CHAPTER VI

Regression Analysis
CHAPTER VI

REGRESSION ANALYSIS

I. Consumption Function of Fertilizer

Fertilizer has been recognized as one of most crucial inputs next to irrigation in increasing the agricultural production. It is estimated that 50 percent of the increase in the food grain production is being attributed to the use of chemical fertilizer. The important factors affecting fertilizer consumption or considered to be grossed cropped area, prices of agricultural produce, gross irrigated area, area under high yielding varieties of crops, availability of credit an annual rain fall.

In the percent study, an attempt has been made to estimate the impact of some of the important factors maintained above of the consumption of fertilizer in the district under study. Some factors like prices of agricultural produce, availability of credit etc. were not included in the regression analyses due to the non-availability of the required information. An additional variance of time variables was included in the regression function. The time series data on the selected variables from 1970-71 to 1990-91 were taken into account for the purposes. To assess the role of the selected variables, Cobb- Douglas type of regression function was fitted.

The shape of regression function is given below.

\[ Y = a x_1^{b_1} x_2^{b_2} x_3^{b_3} x_4^{b_4} x_5^{b_5} \]

where as,

Y = Fertilizer consumption (NPK total) in metric tones.
X1 = Gross cropped area (ha)
X2 = Gross irrigated area (ha)
X3 = Area under high yielding varieties of crops (ha)

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\( X_4 = \) Annual rainfall (cms)
\( X_5 = \) Time element (years)
\( A = \) Constant
\( B_1 \text{ to } B_5 = \) Regression coefficient of each independent variable.

Before discussion on the result of regression analyses, it has been considered better to give the relationship between the dependent variable and each of independent variable and also between each independent variable, the metric of correlation coefficient was prepared which has been given as below.

Table VIII-1: Matrix of simple correlation coefficient between different variables

<table>
<thead>
<tr>
<th>Y</th>
<th>Y</th>
<th>X1</th>
<th>X2</th>
<th>X3</th>
<th>X4</th>
<th>X5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.33</td>
<td>0.92</td>
<td>0.56</td>
<td>0.25</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>X1</td>
<td>1</td>
<td>0.89</td>
<td>0.42</td>
<td>0.27</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>X2</td>
<td></td>
<td>1</td>
<td>0.54</td>
<td>0.18</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>X3</td>
<td></td>
<td></td>
<td>1</td>
<td>0.22</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>X4</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>X5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

A critical examination of correlation coefficient metric, it is quite obvious that the correlation of consumption of aggregate fertilizer with independent variables was observed to be positive and ranged between 0.96 (area under high yielding varieties) Extent of correlation of dependent variable \( Y \) (total fertilizer consumption) with gross irrigated area \( (X_2) \) and area under high yielding varieties of crops \( (X_3) \) came to 0.92 and 0.96 respectively. The coefficient of correlation value between fertilizer consumption and time element \( (X_5) \) was also found quite high being 0.92, indicating thereby that total fertilizer consumption increased with corresponding increase in gross irrigated area, area under high yielding varieties of crops and with the passage of time. The value of coefficient of correlation of \( Y \) in relation to annual rainfall \( (X_4) \) came the lowest being 0.25.
As regards to the correlation of coefficient between the independent variables is concerned. It has been observed that the degree of association between gross irrigated area \((X_2)\) and area under high yielding varieties of crops \((X_3)\), gross irrigated area \((X_2)\) and time element \((X_5)\) and area under high yielding varieties of crops \((X_3)\) and time element \((X_5)\) was observed to be positive and significant being 0.54, 0.32 and 0.92 respectively revealing thereby that area under high yielding varieties of crops increased with a corresponding increase in the area under irrigation. It was also observed that both the areas under high yielding varieties and under irrigation increased with the passage of time.

Regression equation:

\[
Y = 2.64.X1^{0.566} \times 0.612.X2^{0.801} \times 0.305.X3^{0.944} \times 0.361.X4^{0.034} \times 0.041.X5^{0.005} \]

The value constant of regression coefficient (elasticity’s) of each independent variable along with value of \(R^2\) has been given in table VIII-2.

<table>
<thead>
<tr>
<th>Value of a</th>
<th>Value of regression coefficients (elasticities)</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(X_1)</td>
<td>(-0.556)</td>
<td></td>
</tr>
<tr>
<td>(X_2)</td>
<td>(0.801)</td>
<td></td>
</tr>
<tr>
<td>(X_3)</td>
<td>(0.944)</td>
<td></td>
</tr>
<tr>
<td>(X_4)</td>
<td>(0.034)</td>
<td></td>
</tr>
<tr>
<td>(X_5)</td>
<td>(0.005)</td>
<td></td>
</tr>
<tr>
<td>2.64</td>
<td></td>
<td>0.933</td>
</tr>
</tbody>
</table>

Figures in parenthesis indicates the standard error of coefficients.

** - Significant at 5 percent level of significance.

It is quite evident from table VIII-2, that the value of regression coefficient of gross cropped area \((X_1)\) was observed to be negative being \(-0.556\) and non-significant, revealing thereby that there was negative effect of gross cropped area on the consumption of fertilizer which was due to the expansion of area under rainfall crops along with limited availability of capital with the farmers.

The value of regression coefficient of rainfall \((X_4)\) and time element \((X_5)\) being 0.034 and 0.005 were found to be non-significant although there was positive which indicated that these two variables did not influence on the
consumption of fertilizer in the district under study. The exponent of gross irrigated area \((X_2)\) and area under high yielding varieties of crops \((X_3)\) were observed to be positive being 0.801 and 0.944 respectively and were also significant which revealed that fertilizer consumption was affected by these two variable to a greater extent.

The value of coefficient of multiple determination \((R^2)\) observed to be 0.933 indicating thereby that about 93 percent of the variation in fertilizer consumption was due to the variable included in the equation.

It can be concluded from the above discussion that extent of correlation of total fertilizer consumption with the gross irrigated area and area under high yielding varieties was observed to be highly correlated and significant. There has also high degree correlation between fertilizer consumption in the district under study was high yielding varieties of crops. Other independent variables such as rainfall and time did not effect the fertilizer consumption significantly. On the other hand, the gross cropped area effected the fertilizer consumption negatively. Further, the value of coefficient of multiple determination was very high indicating 93 percent variation in the fertilizer consumption was due to their independent variables include in the model.

II. Functional analysis and optimization of farm resources and maximization of wheat production

Production Function

Multiple regression analysis was used as the analytical tool to study the input-output relationship and productivity of various inputs involved in the production of wheat. Thus, regression equation was developed to express the yield of wheat as a function of various inputs used during the production process of wheat.
Cobb-Douglass type of regression equation was developed for further economic analysis. The regression equation of Cobb-Douglas function of wheat production for all the farms under study as a whole is given below.

Regression equation of wheat:

\[ Y = a \cdot x_1^{b_1} \cdot x_2^{b_2} \cdot x_3^{b_3} \cdot x_4^{b_4} \cdot x_5^{b_5} \]

Whereas:

- \( Y \) = Yield of wheat in quintals per hectare.
- \( x_1 \) = Cost of human labour (in rupee) per hectare.
- \( x_2 \) = Cost of bullock labour (in rupee) per hectare.
- \( x_3 \) = Cost of seed (in rupee) per hectare.
- \( x_4 \) = Cost of manures and fertilizer (in rupee) per hectare.
- \( x_5 \) = Cost of irrigation (in rupee) per hectare.
- \( A \) = Constant

\[
Y = 0.000005 \cdot x_1^{0.3796} \cdot x_2^{0.2486} \cdot x_3^{0.1451} \cdot x_4^{0.7284} \cdot x_5^{0.4954}
\]

\( R^2 = 0.8115 \)

*Significant at 5 percent level of significance.
**Significant at 1 percent level of significance.

Figures in parenthesis show the standard error of their respective regression coefficients.

**Coefficients of multiple determination**

An examination of multiple determination of wheat indicates that human labour \((x_1)\), manure's and fertilizer \((x_4)\) and irrigation \((x_5)\) explained about 81 percent of the total observed variation the yield on all the farms under study.

**Elasticities of production of farm resources**

The Cobb-Douglas production function is linear in logarithms and the partial regression coefficient of production on the various input in the equation directly denotes the elasticity of production. The elasticity of production indicates the percentage change in production associated with one percent change in the quantity of a particular input, keeping other input resources at constant level. The elasticity of production along with test of significance and standard error for wheat of the farms under study has been given in table VIII-3.
The examination of elasticities of production of various input used in the production of wheat for all farms under percent study revealed that the coefficients of all the individual input except of seed and bullock labour were significant, positive and less than one indicating thereby diminishing returns to each individual input.

Among the significant variables, the highest elasticity of production was observed in the case of manure fertilizer followed by irrigation and human labour. The production elasticity of bullock labour and seed was observed to be non-significant and lowest.

**Marginal productivity of input**

The marginal physical product of an input factor is the increment in the output fourth coming from the use of it additional unit, the level of input remaining unchanged. The marginal value product is the marginal return of an input variables expressed in monetary terms and can be defined as the additional return obtained from an additional unit of input. The marginal physical and value products of various inputs for all farms under study for wheat have been given in table VIII-4.
It is perspicuous from table VIII-2 that the marginal value product of manure and fertilizer was observed to be Rs. 9.5758 indicating thereby that there is great opportunity of higher return by increasing the use of manure fertilizer. Similar is the case with the marginal value product of irrigation being Rs13.30 revealing high return by increasing the irrigation level as required by the crop. The higher marginal value products for both of manure’s and fertilizers of wheat clearly indicated the low level of these inputs used in the present study by the farmers for production of wheat. Since, the marginal value products of bullock labour and seed were not found to be significantly higher than their respective prices was there is no scope for increasing the level of there input in wheat production. On the contrary, the human and bullock labour already involved should be reduced to the extent where their marginal value products equal to their prices.

Thus from the above discussion, it can be concluded that there is a great scope for increasing the level of manures, fertilizers and irrigation the production of wheat in order to get maximum net return form it.

**Economic optimum levels**

The profits could be maximized on the wheat farms by increasing which resource input to a point where its marginal value product is equal to its price. This is true only when the available

Capital resources with the wheat growers are unlimited. This assumption of unlimited capital with the farmers is very far from reality and has little practical importance. In the case of capital constraints, the maximum profits could be attained by allocating the limited capital among its various competing use in such a way that its marginal value return per unit of money investment on each resource in each use becomes equal. In case, when the value of marginal value products of
various farm resources are not equal at the existing level of their use, the profit could be maximized by shifting the resources having low marginal value product to those which higher marginal value products.

The optimum manned existing levels of various inputs along with their difference under limited capital for wheat for sample farms study has been presented in table VIII-5.

Table VIII-5: Optimum and existing levels of various inputs for the sample farms as a whole.

<table>
<thead>
<tr>
<th>Particular</th>
<th>Variable Inputs (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X₁</td>
</tr>
<tr>
<td>1.Optimum level</td>
<td>593.19</td>
</tr>
<tr>
<td>2.Existing level</td>
<td>1308.61</td>
</tr>
<tr>
<td>3.Difference</td>
<td>725.42</td>
</tr>
</tbody>
</table>

The comparison of optimal and existing levels of from resources on the sample farms as a whole indicated that the optimal levels of manure-fertilizer and irrigation were significantly higher than that of their respective existing mean levels. On the contrary the existing levels of human labour, bullock labour and seed were significantly higher as compared to their respective optimal levels. Thus it can be concluded the shifting and reallocation available funds to be used on human labour, bullock labour and seed to the use of manure fertilizer and irrigation may maximize the return from wheat on the sample farms under study. It is, therefore, suggested that the wheat growers are required to shift and reallocate the farm monetary resources spend on hired labour, seed and on bullock to the input factors may be diverted to words manure-fertilizer and irrigation for maximizing the returns from wheat cultivation.

On the basis of above findings, it may be noted that the returns on the crop in question can be maximized similarly by reallocation of limited capital because the
farmers can not spend additional finance required for from his own resources nor be can borrow additional money beyond his capacity from financing institutions.

Now it is desired to find out as to what extent the returns can be maximized by reallocation of the existing resources. Keeping in view this objective the regression equation optimum levels of inputs for wheat crop has been developed for all sample farms under a study and is given below:

$$Y = a \cdot X_1^{b_1} \cdot X_2^{b_2} \cdot X_3^{b_3} \cdot X_4^{b_4} \cdot X_5^{b_5}$$

$$= 0.000005 \cdot 593.19^{0.7284} \cdot 388.71^{0.4954} \cdot 1138.40^{-0.77429}$$

$$= \log 0.000005 + 0.3796 \log 593.19 + 0.2486 \log 388.71$$

$$+ 0.1451 \log 226.78 + 0.7284 \log 1138.40 + 0.4954 \log 774.29$$

$$= \log 0.000005 + 1.0526687 + 0.6437745 + 0.3417975 + 2.2262081 + 1.431161$$

$$= -6.30103 + 7.9218195$$

Logy = 1.62075

Y = 41.76 Quintals

An examination of the regression equations developed for the farms under study as a whole under optimal levels of input revealed that the yield of wheat per hectare can be maximized from their existing levels of 30.72 quintals on the samples farm as a whole at existing levels of input variables to 41.76 quintals at optimum levels of input under capital constraints simply by reallocations inputs resources indicating thereby a net difference in yield of wheat per hectare between existing and optimum levels of farm inputs being 11.04 quintals valuing Rs 2870.40.

The farmers of different categories of farms can also maximize the production of wheat per hectare on their holding by following the principle of shifting and reallocation of farm resources from low marginal value product inputs in favour of the input factors having higher marginal value product. The additional gain which the farmers of various categories can obtain by following the above motioned principle and on the assumption that the maximized production of wheat
per hectare remains the same as worked out in the case of all selected farms as a whole of the study has been shown in the table VIII-6.
Table VIII-6: Production of wheat per hectare under existing and optimum farm resources and additional and monetary gain under various categories of farms.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Categories of farms</th>
<th>Overall average for all farms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marginal</td>
<td>Small</td>
</tr>
<tr>
<td>1. Yield per hectare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Existing resource</td>
<td>36.69</td>
<td>34.82</td>
</tr>
<tr>
<td>(b) Optimum resource use</td>
<td>41.76</td>
<td>41.76</td>
</tr>
<tr>
<td>(c) Difference</td>
<td>5.07</td>
<td>6.94</td>
</tr>
<tr>
<td>2. Value of product</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) At existing resource use</td>
<td>9539.40</td>
<td>9053.20</td>
</tr>
<tr>
<td>(b) At optimal resource use</td>
<td>10857.60</td>
<td>10857.60</td>
</tr>
<tr>
<td>(c) Difference</td>
<td>1318.20</td>
<td>1804.40</td>
</tr>
</tbody>
</table>

It is quite evident from table VIII-6, that on the assumption of yield of wheat per hectare obtained on all selected farms a whole being Rs. 41.76 under Cobb-Douglas regression equation to the same on the farms of other categories too, the yield of wheat per hectare can be increased from 36.69 quintals, 34.87, 31.75 and 28.65 quintal on marginal small, medium and large farms at existing levels of inputs to 41.76 quintals per hectare at optimum levels of inputs in each category of farm. Highest additional gain in physical and monetary terms was being 13.11 quintals and Rs 3408.60 was observed in the case of large farmers followed by the farmers of medium farms being 10.01 quintals and Rs 2602.60 respectively. The maximum addition gain on the large farms as well on the medium farms was due to comparatively low level of output per hectare on there farms than that of small and marginal farms. The causes of low level of output per
hectare on large and medium farms have already been discussed in the preceding pages of chapter VIII (crop enterprise analysis.)

On the contrary, low addition again both in yield and value of output of wheat per hectare was worked out for marginal farmers being 5.07 quintals and Rs 1318.20 followed by small farmers being 6.949 quintals and Rs 2602.60 respectively. It was due to comparatively higher level yield per hectare on their farms being 36.39 and 34.85 quintals as compared to the farms of medium and large farmers being 31.75 and 28.65 quintals respectively. Further, the higher yield per hectare of wheat on marginal and small farmers was due to comparatively higher levels of production-oriented inputs used by these farmers as compared to medium as well as large farms.

Thus, it can be concluded from the above discussion that from optimization and reallocation of farm resources the yield of wheat per hectare can be increased significantly from their existing levels under capital constraints, resulting in to additional net income of Rs 2870.40 on the sample farms as a whole over and above of original level of net profit.

The above facts also indicated that the maximum additional net return was observed being Rs 3408.60 per hectare on the farms of large farmers followed by medium farmers being Rs 2602.60.

The above findings confirm the views of various economists that there is excessive pressure of human population on the farming as reflected by lower marginal value productivity of human labour on Indian farms. The study further, showed that bullock labour is being kept to optimal level under no capital constraints by the farmers due to their social prestige. But actually the farmers are facing the constraints of capital and hence in view high marginal returns on inputs like manure’s fertilizers and irrigation, it is desirable (in case the farmers are unable to get additional funds to be invested on the above inputs) to reduce the
capital invested on bullock power (use it in other subsidiary occupation like marketing of produce on hire basis) and to increase the level of manure-fertilizers and irrigation. The surplus of family labour may divert to complementary and supplementary enterprises like dairy and poultry farming etc.

In summing up the results of regression analysis it can be conclude that the yield of wheat per hectare on the sample farms under study as a whole can significantly be oriented upward simply by reallocation farm resources under capital constraints.

III. Function analysis, optimization of farm resources and maximization of Bajra production

The regression equation was developed to express the yield of Bajra as a function of different input factors during the production process of Bajra crops. Like wheat the regression equation of Cobb-Douglass function of bajra production for all farms in the present study is as follows.

Regression equation of Bajra:
\[ Y = a \cdot X_1^{b_1} \cdot X_2^{b_2} \cdot X_3^{b_3} \cdot X_4^{b_4} \]

Whereas
\[ Y = \text{Yield of bajra in quintals per hectare.} \]
\[ X_1 = \text{Cost of human labour (in rupee) per hectare.} \]
\[ X_2 = \text{Cost of bullock labour (in rupee) per hectare.} \]
\[ X_3 = \text{Cost of seed (in rupee) per hectare and} \]
\[ X_4 = \text{Cost of manure and fertilizer (in rupee) per hectare.} \]
\[ A = \text{Constant} \]

The fitted regression equation is given below:
\[ Y = a \cdot X_1^{0.2815} \cdot X_2^{0.2609} \cdot X_3^{0.0045} \cdot X_4^{0.2106} \]
\[ R^2 = 0.8530 \]

Coefficient of multiple determination

The value of R2 being 0.8530 clearly indicated that human labour and manure and fertilizer explained about 85% of the total observed variation in the yield of bajra on the farms under study.
Elasticity of production of various input variables along with cost of significance and standard error for bajra has been shown in table VIII-7

Table VIII-7: Elasticity of production, value of ‘t’ and standard error of bajra for the farms under study.

<table>
<thead>
<tr>
<th>Particular</th>
<th>Input variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$X_1$</td>
</tr>
<tr>
<td>1. Regression coefficient</td>
<td>0.4768</td>
</tr>
<tr>
<td>2. Standard error</td>
<td>0.2815</td>
</tr>
<tr>
<td>3. ‘t’ values</td>
<td>3.6215</td>
</tr>
</tbody>
</table>

*Significant at 5% level of significance.

** Significant 1% level of significance.

It is quite evident from the table VIII-5, that $(X_1)$ human labour and $(X_4)$ manure and fertilizer were observed positive and significant on 5% and 1% level of significance. The production elasticities of bullock labour and seed were found to be non-significant.

**Marginal productivities of variable inputs**

The marginal physical and value product of various variable inputs taken in the regression equation for bajra have been given in table VIII-8.

Table VIII-8: Marginal physical and value products of variable inputs used in bajra.

<table>
<thead>
<tr>
<th>Particular</th>
<th>Variable inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$X_1$</td>
</tr>
<tr>
<td>MPP</td>
<td>0.0183313</td>
</tr>
<tr>
<td>MVP(RS)</td>
<td>2.93</td>
</tr>
</tbody>
</table>

Table VIII-8 clearly reveals that the marginal value product of manure and fertilizers being Rs 4.14 was significantly higher than that its price, indicating rater
opportunity of higher production and return from bajra per hectare by increasing the use of fertilizers. Since it is true that the production of bajra per hectare could be maximized by increasing each resource input to a level where its marginal value product is equal to its price. In case, when the value of marginal value products of various variable inputs taken in the production process are not equal at the existing level the production could be maximized by shifting the fund of variable input having low marginal value product in favor of those variable inputs which higher marginal value products.

**Economic optimum levels of various variable inputs:**

The optimum and existing levels of various inputs along with their difference under limited capital of bajra on the sample farms as a whole have been shown in table VIII-9.

**Table VIII-9: Optimum and existing levels of various variable inputs of bajra on the sample farms.**

<table>
<thead>
<tr>
<th>Particular</th>
<th>Variable input</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(X_1)</td>
<td>(X_2)</td>
<td>(X_3)</td>
<td>(X_4)</td>
</tr>
<tr>
<td>1. Optimum level</td>
<td>355.80</td>
<td>163.57</td>
<td>40.80</td>
<td>415.40</td>
</tr>
<tr>
<td>2. Existing level</td>
<td>411.22</td>
<td>202.26</td>
<td>40.25</td>
<td>322.24</td>
</tr>
<tr>
<td>3. Difference</td>
<td>-55.42</td>
<td>-38.29</td>
<td>+00.55</td>
<td>93.16</td>
</tr>
</tbody>
</table>

Comparison of optimal and existing levels of variable inputs on the sample farms as a whole used on bajra crop indicated that the optimal levels of manure fertilizer (\(X_4\)) was significantly higher that that of its existing level, where as, the existing mean levels of human labour (\(X_1\)) and bullock labour (\(X_2\)) being Rs. 411.22 and Rs. 202.26 was significantly higher as compared to their respective optimal levels being Rs. 355.80 and Rs. 163.97. No significant difference between optimal and existing level of seed was observed. Thus, shifting and relocation of
available funds used on human and bullock in favor of manure fertilizers may maximize the production and return from bajra on the sample farms.

**Optimization of variable input and return maximization of production and return per hectare of bajra**

Keeping in view the above objective, a regression equation at optimum level of variable input for bajra has been developed for all sample farms and given below.

\[
y = a + x_1 b_1 + x_2 b_2 + x_3 b_3 + x_4 b_4
\]

\[
\begin{align*}
0.4768 &= 0.01506 \\
0.355.80 &= 0.163.97.40 \\
0.163.97.40 &= 0.0061 \\
0.5273 &= 0.2284 \\
19.50 &= 0.415.40
\end{align*}
\]

The critical examination of regression equation clearly revealed that the yield of bajra per hectare can be maximized from its existing level of 15.81 quintals to 19.50 quintals at optimal level of variables input under capital constraints simply by shifting and reallocation of variable input. The net difference in the yield of bajra result by above process came to 3.69 quintals valuing Rs. 590.40 as addition a gain. Similarly the additional gain which the farmers of various categories can earn by following above mentioned principle and on the assumption that the maximized production being 19.50 quintals of bajra obtained on the sample farms as a whole remain the same. The additional gain of farmers of various categories of farms has been shown in table VIII-10.

It is perspicuous from table VIII-8 that on the assumption of yield of Bajra per hectare obtained on the sample farms as a whole being 19.50 quintals by fitting Cobb-Douglas equation on optimum variable inputs following above principle, yield of bajra per hectare can be increased from existing level of 16.56 quintals, 15.78 quintals, 17.25 quintal and 13.24 quintals on marginal small, medium and large farms respectively to 19.50 quintals per hectare on the farm of each category. Highest physical and monetary gain per hectare being 6.26 quintals and 935.60 was observed on large farms, which was due to comparatively low
level of fertilizer consumption resulting low yield on large farms as compared to the farms of other categories.

Table VIII-10: Production of bajra per hectare under existing and optimum variable inputs and additional physical and monetary gain under various categories of farms.

<table>
<thead>
<tr>
<th>Particular</th>
<th>Categories of farm</th>
<th>Marginal</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
<th>Over all Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Yield of bajra/ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) At existing level of variables (input)</td>
<td>16.56</td>
<td>15.78</td>
<td>17.25</td>
<td>13.24</td>
<td>15.81</td>
<td></td>
</tr>
<tr>
<td>(b) At optimum level of variable input</td>
<td>19.50</td>
<td>19.50</td>
<td>19.50</td>
<td>19.50</td>
<td>19.50</td>
<td></td>
</tr>
<tr>
<td>(c) Difference</td>
<td>2.96</td>
<td>3.72</td>
<td>2.25</td>
<td>6.26</td>
<td>3.69</td>
<td></td>
</tr>
<tr>
<td>2. Value of product bajra (Rs.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) At existing level</td>
<td>2649.60</td>
<td>2524.80</td>
<td>2760.00</td>
<td>2184.40</td>
<td>2529.60</td>
<td></td>
</tr>
<tr>
<td>(b) At optimum level</td>
<td>3120.00</td>
<td>3120.00</td>
<td>3120.00</td>
<td>3120.00</td>
<td>3120.00</td>
<td></td>
</tr>
<tr>
<td>(c) Difference</td>
<td>470.40</td>
<td>595.20</td>
<td>360.00</td>
<td>935.60</td>
<td>590.40</td>
<td></td>
</tr>
</tbody>
</table>

On the contrary lowers additional production of bajra and its additional return per hectare was worked out on the medium farms being 2025 quintals and Rs.360.00 respectively, which was again due to higher level fertilizer consumption resulting higher yield per hectare. Thus, it can be stated that from optimization and relocation of various variable inputs, the yield of bajra per hectare on the sample farms as a whole and on the farms of various categories can be increased significantly from their existing production per hectare resulting addition return of Rs590.40 on the farms as a whole, Rs470.40 on marginal farms Rs595.20 on small farms Rs360.00 on medium farms and Rs 935.60 on the large farms over and above of original net profit per hectare.