Analysis Of Cost Efficiency Of Sorghum Producers In Nigeria

Jimjel Zalkuwi, Rakesh Singh, O. P Singh

Department of Agricultural Economics, Institute of Agricultural science, BHU, Varanasi-221 005.
Corresponding Author's Email: jzalkwi4u@gmail.com

Abstract: The study examined the cost efficiency of sorghum production in Adamawa State, Nigeria. Data were collected from 240 farmers using purposive and simple random sampling with aid of structured schedule. The result of the stochastic frontier production function analysis shows that the variance parameters, that is the sigma squared (δ^2) and the gamma (γ) were statistically significant at 1 % level for sorghum production. The coefficient of farm size, family labor, seed and fertilizer were positive and significant at 1%, 5% and 10% levels while fertilizer was not significant. Profit level can be increased by increasing the amount of farm size, quantity of seed, labor and chemical and decreasing the use of fertilizer. Mean efficiency was 0.68; Farmers operate at 32% below frontier level due to variation in cost efficiency. The inefficiency model shows that the coefficient of Age, literacy level and credit have negative a priori sign and in consonance with the a priori expectation.
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Introduction

Nigeria is the largest producer of sorghum in West Africa accounting for about 71% of the total regional sorghum output. Sorghum is the 3rd cereal in terms of quantity of production in Nigeria. Agricultural industry was accorded scanty attention after the discovery of oil in commercial quantity in Nigeria. This has created a gap between the demand and supply of domestic food requirements. Consequently, the country has found it increasingly difficult to feed her teeming population and supply the local industries from the domestically produced food and raw materials. The annual widening gap between food and raw materials demand and supply in the country gave room for concern (Igben 1988). The productivity growth may be achieved through either technological progress or efficiency improvement (Coelli, 1995). Several studies indicated that the existing low levels of cost efficiency hinder efforts to achieve progress in production (Belete *et al*., 1991; Seyoum *et al*., 1997, Gajja et.al 2014). Despite the significant growth in sorghum production, there is huge inefficiency in the production system of sorghum production. An improvement in the efficiency of production system will have direct positive impact on agricultural growth, nutritional security and rural livelihood in a country like Nigeria, where sorghum is one of the major crops.

Under these circumstances it is important to know that whether the producers have the same or different levels of cost efficiency. The study therefore, tries to measure the cost efficiency under different farm in Adamawa State of Nigeria.

Methodology

Selection of the state and local government:

Adamawa State based on their production level was selected purposively. The state has twenty-one Local Government Areas (LGA) which are categorized into four agricultural zones; South West, Central, North West and North East Zone. Twenty percent of total LGA i.e four LGA were purposively selected from each zone, comprise Viz; Ganye, Guyuk, Mubi South and Girei.

Selection of district

Ten percent (one) district from each LGA was selected purposively on the basis of highest sorghum production. Thus total 4 districts were selected

Selection of villages

A list of all villages in the four districts was prepared on the basis of sorghum production, 10 percent of the villages having the highest sorghum production in each district were selected, and then 10 percent of the farmers were selected randomly to give a total of 240 farmers.

Collection of data

Primary data was collected from 240 sorghum farmers from Adamawa state, Nigeria. The main instrument that was used for collecting the data was structured schedule for the period of July 2013-December 2013

Analytical tools

The inferential statistics (the stochastic frontier production model) was used.

Farell (1957) defined cost efficiency as the ability of a farm to maximize profit by equating the marginal revenue product of inputs to their respective marginal costs.

Cost efficiency measures the degree of correctness in the adoption of factor proportions to current input prices. A producer is costly efficient if production occurs in a sub set of the economic boundary of the production possibilities set that satisfies the producer's behavioural objective.

The Cost Efficiency (AE) in the use of variable inputs is worked as the ratio of,

AEij=MGRj/ OGRij

Where,

MGRj= Maximum possible gross revenue of the jth sorghum producer

OGRij= Gross revenue at the optimum level of the ith input with all input remaining at the same level of the activity by jth sorghum producer

The Empirical Stochastic Cost Frontier Model

The empirical model used in determining cost efficiency of sorghum farmers in the State is given by:

$$\ln C_{ij} = \beta_0 + \beta_1 \ln P_{1ij} + \beta_2 \ln P_{2ij} + \beta_3 \ln P_{3ij} + \beta_4 \ln P_{4ij} + \beta_5 \ln P_{5ij} + \beta_6 \ln P_{6ij} + V_{ij} - U_{ij} \quad (1)$$

Where:

Subscript ij refers to the jth observation of the ith farmer.

Ln = Logarithm to base e

C_{ij} = Total production cost (₦/ha) of the ith farmer

P_1 = Expenses on land (₦)

P_2 = Cost of Family labour (₦/ha)

P_3 = Cost of seeds (₦/ha)

P_4 = Cost of inorganic fertilizer (₦/ha)

P_5 = Cost of agrochemicals (₦/ha)

The parameters of the empirical cost function were measured as:

i). **Total production cost:** This measures the total cost of production per hectare in the last cropping season (July 2013 to December 2013) by the farmers. Since fixed cost of production is negligible in the short-run, the study only used variable cost of production per hectare as a proxy for total production cost.

ii). **Expenses on land:** This is measured as the amount of money or its equivalent paid as rent for the use of land during the last cropping season. Where produce are given, the study used the value of 10% of the total output as proxy for expenses on land.

iii). **Cost of family labour:** This is measured as the amount of money which would have been paid for labour if it is hired during farm operations. It is measured in naira per hectare.

iv). **Cost of hired labour:** This is the amount of money paid for the hire of labour during farm operations. It is measured in naira per hectare.

v). **Cost of agrochemicals:** This is the total expenses on herbicides and pesticides incurred by the farmer during the last cropping season. It is measured in naira per hectare.

vi). **Cost of inorganic fertilizers:** This is the total expenses on inorganic fertilizers such as NPK, Urea incurred by the farmer during the last cropping season. It is measured in naira per hectare.

vii). **Cost of seed:** This is the total expenses on seed incurred by the farmer during the last cropping season. It is measured in naira per hectare.

It is assumed that the cost inefficiency effects are independently distributed and U_i arises by truncation (at zero) of the normal distribution with mean, μ_{ij} and variance δ^2, where μ_{ij} is defined by:

$$\mu_{ij} = \delta_0 + \delta_1 Z_{1ij} + \delta_2 Z_{2ij} + \delta_3 Z_{3ij} + \delta_4 Z_{4ij} + \delta_5 Z_{5ij} + \delta_6 Z_{6ij} + \delta_7 Z_{7ij} \quad (2)$$

Where:

μ_{ij} = Cost inefficiency of the ith farmer

Z_1 = Denotes years of farming experience

Z_2 = Represent years of formal education

Z_3 = Extension contact (number of meetings)

Z_4 = Household size (number)

Z_5 = Primary occupation (dummy, where one indicated farming and zero otherwise)

Z_6 = Crop diversification (dummy, where one indicated mixed cropping and zero

Sole cropping)

Z_7 = Credit availability (dummy, where one indicated those that accessed credit and

zero otherwise)

Results And Discussion

The maximum likelihood estimate of the parameter of the stochastic cost frontier model of the sorghum farmers in the study area in estimating cost efficiency is presented in Table1. It is revealed from table 1 that all parameters estimated have the expected sign. Most of the parameters estimates are significant except cost of hired labour and cost of chemical,

Table 1 Maximum likelihood estimate of the parameters of the stochastic cost function

Variable	Parameter	Coefficient	t-ratio
Cost factors			
Constant	β_0	4.5348***	25.0180
Cost of land (P1)	β_1	0.1554***	4.3465
Cost of hired labour (P2)	β_2	0.0092	0.8391
Cost of seed (P3)	β_3	0.1105***	2.6001
Cost of fertilizer (P4)	β_4	0.2780**	2.522
Cost of chemical (P5)	β_5	0.0269	1.6628
Cost of family labour (P6)	B_6	0.5231**	
Inefficiency effects			
Gender	d_1	-0.1683***	-2.7568
Marital status	d_2	-0.0220	-0.4301
Age		-0.1947**	-2.1432
Family size	d_3	-0.0087	-0.0447
Literacy level	d_4	-0.1692***	-2.7431
Farming experience	d_5	-0.0751	-0.4737
Credit		-0.2271***	-0.3458
Extension contact	d_6	0.0188	0.2704
Diagnostic statistics			
Sigma squared (d^2)		0.7123***	6.4063
Gamma (ϒ)		0.8314***	3.842

*** Estimates are significant at1% level, ** Estimates are significant at 5% level.
*Estimates are significant at 10% level

meaning that these factors are significantly different from zero and thus are important determinant of sorghum output except for cost of hired labour and cost of chemical, which are not significant. The results implies that the variable (cost of land, cost of seed, cost of family labour and cost of fertilizer) used in the analysis have direct relationship with total cost of production. The cost elasticity with respect to all input variables used in the production analysis are positive , implying that an increase in the cost of land , cost of family labour, cost of seed, and cost of fertilizer increases production cost. That is 1% increase in the cost of land will increase total production cost by approximately 0.16%, 1% increase in the cost of family labour will increase total production cost by 0.52% ,1% increase in the cost of seed will increase total production cost by 0.11% and 1% increase in the cost of fertilizer will increase production cost by 0.27%. This finding is in harmony with Maurice (2012), Gwandi (2012) and Daniel et al (2013).

The distribution of sample sorghum producers according to different cost efficiency ratings along with minimum, maximum and average cost efficiency is presented in table 2.

Table 2: Distribution of Sorghum Producers according to Allocating Efficiency ratings

Efficiency	Frequency	Percentage
<0.40	24	10.0
0.40 – 0.49	50	20.8
0.50 – 0.59	52	21.7
0.60 – 0.69	54	22.5
0.70 – 0.79	50	20.8
0.80 – 0.89	10	4.2
0.90 – 1.00	0	0
Total	240	100
Minimum efficiency	0.1156	
Maximum efficiency	0.8709	
Mean efficiency	0.5802	

It is evident from table 2 that there is substantial difference between minimum and maximum efficiency level of sample farmers reflecting the improper allocation of resources by farmers. The average cost efficiency level was found to be the 0.5802, which showed that on an average efficiency level could be increased by 42 percent. More than 50 percent farmers were operating below 60 percent efficiency level, 43 percent producers were operating between 60 to 80 percent efficiency levels. Only 4.2 percent farmers operated above 80 percent efficiency level. Therefore, it is suggested that farmers should be made aware about the proper allocation of resources so that they can achieve higher cost efficiency level and productivity will be increased.

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