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Cost Efficiency Analysis of Maize Production Among Rural Small Scale Farmers in Itesiwaju Local Government Area (LGA), Oyo State, Nigeria

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ABSTRACT

Maize is a crop commonly cultivated in Nigeria and its demand and supply is on the increase every year, this nevertheless pave the way for involvement of majority of rural households in every stage of production. The paper explored the cost efficiency of maize production in Itesiwaju local government area(LGA) of Oyo State. Primary data was collected from 173 maize farmers and this was achieved through the use of copies of well-structured questionnaire and application of multistage sampling procedure. Data collected were analysed using Stochastic Frontier Cost Function (SFCF) in determining factors affecting cost efficiency among farms. Results on socioeconomic characteristics of maize farmers showed the average quantitative variables age (46 years), household size (8 members), years of experience (28 years) and number of extension contacts (11 visits) while the mean seed and agrochemical cost were N1,643.00 and N3,150.00 respectively. Farming experience ($p<0.1$), extension contacts ($p<0.05$) and household size ($p<0.1$) were found to increase cost efficiency of farms. Cost variables such as labour ($p<0.05$), seed ($p<0.1$) and agrochemicals also increased the cost efficiency of maize farms. Gamma (΄Υ) showed that about 0.98 percent of the variation in cost of production was due to factors beyond farmers' control and sigma square ($\sigma 2$) of 1.378($p<0.01$) explained the suitability and appropriateness of the analytical model. The Return to Scale was 1.154 and the majority of maize farmers had clustered cost efficiency distribution between the range of 0.51 and 0.99 suggesting being cost efficient in maize production.

INTRODUCTION

Maize is one of the major cereal crops of the world and the second most important cereal crop in the world after wheat, contributing substantially to the total cereal grain production in the world economy as a trade, food, feed and industrial grain crop (Pingali, 2001; Food and Agriculture Organization, 2009). Developing countries plant two-third of the global maize production while industrialized countries plant one-third. None of the top 25 maize-producing countries are from Africa, producing 17.4 million hectares amounting to 12.5% of the maize global area (FAO, 2014). Of the 140 million hectares of maize grown globally, approximately 22 million (15.7%) are in sub-Sahara Africa, out of this, 17 million hectares are grown in the mid-altitude area and 12.3 million hectares in the tropic lowlands (Pingali, 2001).

The major maize growing countries in Africa are Nigeria, South Africa, Ethiopia, Kenya, Malawi, Tanzania, Congo, Mozambique and Zimbabwe, all mainly Eastern and Southern African countries except for Nigeria. According to FAO (2009), in 2006 alone, African continent cultivated 26 continent cultivated 26,118 million, which increased to 26,726 in 2007 but reduced marginally in 2008 to 26, 106 million. Based on the FAO (2007) estimates, 158 million hectares of maize are harvested worldwide; Africa harvests 29 million hectares with Nigeria as the largest producer in the Sub-Sahara Africa harvesting 3%, followed by Tanzania. In 2017, maize production for Nigeria was 10.4 million tonnes though Nigeria maize production fluctuated substantially in recent years but tended to increase through 1968 to 2017 period ending at 10.4 million tonnes in 2017.Maize Farmers Association of Nigeria (2019) affirmed that the production of maize increased from eight million tonnes to 20 million tonnes in Nigeria between 2015 and 2018.

Maize is Africa's most important cereal, forming a basic part of the cereal – legume intercropping system is common to most developing countries' agriculture (Ofori and Stern, 1987). Being a very important staple food for millions of Nigerians and residents of West Africa, maize is one of the two major crops covering about 40% of the area under agricultural production, and its production accounts for 43% of maize grown in West Africa (FAO, 2002; Iken and Amusa, 2004; McCann, 2005; Ogunsumi *et al.*, 2005). Maize production therefore is of strategic importance for food security and the socio-economic stability of countries and sub-regions in sub Saharan Africa, including Nigeria (Morris, 1998).

Maize is widely grown across Nigeria. All of the 36 states and the FCT (Federal Capital Territory) grow maize (Figure 2). Those states with the highest maize area are Niger, Kaduna, Ogun, Kogi, Taraba, Katsina, Oyo, Plateau, Ondo, and Kano. Together, these account for nearly 57% of the total area. In a similar fashion, Kaduna, Niger, Plateau, Borno, Kano, Ondo, Ogun, Taraba, Kogi, and Bauchi together account for close to 60% of maize production in the country. The productivity of maize is extremely variable among the states. Greater rates of growth were reported for 15 of the 36 states and FCT between 1994 and 2012. Notable among these were Yobe (ROG = 7.5%), Katsina (4.8%), Jigawa (4.2%), Zamfara (2.9%), and Oyo (2.5%). By contrast, 22states had negative growths over the same period– with Kaduna (-6.0%), Taraba (-5.1%), Delta (- 5.1%), Imo (-3.9%), and Plateau (-3.7%), showing the highest negative growth rates between 1994 and 2012.

Drought Tolerant Maize for Africa(DTMA) under the auspices of the International Institute of Tropical Agriculture(IITA) reported that, more than 5.56 million hectares of land planted to maize in 2013 (or about 16% of all of Africa's maize area combined) with Nigeria having the right to claim the position of the giant of maize production in Africa. It stated further that only Tanzania claims a distant second position with about 4.1million ha. Maize production in the former country had a humble beginning; it stayed around one million hectares through the early 1980s but its accelerated growth started in the mid-1980s when hybrids were introduced, exceeding the 5 million hectares mark in the mid-1990s following the introduction of early and extra-early varieties; it declined or remained slow during the late 2000s, mainly due to drought and erratic rainfall, but picked up thereafter (Figure 1). Currently it occupies the largest area of cultivated land in the country, followed by sorghum, cassava, millet, cowpea, yam, rice and groundnut, according to the National Bureau of Statistics (NBOS). Maize, sorghum, and millet occupied about 5.5 million, 4.9 million, and 2.9 million ha, respectively, in 2012.

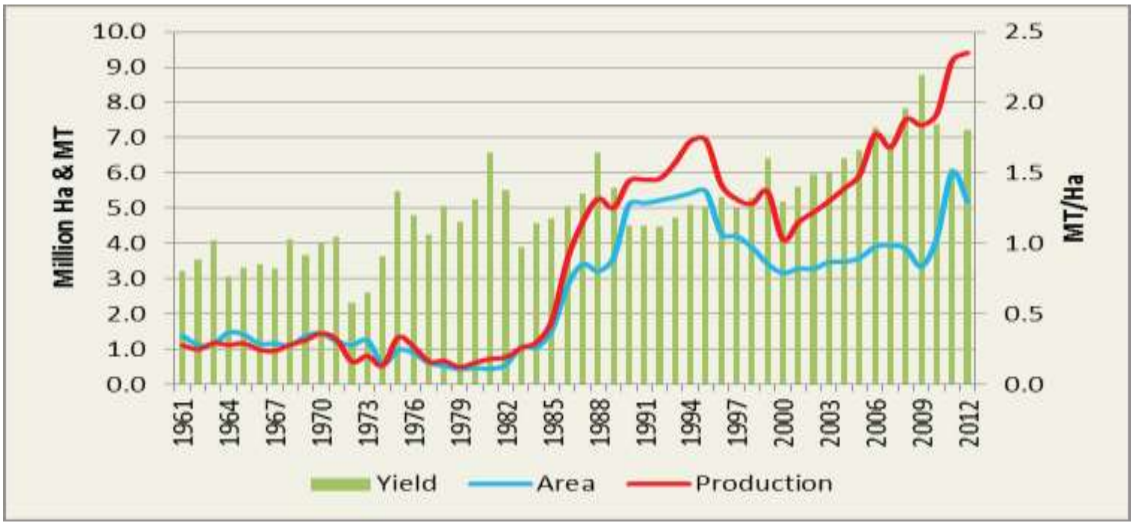

Figure 1: Trend in maize production in Nigeria

Source: Calculated by the authors from FAOSTAT, Jan 2014)

Zalkuwi *et al* (2010) analysed maize production in Ganye local government area of Adamawa State and concluded that farmers in the study were cost efficient in the allocation of the available resources with an index of 1.04. Taiwo *et al* (2011) worked on economic advantage of hybrid maize over open pollinated maize in Giwa local government area of Kaduna State and based on their result concluded that farmers using hybrid seed were more efficient than farmers using open pollinated seed. Olayemi (2004) and Koutsyannis (1988) established that the technical transformation of input to output is at a cost to farmers and the return on investments by a farmer should exceed production cost for the farmer to make profit and still operate as a player in the industry. They established further that, cost of production is disaggregated into variable and fixed cost; the former varies with the scale of production and remained varied over the entire production horizon while the latter does not vary with the scale of production but varied in the long run. They concluded that, in the long run, all costs are variable. Northern Nigeria which is mostly savannah, favours maize production and the cited researches above were from the area. However, this study was being carried out in the Southern Nigeria with more rainfall in order to find out whether farmers in the rain-forest of the country are cost efficient in maize production or not. This study hopes to contribute substantially to the existing literature in the area of assessment of cost efficiency frontier attainment among small farmers and the need to encourage farmers to join the industry.

This study among others hopes to answer the following research questions: What are the socioeconomic characteristics of maize farmers in the study area? Are maize farmers in the study area cost efficient? What are the constraints associated with production of maize in the study area? The following questions among others are hoped to be answered in this study through the following specific objectives, which are to: describe the socioeconomic characteristics of maize farmers; identify the determinants of cost efficiency among rural small scale maize farmers and examine constrains militating against maize production in the study area.

Hypothesis of the Study

This study is built on the null hypothesis that: There is no significant relationship between the cost of production of maize and selected socioeconomic characteristics.

MATERIALS AND METHODS

Study Area

The study area was Itesiwaju local government area (LGA) of Oyo State. The headquarters is Otu. It has a total land area of 1,543km^2 and a population of 128,652(NPC, 2006). Itesiwaju LGA is bounded to the North by Atisbo LGA, to the West by Kajola LGA, to the East by Atiba and Oyo West LGAs and to the South by Iseyin LGA. It is about 115km from Ibadan, the State capital but completely located in the guinea savannah area of the State and based on political affiliation, belongs to Oyo North Senatorial District (Oyo State Diary, 2018). The average annual rainfall and temperature are about 1450mm and ±26.5^{0}C respectively; this paves the way for good edaphic qualities of retaining surface feeder crop needing nutrients at the top-most ground level for accessibility of nutrients by plants. The rainfall regime in the area is bimodal and the distribution is dense in the southern part and sparse in the northern part. The indigenes of the LGA are predominantly farmers practising either on part time or full time basis. Yoruba is the major occupants of the area but playing host to other tribes from other regions such as Hausa, Fulani, Egede and foreigners from the neighbouring countries among others. Itesiwaju LGA government area belongs to Oke-Ogun zone in the State where massive production takes place and as such called the food basket of the State.

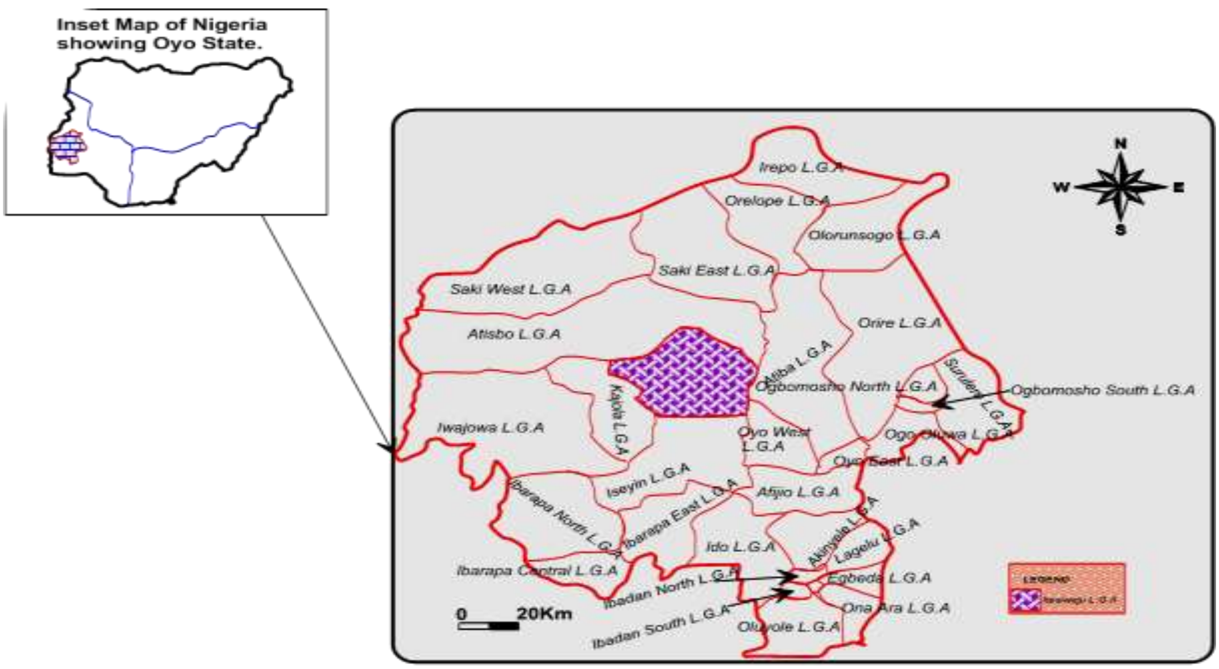

Figure 2: Map of Itesiwaju local government area (LGA) of Oyo State

Type of Data and Instrument of Data Collection

Data used for this study was strictly from primary source and the instrument of data collection was well-structured copies of questionnaire and interview guide. Data relating to the socioeconomic characteristics and cost profile of farmers were collected, among them are: age, years of experience, level of education, cost of land, cost of agrochemicals, cost of seed and cost of labour among others.

Data Collection Technique

A multistage sampling procedure was used in collecting data for the study. The first stage was the purposive selection of Itesiwaju LGA from the thirteen (13) LGAs of Oke-Ogun senatorial district which is the food basket of Oyo State (Assessment and Poverty Rating Report, 2005) and characterised with heavy concentration of small scale maize farmers. Purposive selection of six spatially located noticeable towns in Itesiwaju local government area was done and these are: Babaode, Gbonkan, Ipapo, Oke-Amu, Otu, and Okaka, this forms the second sampling stage. The third sampling stage was the random sampling of 30 respondents from each of the selected towns, Total sampling size was 180 respondents who were reached and interviewed. Eight of the responses were rejected due to bias and inconsistency. A total of 173 responses were eventually used for the study.

Analytical Tools

Cost Efficiency

The cost function representing the dual approach in the technology is seen as a constant towards the optimizing behavior of firms (Chambers, 1983). In the context of the cost function, any error of optimization is taken to translate into higher cost for the producers. However the stochastic nature of the production frontier would still imply that the theoretical minimum cost frontier would be stochastic (Coelli, 1996). The stochastic frontier cost functions model for estimating farm level overall economic efficiency is specified as:

$$C_i = g(Y_i , P_i ,; \alpha) + \varepsilon_i \qquad 1$$

$i = 1,2…n$

This is explicitly stated as:

$$C = \alpha_0+\alpha_1P+\alpha_2P+\alpha_3P+\alpha_4P+\alpha_5P +Y^*+(V_i + U_i) \qquad 2$$

Where the variables are selected based on the work of Ogundari and Ojo (2006) and Ogundari*et al* (2006) thus:

C = total cost (in Naira);
P_1 = Farm-land Acquisition cost(in Naira);
P_2 = Labour Cost (in Naira);
P_3 = Seed Cost (in Naira);
P_4 = Fertilizer Cost (in Naira);
P_5 = Agrochemicals Cost (in Naira);
Y*= Total Farm output (in kg);
ε_i = Error term.

where

$$\varepsilon_i= V_i + U_i \qquad 3$$

Here V_i and U_i are as defined earlier. However, inefficiency is always believed to increase costs as error component has positive signs.

The inefficiency model specified by Battese and Coelli(1993) is stated as follows:

$$\upsilon_i= \delta_0 + \delta_1Z_{1ij}+ \delta_2Z_{2ij} + \delta_3Z_{3ij} \qquad 4$$

υ_{ij} = In-efficiency model of the ith farmer
Z_1 = Farmer's Experience (in years)
Z_2 = Extension Contact (No.)
Z_3 = Household Size (No.)

Test of Hypotheses

Student's t-test was used to test the significant relationship between the cost of production of maize and selected socioeconomic variable. The formula is as follows:

$$\mathbf{t} = \frac{x_{1-} x_2}{s_{x_1x_2}\cdot\sqrt{\frac{2}{\pi}}} \qquad 5$$

Where

$$\mathbf{S_{x_1x_2}} = \sqrt{\frac{1}{2}}(\boldsymbol{S_1^2} + \boldsymbol{S_1^2} \qquad 6$$

RESULTS AND DISCUSSION

Socioeconomic and Input Cost Characteristics of Respondents

Table 1 revealed the socioeconomic characteristics of maize farmers in the study area. Result of age distribution of the respondents showed the mean age of 46 years while the majority (67.6%) were active and capable of working diligently in transforming available inputs to optimal output at reasonable cost. Majority (70.5%) of the farmers were male while their female counterparts were 29.5% suggesting that maize production demands more attention, energy and resources which are mostly available among male farmers. Result on household size distribution of the respondents revealed the range (6-12) members as the highest (58.4%) with the mean household size of 8 members. This size is relatively large with an advantage of family labour to work on the maize farm since farm labour seems to be relatively scarce nowadays due to massive rural-urban drift most especially among by youths. Farming experience of maize farmers revealed that they have a mean farming experience of 28 years and the highest (27.2%) of experience within the range of 21-30 years. It could be inferred from this result that a lot of the farmers had been in maize production of maize for at least about three decades and based on this will always find production easier and flexible. Education of the respondents showed that a high number acquired secondary education (34.2%) and this was closely trailed by primary education (30.6%). Both respondents with no formal education and tertiary education were 22.5% and 12.7% respectively. This result suggests that the majority of the maize farmers had at least primary education inferring that education plays a significant role in ensuring efficient management of maize farms for better realization of output at a remarkable cost reduction level. Extension contacts of the respondents revealed the mean seasonal visits of 7 times, while the highest (53.8%) fell within the bracket of 6-12 visits. This result suggests that farmers had less than 12 extension contacts on-season which is just about 50% of the total recommended extension visits per season; it is an indication that farmers were under-visited in the previous season and invariably received lesser extension services. Highest (49.7%) number of farmers realized between N150, 000 and N200, 000 per season with a mean income of N164, 450.00 which is equivalent to $357.50.

Table 1: Socioeconomic Characteristics of Maize Farmers

Variable	Frequency	Percentage	Mean
Age(in years)			
≤20	01	0.6	
21-40	55	31.8	46 years
41-60	61	35.3	
>60	56	32.4	
Gender			
Male	122	70.5	-
Female	51	27.5	
Household Size(No.)			
≤5	66	38.2	
6-12	101	58.4	8 members
>12	06	3.4	
Farming Exp.(in years)			
≤10	33	19.1	
11-20	41	23.7	
21-30	47	27.2	28 years
>30	52	30.0	
Educational Level			
No Formal Educ.	39	22.5	
Primary Education	53	30.6	-
Secondary Education	59	34.2	
Tertiary Education	22	12.7	
Extension Contacts			
≤5	50	28.9	7 times
6-12	93	53.8	
>12	30	17.3	
Seasonal Income(in N)			N164,450.00
≤100,000	10	5.8	
100,001-150,000	18	10.4	
150,001-200,000	86	49.7	
>200,000	59	34.1	
Total	**173**	**100.00**	

Source: Field Survey, 2020

Determinants of Cost Efficient in Maize Production

The maximum likelihood estimate (MLE) of cost of maize production among farmers in the study area is presented in table 2. The estimate for the variance parameter, ϒ, is close to one, indicating that inefficiency effects are highly significant in the analysis of the total cost of maize produced among sampled farms. Sigma square $(\sigma)^2$ has the value of 1.379 and this indicates the variance was due to measurement error. Log-likelihood function of 373.21 indicated that the value maximizes the joint densities in the estimated model.Of all the efficiency variables modelled; cost of labour, cost of seed, and cost of agrochemicals were found to be significant at 5 percent and 10 percent levels and positively signed, whileinefficiency variables such as years of farming experience, number extension contacts, and household size were negatively signed according *to a priori*expectation and found to be significant at 5 percent and 10 percent respectively. Cost of labour ($p<0.05$), cost of seed ($p<0.1$) and cost of agrochemicals ($p<0.1$) negatively influenced the total cost of production by 17.4%, 80.9% and 13.2% respectively. This result is suggestive of the fact that the three inputs are highly imperative in the production of maize. Based on this, they are scarce and relatively costly being that labour continually drifts to urban and this affects maize production because farming is labour intensive. Seed is very imperative in the maize production process and, whether a farmer uses the high yielding variety or open-pollinated variety, the acquisition is cost determined. Since most farmers are desirous of attaining optimum production frontier, improved varieties are widely patronized.

Moreover, cost of agrochemicals is high and threatens maize production because it is used more often in weeding operation which has been substituted for labour which also seems to be very hard to get in the rural areas in recent times. Inefficiency variable showed that farming experience ($p<0.1$) and number of extension contacts ($p<0.05$) decreased the cost of production of maize by the respective of 20.1% and 60.9% while household size ($p<0.1$) increased the total cost by 58.3%. It could be inferred from this result that farmers with more years of experience are efficient in the allocation of farm input at reasonable prices and farmers who get advisory services from extension agent were able to save cost which in turn widened their profit margin.

Table 2: Maximum Likelihood Cost Estimate of Maize Production among Farmers

Cost Function Estimates Variable		Co-efficient	T-ratio
Cost Variable			
Constant	β_0	4.5729***	5.86***
Cost of Land(in Naira)	β_1	0.0378	0.23
Cost of Labour(in Naira)	β_2	-0.1735**	-4.04**
Cost of Seed(in Naira)	β_3	0.8088*	3.43*
Cost of Fertilizer(in Naira)	β_4	-0.0941	-1.14
Cost of Agrochem(in Naira)	β_5	-0.1319*	-3.04*
Total Output (in Kg)	Y**	0.7067	-0.08
Inefficiency Variable			
Constant	δ_0	0.1153	1.15
Farming Experience(in years)	δ_1	0.2010*	3.31*
Extension Contacts(No.)	δ_2	0.6091**	4.45**
Household Size(No.)	δ_3	-0.5829*	-2.00*
Diagnostic Statistics			
Sigma Sq.	σ^2	1.3786***	
Gamma	Ύ	0.0190(0.981)	
Log-likelihood (LLf)		273.21***	
Likelihood Ratio(LR)		19.577***	
Number of Respondents		173	

Source: Field Survey, 2020

Cost Elasticity Estimate of Maize Production

The elasticity estimate showed the overall input cost influence on the total cost of production. The cost elasticity value was 1.154. This means that on every unit of input cost incurred by maize farmers, there is an increase of 0.154 unit cost expended above the minimum cost. The result suggests that minimum cost was spent by farmers in the production of maize which invariably reduce total cost. Moreover, production at lower cost increases the profit margin in the long-run.

Table 3: Cost Elasticity Estimate of Maize Production and Returns to Scale (RTS)

Variable		Cost Elasticity(CE)
Cost of Land(in Naira)	β_1	0.038
Cost of Labour(in Naira)	β_2	-0.174
Cost of Seed(in Naira)	β_3	0.809
Cost of Fertilizer(in Naira)	β_4	-0.094
Cost of Agrochem.(in Naira)	β_5	-0.132
Total Output (in Kg)	Y**	0.707
Total		1.154

Source: Field Survey, 2020.

Cost Efficiency Profile of Respondents

Cost efficiency distribution of respondents is presented in table 5. The majority (0.90-1.00) of maize farmers (92.49%) operated on the highest efficiency cost frontier. The minority (0.51-0.70) who are 1.16% operated at the average cost efficiency frontier. The overall farmers' population performed between the middle and highest efficiency range. This result indicates that maize farmer in the study area are efficient in their farming practices suggesting strongly that, maize production among farmers in the area in which the study was carried out can continue in the production of maize as it is profitable.

Table 5: Cost Efficiency Distribution of Respondents

Efficiency Range	Frequency	Percentage
≤0.10	-	-
0.11-0.20	-	-
0.21-0.30	-	-
0.31-0.40	-	-
0.51-0.60	01	0.6
0.61-0.70	01	0.6
0.71-0.80	05	2.8
0.81-0.90	06	3.5
0.90-1.00	160	92.5
Total	173	100.0

Source: Field Survey, 2020.

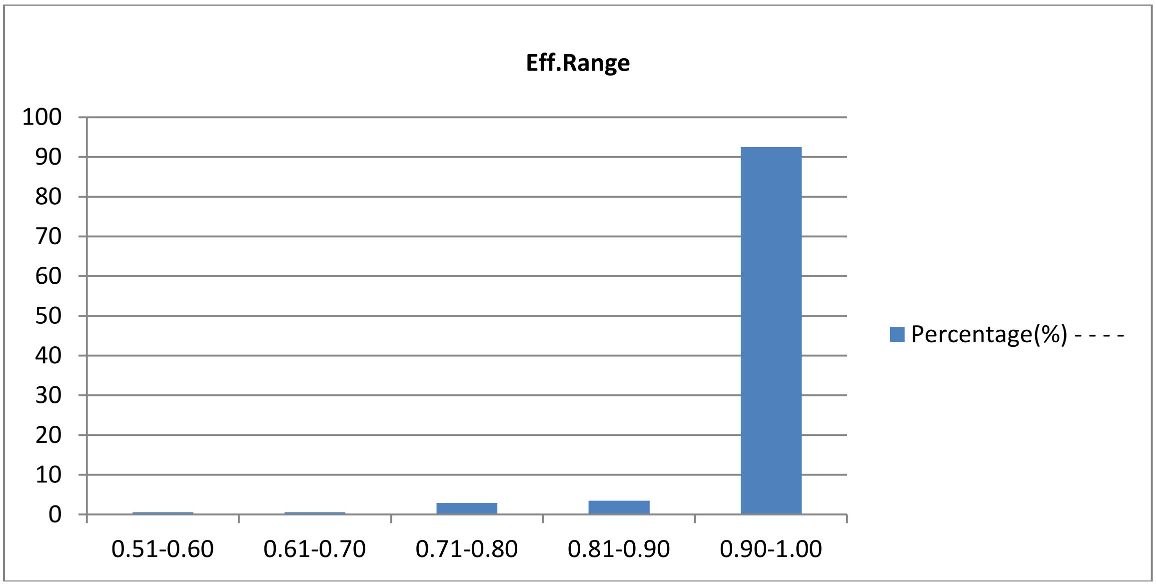

Figure 3: Efficiency range of Maize farmers' performance

Challenges Confronting Maize Production

Maize farmers' responses to the challenges confronting them in the study area are presented in Table 6. High cost of agrochemicals was the most identified problem with 96.5%(1st) while the least was shortage of cultivable land, 55.5 %(8th) for shortage of cultivable land while all other challenges hanged in between. The mean response of the respondents was 80%. Agrochemicals (96.5%) assumed the first identified constraint and was suspected to be due to high cost of labour for farm plot maintenance. It could be inferred from this that, farmers aimed at solving persistent weeding problem through the use of agrochemicals as farm labour is relatively scarce. The least of the identified constraints was the shortage of cultivable land. This problem may be arising due to land tenure problem which was statutorily handled by the land use decree of 1978 that land should be held in trust by the federal and state government and allocate to all users for farm and industrial purpose among others. High cost of labour(90.2%), low market price(85%), high transportation cost (79.8), high cost of seed (78%), shortage of extension (60.7%) andshortage of cultivable land (55.5%) were other identified problems which directly or indirectly challenged maize production in the study area.

Table 6: Constraints to Maize Production

Constraints	Number of Vote	Percentage	Rank
High cost of labour	156	90.2	3rd
High cost of seed	135	78.0	6th
High cost of agrochemicals	167	96.5	1st
Shortage of cultivable land	96	55.5	8th
Pilfering	164	94.8	2nd
Low market price	147	85.0	4th
High transportation cost	138	79.8	5th
Shortage of extension visit	105	60.7	7th
Sample size(173)			
Mean response(80%)			

Source: Field Survey, 2020.

Hypothesis Testing

Based on the result from student's t-test, cost of production of maize was significantly influenced by farmer's experience, number of extension contacts and household's size farming experience and number of seasonal extension contacts increased the cost efficiency of maize farmers while household size was otherwise in the study area.

CONCLUSION AND RECOMMENDATION

Production of maize was found to be cost effective among farmers in the study area given the efficiency index of 1.154. Despite the fact that labour cost, fertilizer cost and agrochemical cost reduced cost efficiency, but farming experience, extension contacts and household sizewere found to increase cost efficiency. It was therefore recommended that:

(i) Farmers should be exposed to advanced agricultural farm machineries which reduces drudges in farm operation hence the reduction in labour use and invariably reduced cost.
(ii) Fertilizer supply should be increased and made available to farmers at affordable price.
(iii) Agrochemicals, which substitutes for more labour use most especially in weeding operation should also be made available and accessible to farmers for timely and efficient weed control.
(iv) More extension services should be made more available to farmers through employment of more trained and capable extension agents.

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