Among cereals produced, maize was the most important and dominant crop in the study area. Moreover, it was used improved seed and fertilizers intensively. Production and productivity of the commodity were much higher as compared to other crops produced in the area.

The result of OLS revealed that education level of household head, previous year price, access to market information, land allocated for maize, extension service, credit access, and yield of maize influenced market supply of maize positively while the distance to the nearest market and family size were found to have a significant negative effect on maize market supply.

4.2 Recommendation

Possible policy implications based on findings of the study are put forward so as to contribute as an input in the future intervention strategies which are aimed at the promotion of maize production and marketing.

- Results of the econometric analysis indicated that access to credit services has a significant effect on the amount supplied. Hence, it is important to provide sufficient credit services at the right time and the required amount to increase production and thereby quantity supplied. Therefore, government and any concerned bodies have to improve the credit system through strengthening institutions like farmer cooperatives.
- Land allocation for maize is also positively and significantly affected the volume of the maize market. Therefore, using best agronomic practices, the use of recommended fertilizers and crop rotation should be given more emphasis for further improvement of land fertility to produce and supply more maize in the market. In addition to this, continuous training and follow-up (for improving farmers' skills in allocating resources) should be provided so that producer will be more experienced through relying on intensive cultivation rather than on extensive one.
- Education is one of the determinant factors that affect the volume of maize supplied to the market positively. In the case of production, household heads with very limited education encounter in successfully managing, fertilizer and pesticide applications, and what to produce in line with taste and preference of consumers demand, especially in the presence of ineffective extension services Therefore, the concerned sector increase the accessibility of education and create awareness about the market.
- Yield of maize is also affected the volume of maize supplied to the market positively. Therefore, policy designers should focus on increasing the production and productivity of maize. This could be partly achieved through identifying new technologies and management systems that would improve the production and yield of the crops. Creating stable demand for surplus production would also enhance farmers' decisions on maize production regularly.
- The result of this study has shown that access to market information affected the quantity supplied of maize positively and significantly. Farmers in the study area do not get timely market information upon which to base their marketing decision. They depend on traders and other farmer friends for price information. Therefore, there have to be market infrastructure (road construction) and institutions that can provide reliable and timely information required by all stakeholders simultaneously. This would make the marketing system operate efficiently and harmoniously. Availability of timely and precise market information increases producers' bargaining capacity to negotiate with buyers of their products and reduces farmers' risk aversion behavior and marketing cost.

- Access to extension services affects the quantity supply of maize positively and significantly. Extension services in agriculture are indispensable and it offers more than just expert assistance in the improvement of production, it also enables the flow of information and transfer of knowledge and scientific findings to practice that will help farmers in the production of maize. Therefore, strengthening agricultural extension services should be considered as an important input for the production of maize.

- Family size of the household has negatively and significantly affected volume maize marketed due to lack of enough product to market because larger family size requires higher amounts for consumption, reducing market supply. Therefore, employing the family members as labor to increase the production, this enabled them quantity supply of maize to the market.

- This research focused only on the output side of maize market supply, did not include the input side. However, the input side of maize market supply has more contribution for smallholder farmers to produce and supply more maize but there are many problems on the input side of maize in the study area. Therefore, it is recommended for other researchers to conduct a further study by including the input side of maize supply to the market in the study area.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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