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The Determinant Factors of Sugarcane Productivity: The Case of Wondo Genet, Ethiopia

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Abstract
The study was conducted to identify the factors affecting sugarcane productivity in Wondo Genet, Ethiopia. Data's were collected from 80 sugarcane growers from Wosha Soyama and Wotera Kechema Kebele administration. Data were collected during the period 2015/16 G.C harvesting. The input output relationship were analyzed by Cobb-Douglas production function. The result of Cobb-Douglas production function reveals that land holding size, costs of inputs for land preparation, DAP and urea were highly significant at 1% level with positive coefficients 0.33, 1.86, 0.65 and 0.18, respectively. Education level and the cost of FYM was significant at 5% level with coefficients of 0.24 and -0.04. The coefficient of adjusted multiple determinations R^2 was 0.8624, which indicated that it is well fitted and 86% variation in the variables was explained by all the hypothesized explanatory variables. On the basis of the research findings some recommendations were given so as enhance sugarcane productivity in the study area. These are; Promotion of formal education, decreasing input cost of Urea, DAP, FYM and cost of land preparation. Finally the government and other related body should work towards use of intensification method for sugarcane production so as to solve the problem of small land holder farmers.
Keywords: Sugarcane, Cobb-Douglas function, urea, cost of irrigation, land preparation, FYM, formal education, land holding size.

1. INTRODUCTION

1.1 background

Agriculture is the foundation of the economy of Ethiopia. It contributes quite significantly to the growth domestic product, account for 85 percent of total employment, and major source of revenue and export earnings(Abebe,2000). The contribution of agriculture to the country's gross domestic product and exports averaged sixty percent and ninety percent, respectively(World Bank, 1995). Agriculture sector had been characterized by a very low growth rate estimated at 1.4% per annum in real term during the last three decades. The growth rate had been meager, when compared with the growth rate of population of 2.49% per annum during the period(Teressa and Heidhues, 1998). According to them, the major causes for low performance of Ethiopian agriculture are diminishing farm size and subsistence farming, soil degradation, inadequate and variable rainfall, tenure insecurity, weak agricultural research base and extension system, lack of financial services, imperfect agricultural markets and poor infrastructure.

Sugarcane, as one of agricultural products, is used as the primary input in the production of sugar. Ethiopia has suitable agro ecology zones for the production of sugarcane. The production of sugar started in Ethiopia in 1951 with a joint venture between a Dutch company and the Ethiopian government to establish Wonji sugar factory. Ethiopia is most suitable for water-intensive sugar production and Ethiopian sugarcane yields are among the highest in the world (Berkum, Roza, and Tongeren, 2005). The sugar sector is important not only for the linkage that it would create between agriculture and industry and the suitable environment for the sector, but also because it is a source of renewable energy and will play a role in the country's climate resilient green economy strategy.

However, the current sugar production provides only 60% of the annual demand for domestic consumption and the annual per capita consumption of sugar in Ethiopia was about 5.1 kg which is considered to be low even by African standards (16.3 kg) international sugar organization(2010). Thus, there is a high need to increase the production and productivity of sugarcane in order to have a reliable supply of sugar in the country. Therefore, to this end this particular study aims at investigating the major factors that affects sugarcane production in the study area.

1.2 statement of the problem

Agricultural development in Ethiopia is hampered by many factors among which land degradation is the major one, which is threatening the overall sustainability of agricultural production of the country. Other constraints to agricultural growth of Ethiopia are population pressure coupled with the dominance of the use of traditional agricultural production technology, including traditional farm tools and farming practice, low application of modern inputs like improved seeds and fertilizers, etc. In Wondo Genet Sugarcane production, as one of the major cash crops, has been practiced by the farmers for long. Although such practice makes them beneficial,

their production is at minimum, which in turn results low level of income. Therefore, the aim of this research paper is to see the overall sugarcane production and its limiting factors in the study area.

1.3 objectives

1.3.1 general objective

the overall objective of the study is to identify the determinant factors of sugarcane productivity in the study area.

1.3.2 specific objective

- ✓ To Obtain relationship between agricultural inputs and sugarcane production
- ✓ To know the determinants of sugarcane production

2. MATERIALS AND METHODS

2.1 description of the study area

The study was conducted at Wondo Genet which is located 264 km south of Addis Ababa and 14 km southeast of Shashemene. It is located within the Ethiopian Rift Valley of the Southern Nations Nationalities and People's Region (SNNPR), Sidama Zone. Geographically it lies between 7°5.9'–7° 6' N latitudes, and 38°37' – 38°37.8' E longitudes. The altitude ranges between 1,800- 2,100 meter above sea level (masl). Wondo Genet has a bimodal rainfall distribution with two rainy seasons. Short rains occur during March-May and the long rains in July-October. It comprises 13 kebele administration and a total population of 119,5565 of which 51.3% male 48.7% female. .

2.2 data source

Both primary and secondary source of data were used for the purpose of this study. The sources for the primary data is generated from open and closed ended questionnaire distributed to farmers. Moreover, secondary data's were collected from concerned bureau of agriculture.

2.3 sampling method

The target population for this study was the sugarcane farmers in Wondo Genet, southern nations nationalities regional state. Two stage random sampling techniques were used in selecting the respondents. Two kebele administration were purposively selected based on their large sugarcane production.

2.4 sample size

After obtaining the total numbers of sugarcane producers from each kebele's , the sample size was determined using the tables of "Selecting the samples from a given population" (Fitz- Gibbon & Morris, 1987; McCall, 1980; Wunsch, 1986) at 10% sampling error rate. The sampling uses stratified sampling because the kebele's cane growers are not equal in size. Disproportional stratified sampling was performed. This sampling ensures that a sufficient number is selected from each group when groups are not equal in size (McMillan, 1999). Therefore, from a total of 800 sugarcane growers, 10% were taken as sample size of which 65 is from Wosha Soyama and the rest 15 From Wotera Kechema.

2.5 method of data analysis and interpretation

The data's were analyzed by using both descriptive and econometric analysis methods. For this study, descriptive statistics like mean, standard deviation and percentile were used to analyze data collected. Cobb-Douglas production function was employed to determine the factors influencing sugarcane production. Stata 10 and statistical package for social science (SPSS) version 20 were employed to analyze the data.

Model Specification

The multiple linear regression model were used to study the relationship between a dependent variable and one or more independent variables. The generic form of the linear regression model is,

$$y = f(x1, x2, ..., xk) + \varepsilon$$
$$= x1\beta1 + x2\beta2 + ... + xk\beta k + \varepsilon \quad .....1$$

Where y is the dependent or explained variable and x1, ..., xk are the independent or explanatory variables. ε is the disturbance factor.

From the above equation, Cobb- Douglas production function, cab be written as

$$\text{In } Y = \beta_o + \beta_1 \text{In} X_1 + \beta_2 \text{In} X_2 + ... \beta_n \text{In} X_n + \varepsilon \quad .....2$$

Where y is the dependent or explained variable(sugarcane production, in birr)

$x_1, ..., x_n$ are the independent or explanatory variables.

ε .....the disturbance factor

Definition of Variables and working Hypothesis

Dependent variable(Y) in this case sugarcane production to the market

Independent variables: The explanatory variables expected to influence the dependent Variable: These are;

According to Azam and Khan (2010), agricultural productivity is greatly affected by a number of inputs such as land, labor, capital, seed, fertilizer, irrigation and soil. All the inputs are categorized into three main variables such as land, labor and capital, where land includes the rental value of land for 12 months and labor consists of the hired labor, and family labor.

According to Malaza and Myeni (2009), it is important that smallholder cane growers improve their yield and sucrose content in order to maximize income. The major determinant of sugarcane productivity is timely and adequate application of inputs through the life cycle of the crop. Lower input use will certainly save costs, but reduce productivity. It is further argued that the age of ratoon has an inverse relationship with crop yield. If no new sugarcane is planted that implies declining trend in productivity. Malaza and Myeni (2009) identified seed, fertilization, irrigation, transport costs and ratoon management as the key elements to be managed for efficient production. The right varieties for the climate and soils need to be grown. Land has to be prepared taking into consideration the method of irrigation to be used and it should facilitate proper water movements.

Narayan (2004) estimated a sugarcane production model of sugarcane production in Fiji and found that the area harvested and fertilizer, labor force and prices paid to sugarcane farmers had positive influence on sugarcane productivity and profitability in both the short- and long-run.

Ogwang (2009) used Cobb-Douglas production function to determine factors affecting sugarcane productivity while gross margin analysis was used to determine profitability of sugarcane production. The results indicated that sugarcane farmers were getting positive gross margins from their sugarcane enterprise. The Cobb-Douglas results revealed that sugarcane acreage (farm size), amount of labor used and the distance from farms to factory were statistically significant

Baiyegunhi and Arnold (2011) investigated the economics of sugarcane production in Eshowe and Entumeni areas of KwaZulu-Natal. Sugarcane yield per hectare was used as the dependent variable and the explanatory variables included in the model were farm size (that is, the area of land devoted to sugarcane, measured in hectares) and other explanatory variables were stated in financial terms(Rands/hectare), these were farm staff, fertilizer, chemicals, fuels/lubricants and machine maintenance. The results showed that all the explanatory variables were significant in explaining the sugarcane yield per hectare.

Hussain and Khattak (2008) studied the economics of sugarcane production in and found that the area under sugarcane, total fertilizer used, total pesticides and insecticides used, human labor, tractor labor and total seedcane used were the main factors affecting sugarcane production.

3. RESULTS AND DISCUSSION

The aim of this analysis is to identify the determinant factors responsible for sugarcane productivity in Wondo Genet. It also look towards socio-economic factors which limit the increase of sugarcane production in the study area. The main concern is to help assess incentives for sugarcane producers.

Table1, shows that majority (37.5%) of the respondents were within the age group of 40-50 years. 31.25% of the age group fells in the age between 29-39. According to (Haruna and Kushwaha, 2003), this age group is considered as productive age group. The young farmers are more active in the adoption of new farming techniques and always willing to change for better than the older ones who are somehow conservative. Asumugha et al., (2000) also stressed that relatively young farmers assume greater risk in anticipation of high profit than the older ones. Regarding to sex the Majority 88.75% of the respondents were male who produces sugarcane in the study area while only 11.25% were found to be female.

The educational level of respondents revealed that majority (41.25%) had primary education followed by secondary education (35%). 20% of the sugarcane farmers had no formal education. This shows that most of the sugarcane farmers in the study area were literate.

Majority (67.5%) of the farmers has a family size between 6 – 10 persons, followed by those with the family size of 1– 5 persons constituting 25%, and 7.5% for family size of more than 10. Most of the respondents have no labor problem as much of it could be supplied within the family. This agrees with the findings of Welsh (2001) who stressed that a farmer incurs less production cost if family labor is being fully utilized for farm production.

The farmers experience revealed that 63.75% of the respondents had farming experience greater than 10 years, followed by those with 6 – 10 years, amounting 27.5%. Only 8.75% had farming experience between 1 – 5 years. The Majority (53.75%) of the respondents engaged in sugarcane production had average land holding size of between 0.2-1 hectares, followed by 1 –1.5 hectares (33.75%). The rest 12.25% holds greater than 1.5 hectares. This result indicated that the largest proportions of total farm holdings in the study area are small scale holdings. Majority (85%) of the sugarcane farmers were married. The high proportion of married individual indicates that more family labor is available for sugarcane production activities. This confirms with the findings of Haruna et al., (2002) which reported that this high proportion of marriage indicates greater responsibilities for catering to their families needs.

Table 1: Socio-Economic Characteristics of the Farmers

Variables	No of respondents	Percentage(%)
Age		
18-28	7	8.75
29-39	25	31.25
40-50	30	37.5
>50	18	22.5
Sex		
Male	71	88.75
female	9	11.25
Education level		
Without formal education	16	20
Primary education	33	41.25
Secondary education	28	35
Tertiary education	3	3.75
Family size		
1-5	20	25
6-10	54	67.5
>10	6	7.5
Farming experience		
1-5	7	8.75
6-10	22	27.5
>10	51	63.75
Land holding(ha)		
0.2-1	43	53.75
1-1.5	27	33.75
>1.5	10	12.25
Marital status		
married	68	85
Divorced	4	5
Widowed	8	10

Source: Field survey, 2016.

Analysis of Sugarcane Productivity

The factors that influence sugarcane production were investigated through production function analysis. Before running the OLS regression model, all the hypothesized explanatory variables were checked for the existence of multicollinearity and heteroscedasticity problem. The study used Variance inflation factor to investigate the degree of multicollinearity among continuous explanatory variables. A statistical package for social science(SPSS) version 20 was employed to compute the VIF. The results for all VIF values were ranging between 3.83 and 1.18. hence, multicollinearity was not a serious problem among the continuous (See Appendix A). In this study heteroscedasticity was also tested for all variables by running heteroscedasticity regression using an econometric software (Stata). The problem of heteroscedasticity were solved by undertaking robust ordinary least square(OLS) and hence all the explanatory variables were included for the model analysis. The coefficient of adjusted R^2 was 0.8624%, this indicates that 86% of the factors were from the hypothesized explanatory variables. (See table 2).

Cost of Inputs

Education

It has a positive effect on cane producers. It is statistically significant at 5% significance level. The model verified that one additional formal year of education level leads to an increase of 24% cane by farmers. (See table 2).

Landholding

The coefficient of farm size is 0.33 and was statistically significant at 1%. This implies that 1% increase in the land under sugarcane production results in the yield to increase by 33%. (See table 2).

Land Preparation cost

The coefficient of regression for the cost of land preparation was positive (1.86) at 1% level of significance, indicating land preparation cost have a positive relation to that of cane production. An increase in the cost of land preparation result in increase of 186% sugarcane yield by individual farmers. (See table 2).

DAP

The estimated variable co-efficient for DAP is highly significant at 1% with positive value (0.65), which

indicated that 1% raise in the use of DAP fertilizer will increases the sugarcane production by 65% . On similar lines Khan et al. (2002; 2005) found that optimal and balanced use of fertilizers improved sugarcane yield and gave maximum economic benefit to the farmers. (See Table 2).

Urea

The coefficient for the variable urea cost was positive (0.18), which indicated that 1% raise in the use of urea raises the production by 18% keeping other factors constant. This co-efficient was significant indicating that production of sugarcane increased extensively owed to optimal use of urea (See table 2).

FYM

The coefficient of regression for the variable FYM cost was negative (-0.04) with 1% significance level, which disguised that 1% increase in the FYM cost would reduce the sugarcane production by 4%, observing the other factors constant(See table 2). Khanzada (1992) also showed that use of FYM was negligible and irregular giving negative impact on sugarcane production.

Seed

The coefficient of regression for the variable of seed cost was negative (-0.06) and also non-significant, which indicated that 1% addition in the seed cost would diminish the productivity by 6% (See table 2). Kamruzzamani and Hasanuzzan (2007) also explained negative relationship among seed cost and sugarcane productivity.

Labor cost

The coefficient of regression for the variable of labor for harvesting cost was negative (-0.06), with non-significant impact on sugarcane productivity, which indicated that 1% increase in the labor for harvesting cost would decline the profit by 0.06%(See table 2). Kamruzzamani and Hasanuzzan (2007) described that as cost of labor increased the farmer benefit decreased having negative impact on crop benefit for the farmers.

Table 2: Estimated value of coefficient and related statistics of Cobb-Douglas production function of sugarcane production

Variable	coefficient	Std Error	t-value	Significance
Education level	0.24	0.02	2.69	0.036**
Land holding	0.33	0.05	5.61	0.000***
labor	-0.06	0.01	-1.53	0.135^{ns}
Cost of land preparation	1.86	0.38	24.74	0.000***
Cost of irrigation water	0.02	0.02	6.28	0.116^{ns}
DAP	0.65	0.30	4.32	0.000***
Urea	0.18	0.01	-3.25	0.000***
FYM	-0.04	0.04	-2.13	0.026**
Seed	-0.06	0.07	-1.96	0.149^{ns}
R^2	0.8651			
Adjusted R^2	0.8624			
Adjusted mean square(MSE)	0.5278			
Standard Deviation	0.7056			

Dependent variable= Productivity of sugarcane, N=80, R-Squared=0.8651, Adjusted R-squared=0.8624 and *** and ** shows significant at 1%, 5% respectively; ns= non significant.

Conclusion

The study was conducted to indentify the major factors that affect sugarcane productivity in Wondo Genet. Data were gathered from 80 sugarcane growers of Wosha Soyama and Wotera Kechema kebele. The data's were collected during 2015/16 G.C. The results of Cobb-Douglas production function reveals that education level, land holding size and the input costs of sugarcane i.e. urea, DAP, FYM, land preparation were significantly influenced sugarcane productivity of farmers.

Recommendation

On the basis of the research findings the following recommendations were given so as enhance sugarcane productivity in the study area. These are;

- Promotion of formal education has to be carried out as it has significant impact on sugarcane productivity.
- Input cost for sugarcane production like, Costs of Urea, cost of DAP, cost of FYM and cost of land preparation has to be minimized since they are significant for increasing productivity.
- Finally the government and other related body should work towards use of intensification method for sugarcane production so as to solve the problem of small landholder farmers.

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