**Resource elasticity, marginal productivity, resources use efficiency and optimum resource use in wheat production**

**B.R. PAWAR, P.M. DAHIWADE AND P.S. MANE**

**ABSTRACT:** Investigation was carried out during the year 2011-12. About 96 wheat growers were randomly selected from eight villages of Renapur tehsil of Latur district of Maharashtra. Cross sectional data were collected from wheat growers with the help of pre-tested schedule by personal interview method. Data were related to wheat output and inputs like hired human labour, family human labour, bullock labour, machine labour, fertilizer, plant protection and irrigation as resources. Cobb-Douglas production function was fitted to the data. The results revealed that, regression co-efficient of area under wheat was 0.263 followed by that of family human labour (0.182), machine labour (0.143) and irrigation (0.300) which were positively significant at one per cent level. Regression co-efficient of bullock labour, potash and plant protection were found significant at 5 per cent level. On the contrary, the regression co-efficient of hired human labour and nitrogen were negative and non-significant. Marginal product of area under wheat was 7.49 quintals followed by that of machine labour (0.42 q), bullock labour (0.24 q), and family human labour (0.23 q) and so on. MVP to price ratio with respect to area under wheat was 2.89 followed by that of family human labour (2.28), machine labour (1.62), irrigation (1.40), phosphorous (1.36) and so on. Hence, preference might be given to increase area on priority basis in wheat production. Optimum use of area under wheat was found to be 1.50 hectares.

**KEY WORDS:** Wheat, Estimates, Geometric mean, Marginal product, Input price


**INTRODUCTION**

Wheat (*Triticum aestivum* L.) is the most important food grain crop in India. It belongs to gramineae family. Origin of wheat is South-West Asia (Turkey). Only four species of wheat are cultivated in India. The common bread wheat, *Triticum aestivum* is the most important species, occupying more than 90 per cent of the total area in the country. The most wheat producing countries are China, India, United States, France, Russia, Canada, Australia, Germany, Pakistan, Turkey, United Kingdom, Argentina, Iran, Poland, Kazakhstan, Italy, Romania and Egypt. China is the largest wheat producing country in the world. India is the second largest producer of wheat next to China in the world. India produced 83 million tonnes of wheat from 29.3 million hectares of land in 2010-11. The major wheat growing areas in India are namely, Uttar Pradesh, Punjab, Haryana, Rajasthan, Madhya Pradesh, Gujarat, Maharashtra and Bihar. In Maharashtra wheat is grown on 7 lakh hectares with average productivity of 13.2 quintals per hectare against the national average of about 26.5 quintals per hectare. In Latur district of Maharashtra, wheat is one of the important crops in *Rabi* season. It is grown after harvesting of either soybean or green gram. Sowing is done in the month of November. It is cultivated under irrigated conditions. Seed, fertilizers, plant protection, human labour, bullock labour and
machine labour are scarce resources in wheat cultivation. Some of the resources are either underutilization or overutilization. Optimum utilization of resources can help to increase production and productivity of wheat without additional investment. Under this background, the present study of production elasticity, marginal productivity, resource use efficiency and optimum resource use in wheat production has been undertaken.

MATERIALS AND METHODS

Multistage sampling design was used in selection of district, tehsil, villages and wheat growers. In first stage, Latur district was purposively selected on the basis of area under wheat cultivation. In second stage, on the basis of area under wheat crop, Renapur tehsil of Latur district was selected on the basis of higher area under wheat cultivation. In third stage, from the tehsil, eight villages were selected on the basis of the highest area under wheat cultivation. The selected villages in the tehsil were namely, Bhokrambha, Faradpur, Kamkheda, Motegoan, Pangoan, Poharegoan, Sindhgoan and Talni. In the fourth stage, from each village, list of wheat growers with area under wheat was obtained. From each village, twelve wheat growers were randomly selected. Thus, from eight villages, 96 wheat growers were selected for present study. The cross sectional data were collected from 96 wheat growers with the help of pre-tested schedule for the year 2011-2012. The data were related to use of resources namely area under wheat, hired human labour, family human labour, bullock labour, machine labour, nitrogen, phosphorus, potash, plant protection and irrigation. Data were also related to wheat production. Cobb- Douglas production function was fitted to the data to estimate resource use efficiency with respect to each of the explanatory variables. The fitted equation was as follows :

\[ Y = aX_1^{b1}X_2^{b2}X_3^{b3}...X_n^{bn}e^u \]

In this functional form 'Y' is dependent variable, 'Xi' are independent resource variables, 'a' is the constant representing intercept of the production function and 'bi' are the partial regression co-efficients of the respective resource variables. The regression co-efficients obtained from this function directly represent the elasticity of production, which remain constant throughout the relevant ranges of inputs. The sum of co-efficients that is 'bi' indicates the nature of returns to scale. This function can easily be transformed into a linear form by logarithmic transformation. After logarithmic transformation, it becomes :

\[ \log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + ... + b_n \log x_n + u \log e \]

The main consequences of multicollinearity are (a) the sampling variances of the estimate co-efficients increases as the degree of collinearity increases between the explanatory variables and (b) estimated co-efficients may become very sensitive to small charges in data that is addition or deletion of a few observations produce drastic changes in some of the estimates of the co-efficients. The equation fitted was of the following formula :

\[ \hat{Y} = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}X_7^{b7}X_8^{b8}X_9^{b9}X_{10}^{b10} \]

where, \( \hat{Y} \) = Estimated yield of the wheat in quintals per farm, a = Intercept of production function, bi = Partial regression co-efficients of the respective resource variables (i = 1, 2, 3, …10), X1 = Area of wheat in hectares per farm, X2 = HIred human labour in mandays per farm, X3 = Family human labour in mandays per farm, X4 = Bullock labour in pairdadays per farm, X5 = Machine labour in hours per farm, X6 = Nitrogen in kg per farm, X7 = Phosphorus in kg per farm, X8 = Potash in kg per farm, X9 = Plant protection in liter per farm, X10 = Irrigation in m³ per farm.

The marginal value of productivity of resource indicates 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 levels. The MVP of various input factors worked out by the following formula :

\[ MVP = \frac{b\bar{Y}}{\bar{X}}Py \]

where, b = Regression co-efficient of particular independent variable, \( \bar{X} \) = Geometric mean of particular independent variable, \( \bar{Y} \) = Geometric mean of dependent variable, Py = Price of dependent variable.

RESULTS AND DATA ANALYSIS

The findings with respect to elasticities of production, marginal production, resource use efficiency and optimum resource use in wheat production were obtained and are presented as follows :

Resource elasticities of wheat production :

Regression co-efficients or resource elasticities with respect to various explanatory variables and geometric means of resources were calculated and are presented in Table 1. Co-efficient of multiple determination (R²) was 0.961 which indicated that 96.10 per cent of variation in wheat production explained due to variation in all independent variables. It was clear that regression co-efficient of area under wheat was 0.263 which was highly significant at one per cent level. It inferred that if one per cent increased in area under wheat over its geometric mean, it would lead to increase wheat production by 0.263 per cent. In the next order, regression co-efficient with respect to family human labour was 0.182 which was positive and highly significant. It was obvious that when increase in family human labour by one per cent over its geometric mean, it would lead to increase wheat production by 0.182 per cent. Similarly, regression co-efficient of machine labour was also highly
significant (0.134). It was clear that when increase the use of machine labour by one per cent over its geometric mean, it would lead to increase wheat production by 0.134 per cent. Similarly, regression co-efficient of irrigation was 0.3 that was positive and highly significant. It indicated that when use of irrigation increased by one per cent, it would lead to increase wheat production by 0.3 per cent. Regression co-efficients of bullock labour, potash and plant protection were found significant at 5 per cent level. On the contrary, the regression co-efficients of hired human labour and nitrogen were negative and non-significant. Regression co-efficient of phosphorous was positive but non-significant. Results are in conformity to the findings of Guatam (1999) with respect to resource elasticity of production.

Marginal productivity of wheat:
Marginal productivity of wheat with respect to various resources were estimated and also presented in Table 1. It was observed from the table that marginal product of area under wheat was 7.49 quintals. In other words addition of one hectare of land to geometric mean which caused to give production of wheat by 7.49 quintals. Marginal product of machine labour was 0.42 quintal. It was clear that, when there was addition of machine labour by one hour, it could give additional yield of wheat by 0.42 quintal. Marginal product of bullock labour was 0.24 quintal. It indicated that, when there was additional use of one pairday of bullock pair, due to one pairday there was additional product of wheat by 0.24 quintal. Similarly, due to addition of one family labour in wheat production that human labour could give 0.23 quintal of additional product. It inferred that use of area under wheat, family human labour, bullock labour, machine labour, phosphorus, potash, plant protection and irrigation could be increased because these factors were under utilization. It was clear that, due to addition of one kg of nitrogen, it caused to reduce wheat production by 0.02 quintal. Similarly, addition of hired human labour could cause reduction of wheat production by 0.04 quintal. It can be concluded that nitrogen and hired human labour were excesses use in wheat production. It implied that use of nitrogen and hired human labour could be reduced because these factors were over utilization.

Resource use efficiency in wheat production:
Resource use efficiency can always be estimated in monetary term (Table 1). Marginal value product due to area under wheat was found to be Rs. 11864.16. Price of input of land under wheat was Rs. 4103.33. Hence, MVP to price ratio was 2.89. Similarly, the MVP to price ratio with respect to family human labour 2.28 followed by that of machine labour (1.62), irrigation (1.40), phosphorus (1.36), potash (1.17) and so on. It was clear that higher the MVP to price ratio there was greater chance to increase these resources. It inferred that there was greater chance to increase area under wheat followed by family human labour, irrigation and so on. It was observed that, the MVP to price ratio with respect to bullock labour was 1.09 which could show the near about full utilization of these resources because the ratio was tending near to unity.

Optimum resource use in wheat production:
In regard to optimum resource use, there was good chance to increase area under wheat upto 1.50 hectares. Similarly, family human labour could be increased upto 26.68 man days. The

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Independent variable</th>
<th>Partial regression co-efficient (bi)</th>
<th>Standard error of bi (SE)</th>
<th>'t' value</th>
<th>Geometric mean of input (X̄)</th>
<th>Marginal product (q)</th>
<th>Marginal value product (Rs.)</th>
<th>Price of input (Rs.)</th>
<th>MVP to price ratio</th>
<th>Optimum resource use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Area under wheat(ha/farm)</td>
<td>0.263</td>
<td>0.076</td>
<td>3.44**</td>
<td>0.52</td>
<td>7.49</td>
<td>11864.16</td>
<td>4103.33</td>
<td>2.89</td>
<td>1.50</td>
</tr>
<tr>
<td>2.</td>
<td>Hired human labour (manday / farm)</td>
<td>-0.043</td>
<td>0.052</td>
<td>-0.82</td>
<td>16.69</td>
<td>-0.04</td>
<td>-63.36</td>
<td>160.00</td>
<td>-0.40</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>Family human labour (manday/ farm)</td>
<td>0.182</td>
<td>0.058</td>
<td>3.11**</td>
<td>11.91</td>
<td>0.23</td>
<td>364.32</td>
<td>160.00</td>
<td>2.28</td>
<td>26.68</td>
</tr>
<tr>
<td>4.</td>
<td>Bullock labour (pairday / farm)</td>
<td>0.051</td>
<td>0.024</td>
<td>2.10*</td>
<td>3.21</td>
<td>0.24</td>
<td>380.16</td>
<td>350.00</td>
<td>1.09</td>
<td>3.42</td>
</tr>
<tr>
<td>5.</td>
<td>Machine labour (hours / farm)</td>
<td>0.134</td>
<td>0.042</td>
<td>3.17**</td>
<td>4.75</td>
<td>0.42</td>
<td>665.28</td>
<td>410.00</td>
<td>1.62</td>
<td>7.67</td>
</tr>
<tr>
<td>6.</td>
<td>Nitrogen (kg / farm)</td>
<td>-0.056</td>
<td>0.181</td>
<td>-0.31</td>
<td>39.08</td>
<td>-0.02</td>
<td>-31.68</td>
<td>12.72</td>
<td>-2.49</td>
<td>-</td>
</tr>
<tr>
<td>7.</td>
<td>Phosphorus (kg / farm)</td>
<td>0.026</td>
<td>0.092</td>
<td>0.28</td>
<td>26.04</td>
<td>0.02</td>
<td>31.68</td>
<td>23.25</td>
<td>1.36</td>
<td>26.23</td>
</tr>
<tr>
<td>8.</td>
<td>Potash (kg / farm)</td>
<td>0.005</td>
<td>0.002</td>
<td>2.20*</td>
<td>9.98</td>
<td>0.01</td>
<td>11.09</td>
<td>9.50</td>
<td>1.17</td>
<td>12.35</td>
</tr>
<tr>
<td>9.</td>
<td>Plant protection (L/farm)</td>
<td>0.008</td>
<td>0.003</td>
<td>2.38*</td>
<td>3.88</td>
<td>0.03</td>
<td>47.52</td>
<td>54.62</td>
<td>0.87</td>
<td>3.44</td>
</tr>
<tr>
<td>10.</td>
<td>Irrigation (m³/farm)</td>
<td>0.300</td>
<td>0.106</td>
<td>2.83**</td>
<td>1534.38</td>
<td>0.01</td>
<td>4.75</td>
<td>3.40</td>
<td>1.40</td>
<td>2099.92</td>
</tr>
</tbody>
</table>

Intercept (log a) = 3.269, F-value = 210.93**, R² = 0.961, Return to scale (2bi) = 0.87

Note: Geometric mean (X̄) of wheat production was 14.81 q per farm and price was Rs.1584/q
* and ** indicate significance of values at 0.05, 0.01, respectively
quantity of phosphorus could be increased up to 26.63 kg followed by potash (12.35 kg). Optimum use of irrigation was found to be 2069.92 m³.

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LITERATURE CITED


