Resource productivity and resource use efficiency of cotton on small farms in Parbhani district of Marathwada region

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ABSTRACT
The study attempted to examine the resource productivity, resource use efficiency and return to scale of cotton production on small farms in Parbhani district of Marathwada region of Maharashtra state. A sample of 54 farmers was selected through multistage sampling technique from Parbhani district and data were collected during November – December 2012. Cobb Douglas production function approach was used to measure the resource productivity, resource use efficiency and return to scale by calculating and comparing Marginal Value Products (MVPs) and MVP to factor price. Results depicted that on small farms, in case of cotton, 53.80 per cent variation in cotton production was explained due to independent variables considered for analysis. Regression co-efficient of manure (X₅) was 0.3871, which was positive and highly significant at 1 per cent level. Whereas regression co-efficient of bullock labour (X₃), fertilizer (X₆) and machine labour (X₇) were 0.4837, 0.6023 and 0.7543, which were positive and significant at 5 per cent level. Regarding utilization of resource, MVP of family labour, bullock labour, machine labour and manure were greater than unity indicating under utilization. However, all other resources were used in excess. The result also indicates that return to scale on small farm was increasing (Σbi: 1.435).

KEY WORDS: Cotton, Small farms, Resource productivity, Resource use efficiency

ranks first in the production of cotton. 60 per cent of the total cotton is produced mainly in Vidharbha, 25 per cent in Marathwada, while 10 per cent is produced in Khandesh. Cotton industry is one of the largest employers in the country accounting for nearly 15 per cent of the total labour force. There are about 60 million owner cultivators in India, out of which about 15 million produce cotton. The processing and manufacturing of cotton from ‘Kapi’ to textiles provides employment to more than 15 million people in the country. Being a commercial crop, cotton is so remunerative that it is being grown by farmers in even un-prescribed agro-climatic zones. The reason for this, practice rests with the reality that it fetches higher returns. In recent years cotton crop has been experiencing many ups and downs due to natural and man-made calamities. Dependency of the crop on rain fall, fluctuations of the area under the crop, fluctuations in productivity due to pests and diseases, fluctuations in prices are the few important factors.

**METHODOLOGY**

**Sampling technique and data description:**

The data were collected for the research during November - December 2012 with multi-stage sampling technique. Parbhani district was selected purposively as study area in the first stage; in the second stage Parbhani tehsil was selected. In third stage four villages were selected in the tehsil. And in fourth stage small farmers including marginal farmers were selected randomly from each village. Thus, 54 small farmers were selected for the study. Well structured questionnaires were used for personal interview from sample farmers.

**Functional analysis:**

The resources productivity and resources use efficiency were analyzed by application of functional analysis. In functional analysis, Cobb-Douglas (power production function) production function was used. Cobb-Douglas production function (non-linear) was used to determine the resources productivity and resources use efficiency of cotton production. The data were, therefore, subjected to functional analysis by using the following form of equation:

\[
Y = a x_1^{b_1} x_2^{b_2} x_3^{b_3} \ldots \ldots x_n^{b_n} e^e
\]

This function can easily be transformed into a linear form by making logarithmic transformation, after logarithmic transformation this function is:

\[
\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + \ldots \ldots + b_n \log X_n + a \log e
\]

where,

- \(Y\) = Output in quintals
- \(a\) = Intercept / constant
- \(X_i\) = Family labour (mandays)
- \(X_j\) = Hired labour (mandays)
- \(X_k\) = Bullock labour (pair days)
- \(X_l\) = Quantity of seeds (kg.)
- \(X_m\) = Manure used (quintals)
- \(X_n\) = Machine labour (hours)
- \(X_o\) = cost of fertilizer (Rs.)
- \(X_p\) = cost of plant protection (Rs.)
- \(X_q\) = Regression co-efficient of respective variables
- \(e\) = Random term with zero mean and constant variance.

**Marginal value product (MVP):**

The marginal value productivity of resources indicate the addition of gross value of farm production for a unit increase in the \(i^{th}\) resources with all resources fixed at their geometric mean level. The MVP of various input is worked out by the following formula:

\[
MVP = b_i \frac{\bar{Y}}{\bar{X}} P_Y
\]

where,

- \(b_i\) = Partial regression co-efficient of particular independent variable.
- \(\bar{X}\) = Geometric mean of particular independent variable (input).
- \(\bar{Y}\) = Geometric mean of dependent variable (output).
- \(P_Y\) = Price of dependent variable.

**Return to scale:**

It refers to the summation of \(b_i\) values, return to scale is:

\[\Sigma b_i\]

If, \(\Sigma b_i = 1\), Constant return to scale.
\(\Sigma b_i = < 1\), Decreasing returns to scale.
\(\Sigma b_i = >1\), Increasing returns to scale.

**ANALYSIS AND DISCUSSION**

The findings of the present study as well as relevant discussion have been presented under following heads:

**Resource productivity and resource use efficiency of cotton:**

The effect of various resources on cotton production has been studied by employing Cobb-Douglas production function in order to determine resource productivity and resource use efficiency of cotton. Cobb-Douglas production function gives elasticities of production directly. The sum of regression co-efficient indicates the return to scale. Also these regression co-efficients can be used to determine the resource productivity and resource use efficiency directly.

Regression co-efficient with relation to various explanatory variables were calculated with 't' values which is presented in Table 1. It was observed that regression co-efficient of manure (\(X_o\)) was 0.3871, which was positive and
highly significant at 1 per cent level. It inferred that when 1 per cent increase in use of manure, it would lead to increase production of cotton by 0.3871 per cent. Whereas regression co-efficient of bullock labour (X₁), fertilizer (X₂) and machine labour (X₃) were 0.4837, 0.6023 and 0.7543, which were positive and significant at 5 per cent level. It inferred that 5 per cent increase in use of bullock labour, fertilizer and machine labour, would lead to increase production of cotton by 0.4837 per cent, 0.6023 per cent and 0.7543 per cent, respectively. Similarly regression co-efficient of hired labour (X₄) and seed (X₅) was -0.8036 and -0.3977, which was negative and significant at 5 per cent level. It inferred that when 5 per cent increase in use of hired labour and seed, it would lead to decrease production of cotton by 0.8036 and 0.3977 per cent, respectively. Other variables like family labour (X₆) and plant protection (X₇) were non-significant.

Co-efficient of multiple determination (R²) was 0.538 which indicated that 53.80 per cent variation in cotton production was explained because of variables (independent) included in the model. ‘F’ value was significant (6.548), it means that model has statistical fit. It is clear that explanatory variables together explained significant part of variation in cotton production. The sum of regression co-efficient was 1.435 which indicated increasing return to scale.

### Marginal value productivity and resource use efficiency of cotton production:

The marginal value productivity (MVP) of independent variables in the fitted equation for cotton production was derived at geometric mean level of respective input and output. The ratio between marginal value productivity and factor price of respective variables were then worked out to know the resource use efficiency. The results of the analysis are presented in Table 2.

With regard to resource use efficiency, it is evident from Table 2 that, use of machine labour in cotton production indicated that highest MVP to price ratio (92.15), followed by manure (21.75), bullock labour (6.306) and family labour (5.814). If MVP to price ratio was greater than unity, the use of resource could be increased to increase the level of profit. The resource use efficiency analysis further showed that hired labour, seed, fertilizer and plant protection chemicals were used in excess on selected farm, which increase the cost of cultivation of crop. Therefore, to maximize the profit from cotton production, the farmers in study area have to reallocate the available resources. Ashfaq et al. (2012) and Balakrishna (2012) home aslo generated some information related to the present investigation from Pakistan and India, respectively.

### Table 1: Estimates of cobb-douglas production function for cotton

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Regression co-efficient (bi)</th>
<th>Standard error of (bi)</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family labour (X₁)</td>
<td>0.5289</td>
<td>0.3898</td>
<td>0.1356</td>
</tr>
<tr>
<td>Hired labour (X₄)</td>
<td>-0.8036</td>
<td>0.3772</td>
<td>-2.1306</td>
</tr>
<tr>
<td>Bullock labour (X₃)</td>
<td>0.4837</td>
<td>0.2256</td>
<td>2.1735</td>
</tr>
<tr>
<td>Seed (X₅)</td>
<td>-0.3977</td>
<td>0.1983</td>
<td>-2.0054</td>
</tr>
<tr>
<td>Manure (X₆)</td>
<td>0.3871</td>
<td>0.1389</td>
<td>.7874**</td>
</tr>
<tr>
<td>Fertilizer (X₂)</td>
<td>0.6023</td>
<td>0.2803</td>
<td>2.1483*</td>
</tr>
<tr>
<td>Machine labour (X₇)</td>
<td>0.7543</td>
<td>0.3583</td>
<td>2.1099*</td>
</tr>
<tr>
<td>Plant protection chemicals (X₇)</td>
<td>-0.1193</td>
<td>2.5518</td>
<td>-4.6738**</td>
</tr>
</tbody>
</table>

Intercept = 8.872. Return to scale (? bi):1.435, F valu =6.548**, R² =0.538, * and** indicate significance of values at P=0.05 and 0.01, respectively NS=Non-significant

### Table 2: Resource use efficiency of cotton production

<table>
<thead>
<tr>
<th>Resources</th>
<th>G.M.</th>
<th>MPP</th>
<th>MVP</th>
<th>Factor price (Px)</th>
<th>MVP</th>
<th>Level of resource use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family labour (X₁)</td>
<td>64.880</td>
<td>0.138</td>
<td>581.43</td>
<td>100</td>
<td>5.814</td>
<td>Under</td>
</tr>
<tr>
<td>Hired labour (X₄)</td>
<td>37.578</td>
<td>-0.363</td>
<td>-1525.36</td>
<td>100</td>
<td>-15.25</td>
<td>Excess</td>
</tr>
<tr>
<td>Bullock labour (X₃)</td>
<td>16.579</td>
<td>0.494</td>
<td>2081.05</td>
<td>330</td>
<td>6.306</td>
<td>Under</td>
</tr>
<tr>
<td>Seed (X₅)</td>
<td>1.908</td>
<td>-3.539</td>
<td>-14865.61</td>
<td>1500</td>
<td>-9.910</td>
<td>Excess</td>
</tr>
<tr>
<td>Manure (X₆)</td>
<td>12.695</td>
<td>0.518</td>
<td>2175.13</td>
<td>100</td>
<td>21.75</td>
<td>Under</td>
</tr>
<tr>
<td>Fertilizer (X₂)</td>
<td>5390.62</td>
<td>0.002</td>
<td>7.9690</td>
<td>46.12</td>
<td>0.173</td>
<td>Excess</td>
</tr>
<tr>
<td>Machine labour (X₇)</td>
<td>1.668</td>
<td>7.679</td>
<td>32352.48</td>
<td>350</td>
<td>92.15</td>
<td>Under</td>
</tr>
<tr>
<td>Plant protection chemicals (X₇)</td>
<td>3320.77</td>
<td>-0.0006</td>
<td>-2.5615</td>
<td>1500</td>
<td>-0.002</td>
<td>Excess</td>
</tr>
</tbody>
</table>

Geometric mean of Y = 16.982, Price of output = 4200
Conclusion and recommendation:

This study has examined the resource productively, resource use efficiency and return to scale among small farms in Parbhani district of Marathwada region of Maharashtra state. The functional analysis of cotton revealed that in case of cotton 53.80 per cent variation in cotton production was explained due to independent variables considered for analysis. Regression co-efficient of manure ($X_5$) was 0.3871, which was positive and highly significant at 1 per cent level. Whereas regression co-efficient of bullock labour ($X_3$), fertilizer ($X_6$) and machine labour ($X_7$) were 0.4837, 0.6023 and 0.7543, which were positive and significant at 5 per cent level. Similarly regression co-efficient of hired labour ($X_2$) and seed ($X_4$) was -0.8036 and -0.3977, which was negative and significant at 5 per cent level. Other variables like family labour ($X_1$) and plant protection ($X_8$) were non-significant. Regarding utilization of resource, MVP of family labour, bullock labour, machine labour and manure were greater than unity indicating under utilization. However, all other resources were used in excess.

REFERENCES


