COMPARATIVE ANALYSIS OF ECONOMIC EFFICIENCY OF
SORGHUM PRODUCTION IN MAHARASHTRA AND
KARNATAKA STATE OF INDIA

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ABSTRACT

This study analyzed and compared the technical, allocative and economic efficiency of sorghum production in Maharashtra and Karnataka States of India. Data were collected through the administration of 200 copies of questionnaires to selected sorghum farmers (100 from each of the two states of sorghum production) using simple random sampling and purposive sampling technique. The result of the stochastic frontier production function analysis shows that the variance parameters, that is the sigma squared ($\sigma^2$) and the gamma ($\gamma$) were statistically significant at 1% level each for both states of sorghum production. The coefficient of farm size, labour, fertilizer and chemicals were positive for Maharashtra and significant while farm size, labour and seed were positive and significant in Karnataka. Profit level can be increased in Maharashtra by increasing the amount of farm size, labour, fertilizer and chemicals and decreasing the use of seed while Profit level can be increased in Karnataka by increasing the amount of farm size, labour and seed and decreasing the use of fertilizer and chemical. Mean technical, allocative, economic efficiencies were (0.6774, 0.6312, 0.5445) and (0.6128, 0.3729, 0.4008) for Maharashtra and Karnataka respectively. Farmers operate at (32%, 37%, 45%) and (39%, 63%, 60%) for Maharashtra and Karnataka respectively below frontier level due to variation in technical, allocative and economic efficiencies respectively. The inefficiency model shows that the coefficient of Age and Literacy Level was negative a priori sign and in consonance with the a priori expectation. It can be concluded that the farmers in the Karnataka state are more efficient than the farmers in Maharashtra state.

KEYWORDS: Technical Efficiency, Allocative Efficiency, Economic Efficiency, Sorghum Maharashtra, Karnataka

INTRODUCTION

Sorghum (jowar or jowari) is an important nutrition cereals constituting staple diet in the country (Dayakar et al., 2005). India contributes about 16% of the world’s sorghum production. It is the fourth most important cereal crop in the country. This crop was one of the major cereal staple during 1950’s and occupied an area of more than 18 million hectares come down to 5.72 million hectares in 2013-2014 (TE 2014). Production increases from 9 million tons in the early 1970s to 12 million tons in early 1980 and maintained this level for over a decade until early 1990s, followed by a steep decline to 10.62 million tons 2013-2014. Despite the decrease in area over the year, production has been sustained at 10.62 million tons due mainly to adoption of improve varieties and hybrids. Sorghum grain yields in India have average 1170kg/ha in the rainy season and 880kg/ha in the post rainy season in recent years (www.icrisat)
All India total sorghum production has registered a constant growth rate of 0.10% per annum during the period 1967-68 to 2010-2011 which can be mainly attributed to negative production of kharif sorghum rather than positive growth in rabi sorghum production. Though, kharif sorghum yield growth rates were relatively higher, it could not offset the declining growth rates in production, as the growth rates in kharif sorghum area were negative and high. Just opposite is true in case of rabi sorghum where the area decline was not sufficient to undermine the yield growth, thus resulting in positive production growth rates. Among the states, Maharashtra alone recorded positive growth in production during both kharif and rabi seasons, while Karnataka registered a positive growth rate in rabi production. Gujarat recorded highest growth in yield of 3.72%, while it also recorded highest decline in area in kharif. Based on the performance of sorghum in Maharashtra, it appears that relatively it has a promising future during both kharif and rabi. This therefore prompts the need for the study on efficiency of the farmer enterprise so as to ascertain its viability among the producing states.

METHODOLOGY

Study Area

The study was carried in India being the fourth sorghum producer in the world. The sorghum producing states was purposively selected that is Maharashtra and Karnataka. The production of sorghum in India is usually concentrated in the southern part of in India. So Maharashtra and Karnataka were purposively selected based on its production.

Nature and Source of Data

The data was collected from a panel data collected by ICRISAT; primary data were collected from different farmers in which 100 respondents from each state were used for this study to ascertain the technical, allocative and economic efficiency of sorghum farmers in the study area.

ANALYTICAL TOOL

Following form of stochastic frontier production model was used to determine the efficiency of the sorghum farmers;

\[
\log Y_i = B_0 + B_1 \log X_1 + B_2 \log X_2 + B_3 \log X_3 + B_4 \log X_4 + V_i - U_i
\]

Where

Y = Output of sorghum (kg)
X₁ = Farm size (hectares)
X₂ = Amount of family labour used (man-days)
X₃ = Quantity of sorghum seed planted (kg)
X₄ = Quantity of fertilizer used (kg)
X₅ = Quantity of chemicals used (litres)
Vᵢ = Random noise (white noise) which are \( N(0, \delta^2, V) \)
Uᵢ = Inefficiency effects which are non-negative, half normal distribution \( N(0, \delta^2, U) \)
Operational definition of the variables of empirical stochastic production function for Sorghum Production is as follow:

- **Output of Sorghum farmer**: This is the total yield obtained per hectare by farmers in kilogram equivalent weight.
- **Farm size**: This is the size of land used in producing Sorghum crop by the farmers.
- **Quantity of fertilizer**: This refers to the quantity of fertilizer use in kilograms.
- **Quantity of Seed**: This refers to the quantity of seed in Kilogram equivalent weight used for planting by the farmers.
- **Chemicals**: This refers to the quantity of herbicide used in litres.
- **Labour**: This is the total man days of labour per hectare supplied by household and hired during the farm operation. The standard man day is 8 hour per day.

The technical efficiency of sorghum production for \( i \)th farmers, defined by the ratio of observed output as to the corresponding frontier production associated with no technical inefficiency, is expressed by:

\[
TE = \text{Exp} (-U_i) \quad \text{so that } 0 \leq Te \leq 1
\]

Variance parameters are \( \delta^2 = \delta^2_v + \delta^2_U \) and \( \gamma = \delta^2_U / \delta^2 \)

So that \( 0 \leq \gamma \leq 1 \)

The inefficiency model is defined by,

\[
U_i = \delta_o + \delta_1Z_1 + \delta_2Z_2
\]

Where,

- \( U_i \) = inefficiency effect
- \( Z_1 \) = Age of farmer (in years)
- \( Z_2 \) = Literacy level (in years)

The operational definition of the empirical inefficiency parameter of the stochastic frontiers for Sorghum Production is given as

- **Age**: This is the age of individual farmers involved in the farm operation.
- **Literacy level**: This is measured as the numbers of years put in by farmers to acquired basic formal education. Specifically ‘O’ years denotes no formal education: 6 years denote primary education. 12 years denote secondary education. 15 years denote diploma and NCE holder: while greater than 15 years denotes graduates.

The Empirical Stochastic Frontier Cost Model

The Cobb-Douglas functional form was used to specify the cost production technology of the farms. The explicit
Cobb-Douglas cost function model used in determining technical efficiency of sorghum farmers in the study is given:

\[ \ln C_i = \beta_0 + \beta_1 \ln P_1 + \beta_2 \ln P_2 + \beta_3 \ln P_3 + \beta_4 \ln P_4 + \beta_5 \ln P_5 + V_i - U_i \quad (5) \]

Where

\[ \ln = \text{Logarithm to base } e \]

\[ C_Y = \text{Total production cost (₦/ha) of the } i^{th} \text{ farmer} \]

\[ P_1 = \text{Cost of land} \]

\[ P_2 = \text{Cost of labour (in man days)} \]

\[ P_3 = \text{Cost of seed in kg} \]

\[ P_4 = \text{Cost of fertilizer in kg} \]

\[ P_5 = \text{Cost of chemical in litres} \]

\[ V \text{ and } U \text{ as previously defined above.} \]

The operational definitions of the variables of the empirical stochastic cost function are as follows.

- **Total Production Cost**: This measures the total cost of production per hectare in the last cropping season by the farmers.

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

- **Cost of Labour**: This is the amount of money paid for the labour during farm operations. It is measured in rupees per hectare.

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

- **Cost Fertilizer**: This is the total expenses on inorganic fertilizer incurred by the farmer during the last cropping season. It is measured in rupees per hectare.

- **Cost of Chemicals**: This is the total expenses on herbicides incurred by the farmer during the last cropping season. It is measured in rupees 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, \( \mu_{ij} \) and variance \( \sigma^2 \), where \( \mu_{ij} \) is defined by:

\[ \mu_{ij} = \delta_0 + \delta_1 Z_{ij} + \delta_2 Z_{ij} + \delta_3 Z_{ij} + \delta_4 Z_{ij} + \delta_5 Z_{ij} \quad (6) \]

Where

\[ \mu_{ij} = \text{Cost inefficiency of the } i^{th} \text{ farmer} \]

\[ Z_1 = \text{Family size (Number)} \]

\[ Z_2 = \text{Farming experience (years)} \]
Comparative Analysis of Economic Efficiency of Sorghum Production in Maharashtra and Karnataka State of India

\[ Z_3 = \text{Literacy level (Number)} \]
\[ Z_4 = \text{Extension contact (Number of meetings)} \]

**Allocative Efficiency**

Allocative efficiency measures the degree of correctness in the adoption of factor proportions to current input prices. A producer is allocative 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 Allocative Efficiency (AE) in the use of variable inputs is worked as the ratio of,

\[ AE_{ij} = \frac{MGR_j}{OGR_{ij}} \]  \hspace{1cm} (7)

Where

\[ MGR_j = \text{Maximum possible gross revenue of the } j^{th} \text{ farms} \]
\[ OGR_{ij} = \text{Gross revenue at the optimum level of the } i^{th} \text{ input with all input remaining at same level of the activity by } j^{th} \text{ farmer} \]

Farm specific optimum input level level \( (X_{ij}) \) equated by marginal value product of an input with its price

\[ X_{ij}^* = \frac{P_i/b_i}{[1/[1-b_i]]} \]  \hspace{1cm} (8)

Where

\[ P_i = \text{per unit price of input (i)} \]
\[ B_0 = \sum_{i=0}^{n-1} b_i \]

In order to determine optimal use of a resource, keeping the other resource constant, MVP and opportunity cost (factor) of that resources will be compared. The marginal product cost MPC will be estimated from the parameter of Cob Douglas production function.

The criterion for determining optimality of resource use;

\[ \frac{\text{MVP}}{\text{MPC}} > 1 \text{ underutilization of resource} \]
\[ \frac{\text{MVP}}{\text{MPC}} = 1 \text{ optimal use of resource} \]
\[ \frac{\text{MVP}}{\text{MPC}} < 1 \text{ excess use of resources} \]

**Economic Efficiency**

Economic Efficiency is combination of both technical and allocative Efficiencies. Technical and allocative efficiencies are mutually exclusive and simultaneous achievement of both efficiencies provided sufficient condition to ensure economic efficiency.

\[ EE_j = TE_j \times AEE_j \]  \hspace{1cm} (8)

Where

\[ TE_j = \text{farm specific technical efficiency of } j^{th} \text{farmer} \]
AEE\textsubscript{j} = allocative efficiency of all input on j\textsuperscript{th} farm

RESULTS AND DISCUSSIONS

Efficiency Estimation in Sorghum Production

This section examines the relative performance of the process used in transferring given input into output. The technical, allocative and economic efficiency of the respondents in sorghum production were estimated using stochastic frontier functions.

Technical Efficiency

The maximum likelihood estimate of the stochastic frontier production for sorghum farmers in the study areas are presented in Table 1. The estimated coefficients of all the Parameters of production function were positive. This means that total sorghum output increases by the value of each coefficient as the quantity of each variable input increases by one percent. All the inputs used in the model except seed were statistically significant at 1%, 5% and 10% level

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter</th>
<th>Maharashtra</th>
<th>T-Ratio</th>
<th>Karnataka</th>
<th>T-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>$\beta_0$</td>
<td>5.1671</td>
<td>12.4552</td>
<td>5.4426</td>
<td>14.7894</td>
</tr>
<tr>
<td>Farm size (X1)</td>
<td>$\beta_1$</td>
<td>0.8457</td>
<td>4.9781</td>
<td>0.5901</td>
<td>4.9384</td>
</tr>
<tr>
<td>Labour (X2)</td>
<td>$\beta_2$</td>
<td>0.3308</td>
<td>3.6577</td>
<td>0.2773</td>
<td>2.1424</td>
</tr>
<tr>
<td>Seed (X3)</td>
<td>$\beta_3$</td>
<td>0.0554</td>
<td>0.3328</td>
<td>0.1726</td>
<td>3.1038</td>
</tr>
<tr>
<td>Fertilizer (X4)</td>
<td>$\beta_4$</td>
<td>0.1682</td>
<td>1.950</td>
<td>0.1489</td>
<td>0.9850</td>
</tr>
<tr>
<td>Chemicals (X5)</td>
<td>$\beta_5$</td>
<td>0.1243</td>
<td>2.3305</td>
<td>0.0467</td>
<td>0.8680</td>
</tr>
<tr>
<td>Inefficiency Effects</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (Z1)</td>
<td>$\delta_1$</td>
<td>-0.1001</td>
<td>-2.0707</td>
<td>-0.1853</td>
<td>-2.8018</td>
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<tr>
<td>Literacy level (Z2)</td>
<td>$\delta_2$</td>
<td>-0.5484</td>
<td>-3.3482</td>
<td>-0.1468</td>
<td>-2.3978</td>
</tr>
<tr>
<td>Diagnostic Statistics</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sigma squared ($\delta^2_1$)</td>
<td></td>
<td>0.2200</td>
<td>3.1100</td>
<td>0.1836</td>
<td>7.1208</td>
</tr>
<tr>
<td>Gamma ($\gamma$)</td>
<td></td>
<td>0.5179</td>
<td>4.8537</td>
<td>0.4382</td>
<td>3.6641</td>
</tr>
</tbody>
</table>

***Estimates are significant at 1% level,

**Estimates are significant at 5% level.

* Estimates are significant at 10% level

The maximum likelihood estimates of the stochastic frontier production function and inefficiency model results are presented in Table 1. The estimate for parameters of the stochastic frontier production function indicates that the elasticity of output with farm size was positive and approximately 0.8457 in Maharashtra and it was 0.5091 in Karnataka. They were all statistically significant at 1 % level. This implies that a one percent increase in area under sorghum production will raise output of sorghum by 0.8457% in Maharashtra and 0.5091%. This shows that land is a very important factor in sorghum production both in Maharashtra and Karnataka. This finding is at tandem with the findings of; Maurice \textit{et al.}, (2005); Udoh and Folake (2006); Zalkuwi(2012), that land has positive sign and statistically significant.

The significance of labour in the study area cannot be over-emphasized as the coefficient of labour were (0.3308) and (0.277) in Maharashtra and Karnataka respectively, are significant and positively related to sorghum output. This means that an increase in man days of labour by 1% would increase sorghum output by 0.33% and 0.28% respectively. The
implication of this is that respondents with relatively large household size have the potential to increase their total farm output in that labour needed for the execution of important farm operations such as weeding is not expected to be a limitation. Also, farmers whose main objective is household food security would be more concerned with maximizing their output per unit of resource used, especially family labour; that is, they tend to emphasize technical efficiency (Amaza et al., 2006).

The production elasticity of seed in Maharashtra was 0.0554 and it was not statistically significant this implies that a one percent increase in one kg of seed under sorghum production will decrease the output of sorghum production 0.0554%. So seed is not an important factor of production. While it was an important factor in Karnataka with Seed input having an elasticity coefficient of 0.1726 and positively related to total output of sorghum in the study area. This shows that a 1% increase in quantity of seeds used in production would increase output of sorghum by 0.173%. By implication, raising the productivity of seed is expected to translate into a more than proportionate increase in the output of sorghum per hectare. This agrees with Olayide and Heady (1982) who stated that agricultural productivity can be increased through increase in the quantity of a particular input, or increase in the productivity of input, or a combination of both. So seed is a very important factor of production. The significant and positive sign of seed variable also indicated that a moderate increase in population of sorghum on the field will increase the yield provided that, the farm is not over populated beyond the recommended sorghum ration or mixture ratio capacity that will lead to competition for nutrients which will lower the yield. This finding is in consonance with the work of Shehu et al. (2007a) and Ogundari (2008), who found that seed is an important factor in production

The production elasticity for fertilizer in Maharashtra was significant at 10% level. Fertilizer improves the productivity of existing land by increasing crop yields per hectare. A 1% increase in the use of fertilizers would increase output of sorghum crop by 0.1682%, from the findings therefore is an indication that fertilizer is a critical variable input in sorghum production in the study area which increase the output of sorghum farmers. This agrees with comparable findings by Daniel et al. (2013) who reported positive relationship between fertilizer and output of farmers, while The production elasticity of fertilizer in Karnataka was 0.1489, it was not statistically significant, the insignificance of fertilizer use may be due to the good and fertile nature of the soil of the area which makes farmers to cultivate without much need for fertilizer. This has also encouraged more farmers in the study are to shift much of their attention to sorghum cultivation, since access to fertilizer has become prerogative of the few elite and politically connected farmers.

Chemicals have an elasticity coefficient of 0.1243 and statistically significant at 5%. This means that a 1% increase in the quantity of chemical use in sorghum production would increase output by 0.1243%. The use of chemical reduces expenditure on weeding and at the same time reduces fatigue and drudgery associated with production process. This implies that the use of chemical increases productivity and also enables farmers to cultivate large hectares of land which in turn bring about increase in output, while The production elasticity for chemical in Karnataka was 0.0465 and was not significant This might be because of the technicality involved in using chemicals in multi-cropping system, so it requires skills.

The above result reveals that the important factors of sorghum production in Maharashtra are land, labour, fertilizer and chemical while the important factor of sorghum production in Karnataka are land, labour and seeds

The estimated coefficient of the explanatory variables in the inefficiency production model shows that all the coefficients have the expected signs. The coefficient of age (Z1) and literacy level (Z2) in both states are negative which
implies positive effect on technical efficiency and vice-versa

The estimated gamma parameter ($\gamma$) are 0.5179 and 0.4382 for Maharashtra and Karnataka respectively and also significant at 1% level, indicating that 52% and 44% of the variation in the total output of production among the sampled farmers is due to differences in their technical efficiencies in Maharashtra and Karnataka respectively. The estimated sigma square ($\delta^2$) for Maharashtra in Table 1 was (0.2200) and significantly different from zero at 1% level. This indicates a good fit and the correctness of the specified distributional assumption of the composite error term also the Sigma squared ($\sigma^2$) on the other hand was 0.1836 and statistically significant at 1% level indicating correctness of fit of the model as assumed for the composite error term.

Table 2: Technical Efficiency Rating of the Sorghum Farmers

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Maharashtra</th>
<th>Karnataka</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Percentage</td>
<td>Frequency</td>
</tr>
<tr>
<td>&lt;0.40</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>0.40 – 0.49</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>0.50 – 0.59</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>0.60 – 0.69</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>0.70 – 0.79</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>0.80 – 0.89</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>0.90 – 1.00</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Minimum efficiency 0.2864, Maximum efficiency 0.9350, Mean efficiency 0.6774

Source: Computed From Stochastic Frontier Result

The technical efficiency in Table 2 was derived from MLE result of the stochastic production function. The result shows that the TE of the respondents was less than 1 (100 %) hence the variation in TE exits among respondents. It means that, all the respondents produced below maximum efficiency. The minimum efficiency in Maharashtra was 0.2864, while their maximum efficiency was 0.9350; and their mean efficiency were 0.6774. The distribution of the farm efficiency for sorghum production shows that, majority (69 %) of them operated above 59 % of their maximum efficiency and 31 % operated below 59% while the distribution of technical efficiency of the farmers in Karnataka reveals that about 23% had technical efficiency of less than 50 percent, while about 27% had technical efficiency of 50-69 percent. 50% of the respondents had technical efficiency of 70% and above. The magnitude of the mean technical efficiency of the farmers is a reflection of the fact that most of the sampled farmers carry out sorghum production under technical conditions, involving the use of inefficient tools, local seed varieties and so on.

Table 3: Maximum Likelihood Estimate of the Parameters of the Stochastic Cost Function

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter</th>
<th>Maharashtra</th>
<th>Karnataka</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Coefficient</td>
<td>T-Ratio</td>
</tr>
<tr>
<td>Cost Factors</td>
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</tr>
<tr>
<td>Constant</td>
<td>$\beta_0$</td>
<td>-0.1531</td>
<td>-0.1624</td>
</tr>
<tr>
<td>Cost of land (P1)</td>
<td>$\beta_1$</td>
<td>0.1585</td>
<td>7.4996</td>
</tr>
<tr>
<td>Cost of labour (P2)</td>
<td>$\beta_2$</td>
<td>0.2202</td>
<td>3.5386</td>
</tr>
<tr>
<td>Cost of seed (P3)</td>
<td>$\beta_3$</td>
<td>0.4744</td>
<td>3.8908</td>
</tr>
<tr>
<td>Cost of fertilizer (P4)</td>
<td>$\beta_4$</td>
<td>0.2518</td>
<td>2.0730</td>
</tr>
<tr>
<td>Cost of chemical(P5)</td>
<td>$\beta_5$</td>
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<td>0.0616</td>
</tr>
<tr>
<td>Inefficiency Effects</td>
<td>$d_1$</td>
<td>-2.3062</td>
<td>-0.2102</td>
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Comparative Analysis of Economic Efficiency of Sorghum Production in Maharashtra and Karnataka State of India

Table 3: Contd.,

<table>
<thead>
<tr>
<th>Literacy level (Z2)</th>
<th>di</th>
<th>-0.0310</th>
<th>-3.3682</th>
<th>-0.1228</th>
<th>-2.0323</th>
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</thead>
<tbody>
<tr>
<td>Diagnostic Statistics</td>
<td>Sigma squared (d^2)</td>
<td>0.3559</td>
<td>3.6827</td>
<td>0.4491</td>
<td>0.4637</td>
</tr>
<tr>
<td>Gamma (y)</td>
<td>0.5205</td>
<td>0.0125</td>
<td>0.3672</td>
<td>0.3148</td>
<td></td>
</tr>
</tbody>
</table>

***Estimates are significant at 1% level,

**Estimates are significant at 5% level,

*Estimates are significant at 10% level

The maximum likelihood estimate of the parameter of the stochastic cost frontier model of the sorghum farmers in Maharashtra used in estimating allocative efficiency is presented in Table 3. All parameters estimated have the expected sign. Most of the parameters estimates are significant except cost of chemical meaning that these factors are significantly different from zero and thus are important determinant of sorghum output except for cost of chemical not significant. The results implies that the variable (cost of land, cost of labour, cost of seed, 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 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 labour will increase total production cost by 0.22%, 1% increase in the cost of seed will increase total production cost by 0.47% and 1% increase in the cost of fertilizer will increase production cost by 0.25%. The maximum likelihood estimates of the parameters of the stochastic cost frontier model used in Karnataka estimating allocative efficiency is presented in Table 3. Three parameters out of five estimates have the expected sign and are statistically significant, ie cost of land (P1), cost of labour (P2), cost of fertilizer (P4) while cost of seed (P3) and cost of chemical (P5) are not statistically significant, meaning that these factors (cost of land, labour and fertilizer are important determinants of total cost associated with sorghum production in the study area. The cost elasticities with respect to this three input variables used in the production analysis are positive, implying that an increase in the cost of land, cost of labour, cost of fertilizer increases total production cost. That is, 1% increase in the cost of land will increase total production cost by approximately 0.388%, 1% increase in the cost of labour will increase total production cost by 0.63%, 1% increase in the and cost of fertilizer will increase total production cost by 0.35%.

Table 4: Allocative Efficiency Rating of the Sorghum Farmers

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Frequency</th>
<th>Percentage</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.40</td>
<td>20</td>
<td>20</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>0.40 – 0.49</td>
<td>17</td>
<td>17</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>0.50 – 0.59</td>
<td>14</td>
<td>14</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>0.60 – 0.69</td>
<td>19</td>
<td>19</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>0.70 – 0.79</td>
<td>20</td>
<td>20</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>0.80 – 0.89</td>
<td>9</td>
<td>9</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>0.90 – 1.00</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

Minimum efficiency 0.1144 0.2080
Maximum efficiency 0.9000 0.8664
Mean efficiency 0.5445 0.6128

The distribution of farmers’ allocative efficiency indices derived from the analysis of the stochastic cost function is presented in Table 4. The allocative efficiency of the sampled farmers ranged from 0.1144 to 0.9000. The mean
allocative efficiency is estimated to be 0.5445, meaning that an average farmer in the study area has the scope for increasing allocative efficiency by 45% in the short-run under the existing technology. This would enable the average farmer equate the marginal value product (MVP) of the inputs to the total production while for Karnataka the distribution of farmers’ allocative efficiency indices derived from the analysis of the stochastic cost function is presented in Table 4. The allocative efficiency of the sampled farmers ranged from 0.2080 to 0.8664. The mean allocative efficiency is estimated to be 0.6128, meaning that an average farmer in the study area has the scope for increasing allocative efficiency by 39% in the short-run under the existing technology. This would enable the average farmer equate the marginal value product (MVP) of the inputs to the total production.

Table 5: Economic Efficiency Rating of the Sorghum Farmers

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Frequency</th>
<th>Percentage</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.40</td>
<td>62</td>
<td>62</td>
<td>37</td>
<td>46.25</td>
</tr>
<tr>
<td>0.40 – 0.49</td>
<td>15</td>
<td>15</td>
<td>14</td>
<td>17.50</td>
</tr>
<tr>
<td>0.50 – 0.59</td>
<td>12</td>
<td>12</td>
<td>16</td>
<td>20.00</td>
</tr>
<tr>
<td>0.60 – 0.69</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>11.25</td>
</tr>
<tr>
<td>0.70 – 0.79</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>0.80 – 0.89</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1.25</td>
</tr>
<tr>
<td>0.90 – 1.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>80</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td>Minimum efficiency</td>
<td>0.0951</td>
<td></td>
<td>0.0761</td>
<td></td>
</tr>
<tr>
<td>Maximum efficiency</td>
<td>0.7476</td>
<td></td>
<td>0.8021</td>
<td></td>
</tr>
<tr>
<td>Mean efficiency</td>
<td>0.3729</td>
<td></td>
<td>0.4008</td>
<td></td>
</tr>
</tbody>
</table>

The distribution of the farm economy efficiency for sorghum production in Maharashtra shows that, majority (62%) of them operated below 40% of their maximum efficiency and 38% operated above 40% while The distribution of the farm efficiency for sorghum production in Karnataka shows that only (37%) of them operated below 40% of their maximum efficiency and 63% operated above 40%.

Table 6: Technical, Allocative and Economic Efficiency in Sorghum Production (%)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>Maharashtra</th>
<th>Karnataka</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Technical efficiency</td>
<td>67.74</td>
<td>63.12</td>
</tr>
<tr>
<td>2.</td>
<td>Allocative efficiency</td>
<td>54.45</td>
<td>61.28</td>
</tr>
<tr>
<td>3.</td>
<td>Economic efficiency</td>
<td>37.29</td>
<td>40.08</td>
</tr>
</tbody>
</table>

Figure 1: Graph Showing the Different Levels of TE (1), AE (2) And EE (3) In Study Areas
Comparison of the Economic Efficiency of the Sorghum Producers in Maharashtra and Karnataka

Hypothesis 1: there is no significant deference between the economic efficiency of the farmers in the two state ($X_1 = X_2$).

$X_1$ = Maharashtra Sorghum Farmers

$X_2$ = Karnataka sorghum Farmers

Level of significance $\alpha = 0.05 \%$

$\alpha/2 = 0.025$

$Z$ computed is 0.395, $Z$ tabulated =1.96 thus at 5 % level of significance $Z$ computed is greater than $Z$ tab (0.395 < 1.96). From the result, the null hypothesis was accepted and the alternative hypothesis was rejected. Meaning that at 5 % level of significance there was no significant difference between the economic efficiencies for Maharashtra sorghum and Karnataka sorghum farmers.

CONCLUSIONS

It may be concluded from the study that under the given socio-economic and farm conditions (including technology), the production of sorghum can be increased in both states since the farmers operate below the frontier level. From the result its can also be concluded that the farmers in Karnataka are more efficient than the farmers in Maharashtra since more than majority of the farmers operate below 40%

REFERENCES


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