Chapter V

Resource Use Efficiency of Farms
CHAPTER V

RESOURCE USE EFFICIENCY OF FARMS

This chapter on resource use efficiency of farms contains three parts. Part I deals with technical efficiency and its determinants. Part II deals with the allocative efficiency and Part III presents the returns to scale.

Resource use efficiency which is also called as economic efficiency includes technical efficiency and allocative efficiency. These two concepts are highly interrelated.

Improvement in the productivity of the crop is necessary for increasing production. Productivity can be enhanced by the efficient use of resources already at the disposal of the farmers. Thus, resource use efficiency in crop production becomes important.

Efficiency measurement is given due weightage because it is a factor for productivity growth. Measurement of efficiency is much helpful to determine the extent to which the farms can raise productivity with the existing resource base and available technology. Improvement in resource use efficiency will not only enable farmers to increase the use of productive resources, but it will also give direction for the adjustments required in the long run.

So, this study has made an attempt to analyse the technical and allocative efficiencies of the farmers in the study area.
PART I

Technical Efficiency

The technical efficiency of a farm can be defined as "The ability and willingness of the farm to obtain the maximum possible outcome with a specified endowment of inputs, given the technology and environmental conditions surrounding the farm."

Technical efficiency can be explained with the help of Figure V-1.

Figure V-1
Technical Efficiency

In the above figure the Total Physical Product Curve one (TPP₁) shows a higher level of output for all levels of input used than TPP₂. Thus, TPP₁ is technically superior to TPP₂. The point 'A' on TPP₁ is technically efficient than point 'C' on TPP₂ because A represents a higher level of output
than C even though both of them absorb the same level of variable input. This shows technical efficiency.

The increased output is due to the availability of best technologies to the farmer. Thus, technical efficiency is also defined as the ability of the farmers to practise good skills or knowledge in farming operations. A number of studies have disclosed the importance of technical efficiency in promoting farm productivity and also have identified the factors which influence technical efficiency.

A study on technical efficiency was first made by Farrell\(^1\) on a cross section of firms by using a deterministic approach. Since this approach ignores the random factors which affect the efficiency of a firm, the stochastic Frontier model was developed by Aigner et al.,\(^2\) and Meeusen and Von den Broeck\(^3\). The technical efficiency estimation for each farm was made possible by Jondrow et al.,\(^4\)

The technical efficiency of rice growers in Tamil Nadu had been measured by Kalirajan\(^5\), Tadesse and Krishnamoorthy\(^6\), Kalirajan and Shand\(^7\) and Mythili and Shanmugam\(^8\).

Goyal, et al.,\(^9\) estimated the technical efficiency of paddy farmers in Haryana state for 3 years by employing the stochastic Frontier Approach. They investigated the influence of some farmer specific variables like age, family size, schooling, etc. They concluded that
(i) There is scope to improve the productivity of the crop with the given level of input use and technology.

(ii) Farm size was not found to have any significant relationship with technical efficiency; and

(iii) The older farmers are technically in-efficient than younger farmers.

Shanmugam and Atheendar Venkatramani attempted to measure technical efficiency of agricultural production in 248 districts across 12 major states in India for the year 1990-91. Also they tried to identify the socio-economic and ecological factors determining technical efficiency level in those districts. They introduced health status of farmers as one of the determinants of efficiency along with education, land size, climatic zone, etc. The stochastic Frontier Production function model was used. They found that Indian districts have a mean technical efficiency of 79% and in 123 districts, the technical efficiency lie below 80%. They also concluded that health, education and infrastructure are the drivers of efficiency at the district level.

As most of the studies on technical efficiency reveal that socio-economic and demographic factors of farmers have a meaningful impact on farm efficiency, it became necessary to identify the factors influencing the technical efficiency of farmers in the study area. So, the variables age, education, experience, family size and extension agency contact are included to examine the possible effects of farmers' characteristics on the efficiency of
paddy production in the study area. These factors are termed as quantifiable determinants.

The relationship between technical efficiency of farmers and farm attributes has been brought out by using the following specification.

$$TE = a_0 + a_1 X_1 + a_2 X_2 + a_3 X_3 + a_4 X_4 + a_5 X_5 + e$$

where $TE$ = Technical Efficiency

$\alpha =$ Parameters

$X_1 =$ Age of farmers

$X_2 =$ Farmer’s year of education

$X_3 =$ Farmer’s experience

$X_4 =$ Number of extension contacts with extension personnel.

$X_5 =$ Family size; and

$e =$ error term

Table V-1 describes technical efficiency and farm characteristics of all farms.
Table V-1

Technical Efficiency and Farm Characteristics of All Farms

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Unstandardised Co-efficient</th>
<th>Standard Error</th>
<th>β-Value</th>
<th>‘t’ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>12424.109</td>
<td>1081.181</td>
<td>0.061</td>
<td>11.491</td>
</tr>
<tr>
<td>Age</td>
<td>18.856</td>
<td>29.712</td>
<td>0.006</td>
<td>0.635</td>
</tr>
<tr>
<td>Education</td>
<td>7.96</td>
<td>53.802</td>
<td>-0.001</td>
<td>0.148</td>
</tr>
<tr>
<td>Experience</td>
<td>-0.243</td>
<td>31.81</td>
<td>-0.001</td>
<td>-0.008</td>
</tr>
<tr>
<td>Extension Contact</td>
<td>6915.632</td>
<td>258.756</td>
<td>0.845</td>
<td>26.727*</td>
</tr>
<tr>
<td>Family size</td>
<td>-325.847</td>
<td>137.919</td>
<td>-0.087</td>
<td>-2.363</td>
</tr>
</tbody>
</table>

R² = 0.743  \( N = 285 \)  \( F\)-ratio = 161.585
* Significant at 1% level
Source: Primary data.

Table V-1 reveals that the extension contact positively and significantly influences farm productivity. Agricultural extension contact is a technique by which information about new technologies, better farming practices and methods of co-ordination of farm inputs are transmitted to the farmers. The Block Extension Functionaries\(^1\) are the instructive and informative agencies to the farmers. This study observed that the extension contact enhances productivity and reduces inefficiency in the study area. But the Block Extension Functionaries are subject to the criticism that they favour medium and large farmers and are indifferent towards small and marginal farmers. The World Food Report\(^2\) issued by FAO in 1987 also viewed that the extension services were directed towards the rich farmers in order to make them still richer. But this study inferred that the extension contact has a positive impact on farm productivity significantly irrespective of farm size and farm tenure.
Age and education influences farm productivity positively but not significantly. Most of the farmers in the study area have studied up to 12th standard. Some are graduates also. Education enables them to select improved inputs, optimal allocation of inputs among competing use, and ensures better co-ordination of farming activities. However, the farmers lack specialized technical education in the field of agriculture. Hence they need more extension contacts to bridge the gap in their technical knowledge.

Technical efficiency of each type of farm also has been examined individually and the results are presented below.

**Own Farms**

Table V-2 presents the technical efficiency and farm characteristics of own farms.

**Table V-2**

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Unstandardised Co-efficient</th>
<th>Standard Error</th>
<th>β-Value</th>
<th>‘r’ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>11244.142</td>
<td>1402.977</td>
<td></td>
<td>8.014*</td>
</tr>
<tr>
<td>Age</td>
<td>-40.099</td>
<td>31.701</td>
<td>-0.118</td>
<td>-1.265</td>
</tr>
<tr>
<td>Education</td>
<td>-5.574</td>
<td>64.615</td>
<td>-0.004</td>
<td>-0.086</td>
</tr>
<tr>
<td>Experience</td>
<td>36.934</td>
<td>33.149</td>
<td>0.112</td>
<td>1.114</td>
</tr>
<tr>
<td>Extension Contact</td>
<td>8604.989</td>
<td>306.282</td>
<td>0.923</td>
<td>28.095*</td>
</tr>
<tr>
<td>Family size</td>
<td>-354.935</td>
<td>156.144</td>
<td>-0.099</td>
<td>-2.273</td>
</tr>
</tbody>
</table>

R² = 0.895   N=130   F-ratio =211.025

* Significant at 1% level

Source: Primary data.

From the Table V-2, we learn that the extension contact alone significantly influences the productivity of own farms.
The older farmers are expected to have more farming experience and enhanced efficiency. But this study reveals that age is not associated with efficiency. That is, the younger farmers are more efficient than older farmers with regard to own farms. The reason is that the older farmers are more conservative in nature and so less willing to adopt new farm practices.

Education does not have positive influence on productivity. The family size also has a negative influence on productivity. The farmers of own farms keep their farms not only for maintaining their livelihood but for maintaining their heritage also. Further, they have alternative sources of income. So, their efforts on farming operations are very low which results in lower efficiency in own farms.

Hence it has been observed that age, education and family size are not supportive for augmenting farm productivity. Extension contact alone is effective in promoting farm productivity. Experience has very low impact. Therefore the second hypothesis is proved correct.
Tenant Farms

Table V-3 contains the technical efficiency and farm characteristics of tenant farms.

**Table V-3**

Technical Efficiency and Farm Characteristics of Tenant Farms

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Unstandardised Co-efficient</th>
<th>Standard Error</th>
<th>β-Value</th>
<th>'t' Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>16573.99</td>
<td>2932.705</td>
<td>0.021</td>
<td>5.651</td>
</tr>
<tr>
<td>Age</td>
<td>4.771</td>
<td>78.106</td>
<td>-0.175</td>
<td>-1.267</td>
</tr>
<tr>
<td>Education</td>
<td>-140.307</td>
<td>110.773</td>
<td>-0.008</td>
<td>-0.024</td>
</tr>
<tr>
<td>Experience</td>
<td>-1.821</td>
<td>76.509</td>
<td>0.55</td>
<td>5.253*</td>
</tr>
<tr>
<td>Extension Contact</td>
<td>4642.817</td>
<td>883.906</td>
<td>0.076</td>
<td>0.634</td>
</tr>
<tr>
<td>Family size</td>
<td>199.721</td>
<td>315.111</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R² = 0.369 \hspace{1cm} N=65 \hspace{1cm} F-ratio = 6.905

* Significant at 1% level

Source: Primary data.

In the case of tenant farms, the extension contact alone significantly influences farm productivity. Age and family size influence productivity positively but it is not significant. Education and experience have a negative impact on farm productivity but it is not significant.

Negative impact of education and experience account for the lower efficiency of tenant farms than all other type of farms. It seems tenant farmers do not fully use their farm knowledge and experience for allocating resources efficiently. Since their share in the crop yield is relatively lower, they are not much interested in enhancing their productivity.
Own Holdings

Table V-4 deals with the technical efficiency and farm characteristics of own holdings.

Table V-4

Technical Efficiency and Farm Characteristics of Own Holdings

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Unstandardised Co-efficient</th>
<th>Standard Error</th>
<th>β-Value</th>
<th>‘t’ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-919.128</td>
<td>4052.42</td>
<td>0.463</td>
<td>-0.227</td>
</tr>
<tr>
<td>Age</td>
<td>101.722</td>
<td>65.285</td>
<td>0.223</td>
<td>1.889**</td>
</tr>
<tr>
<td>Education</td>
<td>273.226</td>
<td>144.642</td>
<td>-0.118</td>
<td>-0.386</td>
</tr>
<tr>
<td>Experience</td>
<td>-28.42</td>
<td>73.663</td>
<td>0.565</td>
<td>4.963*</td>
</tr>
<tr>
<td>Extension Contact</td>
<td>9536.716</td>
<td>1921.47</td>
<td>0.108</td>
<td>1.007</td>
</tr>
<tr>
<td>Family size</td>
<td>348.317</td>
<td>345.841</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R² = 0.556    N=45    F-ratio = 9.751

* Significant at 1% level. ** Significant at 5% level. *** Significant at 10% level.

Source: Primary data.

It has been observed from Table V-4 that age, education and extension contact significantly influence the productivity of own holdings. Age is associated with clear thinking and decision making. Higher level of formal education is associated with the ability of farmers in understanding the informations gained by extension contact and executing it promptly. Hence, education plays a dominant role in promoting agricultural productivity of own holdings in the study area. This result is in accordance with the findings of Abdulai and Huffman13, Weirs14, Owens et al.,15, Chaudhri16, and Shanmugam and Atheendar Venkataramani17. Hence the third hypothesis that age, education, farming experience and family size affect farm
productivity positively is more relevant with reference to own holdings alone. So, it is partly correct.

The size of family influences the productivity positively but not significantly. The large family size of the farmers of own holdings ensure adequate supply of family labour for rice production activities.

Farmers of own holdings excel in per acre productivity than all other type of farmers. Since all other factors positively influence farm productivity, the negative impact of experience is not reflected in farm productivity. Hence it has been observed that farming experience has no relevance for the productivity gain by the farmers of own holdings in the study area.

Thus, the combination of age, education, extension contact and family size make a favourable impact on the productivity of own holdings.

**Tenant Holding Farms**

Table V-5 shows the technical efficiency and farm characteristics of tenant holding farms.
Table V-5

Technical Efficiency and Farm Characteristics of Tenant Holding Farms

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Unstandardised Co-efficient</th>
<th>Standard Error</th>
<th>β-Value</th>
<th>‘r’ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>17578.048</td>
<td>3470.278</td>
<td>0.001</td>
<td>0.002</td>
</tr>
<tr>
<td>Age</td>
<td>0.106</td>
<td>52.397</td>
<td>0.091</td>
<td>0.564</td>
</tr>
<tr>
<td>Education</td>
<td>66.434</td>
<td>117.822</td>
<td>0.154</td>
<td>0.372</td>
</tr>
<tr>
<td>Experience</td>
<td>21.969</td>
<td>59.083</td>
<td>0.318</td>
<td>2.065*</td>
</tr>
<tr>
<td>Extension Contact</td>
<td>3188.642</td>
<td>1544.36</td>
<td>0.159</td>
<td>1.042</td>
</tr>
<tr>
<td>Family size</td>
<td>303.482</td>
<td>291.196</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R² = 0.162  N=45  F-ratio = 1.506

*N Significant at 1% level

Source: Primary data.

Table V-5 depicts that extension contact alone positively influences farm productivity significantly. Age, education, experience and family size also influence farm productivity positively. But it is not significant.

The larger family size ensures the supply of farm labour at the required time. This enables them to carry on the farm operations effectively and enhance productivity.

Also it has been observed that the per acre productivity of tenant holdings is relatively higher than that of own farms and tenant farms which are characterized by lower impact of education. Thus, it is clear that farmers' education has positive impact on productivity.

Since all factors positively influence farm productivity, the per acre production of tenant holdings is on par with own holdings.
Non-quantifiable Determinants of Farm Productivity

The previous studies have revealed that the non-quantifiable factors such as the farmers access to rural infrastructure, road, electricity, markets, banks, co-operatives, policy support of the Government, public investment, subsidies, agricultural development and economic size of farms also determine the efficiency of farms.

So, this study also tried to bring out the role of non-quantifiable factors on farm productivity in the selected area. The Non-quantifiable factors influencing farm productivity are discussed below.

1. Agricultural Development

Agriculturally developed areas are characterized by (i) higher incidence of irrigation, (ii) HYV facilities; and (iii) double cropping. On the contrary, agriculturally backward areas are having limited sources of irrigation and lower HYV facilities and mono cropping.

The study made by Berry and Cline confirms that in a less developed agriculture, inverse relationship is an established experience.

The study of Begai and Soni visualised that the relationship was inverse where the agriculture is less developed and positive in the regions where the Green Revolution was in operation.

The area selected for our analysis is agriculturally backward. There the sources of irrigation are limited and of mono cropping system prevails. The technology absorption in the study area is meaningful but it is not up to
the mark. The farmers do not have technical education. They are not owning harvesters and threshers. Even then, they are capable of producing reasonably good returns by combining the farm inputs in a more efficient way.

So, it is proved that for a farm in an agriculturally backward area can also produce a reasonably good level of output from a given set of inputs.

This conclusion is on par with the findings of Debendra Sarkar and Sudpita De.\textsuperscript{21}

2. Available Infrastructure

It becomes essential to analyse to what extent the farmers' differential access to rural infrastructure and institutions like road, electricity, markets, banks, co-operatives and administrative organizations influence efficient use of resources in agriculture in the study area. Public investment in basic infrastructure creates conditions conducive for larger private investments in open wells, tube wells, land improvement and a variety of other agriculture related activities.

In the selected area, the available infrastructure is not fully conducive for agricultural growth. There is no well established connecting road between the paddy fields and the nearby markets. There is also no provision for storing paddy and hence the farmers are forced to sell their produce immediately after reaping at lower prices.

Enquiry reveals that the supply of electricity is highly irregular in the study area. There is no canal irrigation. So, the farmers rely on open wells
and tube wells to satisfy their water requirements. The farmers’ investment in tube wells and pumpsets has been rising. The widespread decline in water tables forces competitive deepening and installation of more powerful pumps. This further depletes the ground water reserves.

The Primary Agricultural Co-operative Societies are the major financial sources for the farmers of this area. But they do not fully satisfy the financial needs of the farmers. So, they rely on the rural vendors and farm owners for their financial requirements. The interest rates charged by these financial intermediaries are not affordable by the farmers.

Banks are also not playing an active role in providing farm capital. Hence the farmers are unable to own farm capital equipments. Instead they hire the services of the equipments.

3. Government Policies

Government policies are framed with the good intension of promoting and facilitating agricultural growth in different spheres. But the government policies and programmes become ineffective because of their defective implementation.\(^{22}\)

Even though the Government of Tamil Nadu supply electricity for farm operations at free of cost, the farmers in the selected area face the following practical difficulties.

(i) The three phase power supply which is required for pumping operations is available only for minimum number of hours per day.
(ii) The drastic and unannounced power cut affects the irrigation system severely.

(iii) The low voltage power supply makes the motor pumps often defective.

Moreover, the often and uneven hike in the prices of petroleum products makes the hiring charges of capital equipments like tractors and harvesters too high.

Withdrawal of subsidies for chemical fertilizers makes their prices so high that they could not be purchased by the farmers.

The Government of Tamil Nadu enacted laws to restrict the unauthorized draining of soil in the selected area. But it has not been properly enforced. Thus, there is heavy depletion of soil in the selected area. This affects the water holding capacity of the agricultural fields and adversely affects farm productivity.

The implementation of MGNREGP (Mahatma Gandhi National Rural Employment Guarantee Programme) drastically affects the supply of women labourers for agricultural operations. The beneficiaries of the welfare scheme are not willing to work in paddy fields as they feel that farming operations are tedious, cumbersome and time consuming also.

4. Economic Size of Farms

Even though there exists a meaningful relationship between farm size and productivity, a debate prevails regarding the required farm size for maintaining the livelihood of farmers.
It has been proved that if the farm size is too small, it becomes un­
economical and thus impedes the entire agricultural progress.23 On contrary, if the farm size is too large, it becomes unmanageable and thus leads to in­
efficiency in terms of productivity.24

Khusro25 has observed that in Indian conditions, holding of less
than 5 acres is considered to be un-economical because it is difficult to employ
a minimum ploughing unit or a minimum work unit or an income unit and it
does not fully absorb the family labour and it is also unable to generate
surplus over and above farm family requirements.

To substantiate this view, Kohlon26 opined “In order to keep the
full employment of the family members, and to maintain a pair of bullock
labour busy on the farm, a minimum irrigated holding of size varying
between 7.5 acres to 10 acres is needed in India”.

No bullock labour is involved in farming operations. Family labour
is also not fully engaged in agricultural activities. So, there is no question of
maintaining minimum subsistence for bullock and human labour in the study
area.

But, it is expected that the yield must be good enough to maintain a
minimum standard of living of the farming families. The range of 4-5 acres
provides a reasonable share to the farmers over and above the cost of
production. So, it has been observed that 4-5 acres of land is the economic size of farm in the study area.\textsuperscript{27}

5. Depletion of Resources

It has also been reported in the earlier studies\textsuperscript{28} that some resources are over exploited for maximizing farm income in the short run which in turn lead to the depletion of those resources. For testing this view, this study has attempted to know the sustainable use of farm resources. The only resource which has been put to substantial use here is ground water which is being depleted.

PART II

ALLOCATIVE EFFICIENCY

Since the resources of farmers vary in terms of quality and quantity, the returns per unit of inputs used also differ significantly from farm to farm. So, efficient allocation of resources by the farmers is inevitable to maximize the farm output.

Thus allocative efficiency describes the adjustment of inputs and outputs reflecting the relative prices, and the technology of production already chosen. It shows the possibility of enhancing production by adjusting the quantum of inputs.

The allocative efficiency has been well explained with the help of Figure V-2.
In the figure V-2, YY' represents the equal production possibilities of a homogeneous product by employing land and labour inputs. The Iso-cost line I'I, shows the price ratio of these two inputs and hence this is the limiting point of input application. Combining factor inputs beyond YY' (Point Q₂ and Q₃) cannot be afforded because they are away from the budget line I'I. Any point lying on YY' (Q₁) is technically efficient. Since Q lies at the point of tangency of YY' and I'I it represents both technical and allocative efficiency.
Since allocative efficiency is associated with profit maximization, it must satisfy three conditions.

(i) The marginal value product\(^{29}\) of each factor must be equal to its price, that is, \(\text{MVP}_x = P_x\).

(ii) The available factors must be combined in such a way that it must involve least cost; and

(iii) The products must be combined in a manner that it must yield maximum profit.

This study measures allocative efficiency by grouping the farms on the basis of (i) Type of tenure and (ii) Farm size. This categorical classification ensures uniformity and hence generalization is quite possible.

The earlier studies\(^{30}\) disclosed the allocative efficiency by employing Cobb-Douglas Production Function. The Cobb-Douglas Production Function provides an appropriate estimation of the marginal contribution of each input to output. As such, it helps to evaluate the relative performance of farms and facilitates easy comparison of different types of tenures.

The ordinary least square technique has been employed to estimate the production function. The form of equation is

\[ Y = A X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} \]
Where $Y = \text{Output}$

$X_1 = \text{Farm Size}$

$X_2 = \text{Bio-Chemical Input}$

$X_3 = \text{Labour Input}; \text{and}$

$X_4 = \text{Capital Input}$

The function was transformed into log-linear form as given below.

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + \log e$$

The estimated co-efficients are elasticities of production of different inputs. These elasticities of factor inputs are used to calculate their respective marginal productivities. Marginal products in terms of money value was obtained by using the following formula.

$$MP_i = b_i \frac{\bar{Y}}{\bar{X}_i} \text{ or } MP_i = b_i \times AP_i$$

Where $MP_i = \text{Marginal Product of } i^{th} \text{ input}$

$b_i = \text{Elasticity Co-efficient of } i^{th} \text{ input}$

$\bar{Y} = \text{Geometric mean of the output}$

$\bar{X}_i = \text{Geometric mean of the } i^{th} \text{ input}$

Since bio-chemical and capital inputs used in this analysis have been measured in terms of money value, the calculated marginal product itself represents the marginal value product of the respective inputs. Hence, they by themselves indicate the allocative efficiency also. For land, the ratio of
marginal value product to factor cost is worked out by considering the rental value prevailing in the study area.  

Similarly prevailing wage rate was used to know the ratio of marginal value product to labour cost.

In the agricultural economic analysis, the marginal concept is given due weightage since it is the real indicator of net efficiency of farms. Since the objective of the rational farmer is profit maximization, he allocates his resources in relation to their respective marginal contributions in monetary terms. The degree to which it is accomplished indicates allocative efficiency.

If the marginal contribution of one unit of input is greater than its price, it means that the farmer is efficient in allocating the resources and hence there is further scope for expanding the particular input use. On the contrary, if the marginal contribution is negative, then it is inferred that the specific input is excessively used by the farmers and hence the fixed resources are not responsive to the variable input applied.

In order to understand the allocative efficiency of farmers in the selected area, the marginal value products of different inputs are compared with their respective acquisition cost. Tables V-6 and V-7 exhibit the marginal value product of input factors and their ratios to factor costs.
### Table V-6
Marginal Value Product of Factor Inputs

<table>
<thead>
<tr>
<th>Regression Equation</th>
<th>Farm classification on the basis of type of tenure and size (in acres)</th>
<th>Marginal Value Product of Factor Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Land</td>
<td>Bio-Chemical Input</td>
</tr>
<tr>
<td>1. All Farms</td>
<td>20336</td>
<td>-1.407</td>
</tr>
<tr>
<td>2. Own Farms</td>
<td>20771</td>
<td>-0.978</td>
</tr>
<tr>
<td>3. Own Holdings</td>
<td>14257</td>
<td>-1.701</td>
</tr>
<tr>
<td>4. Tenant Farms</td>
<td>19607</td>
<td>2.241</td>
</tr>
<tr>
<td>5. Tenant Holdings</td>
<td>25424</td>
<td>0.327</td>
</tr>
<tr>
<td>6. Up to 2 acres</td>
<td>21883</td>
<td>-1.579</td>
</tr>
<tr>
<td>7. 2 - 4 acres</td>
<td>19365</td>
<td>-1.309</td>
</tr>
<tr>
<td>8. 4 - 6 acres</td>
<td>15779</td>
<td>-0.954</td>
</tr>
<tr>
<td>9. Above 6 acres</td>
<td>17263</td>
<td>-1.658</td>
</tr>
</tbody>
</table>

Source: Primary Data.

### Table V-7
Ratio of Marginal Value Product to Factor Cost

<table>
<thead>
<tr>
<th>Regression Equation</th>
<th>Farm classification on the basis of type of tenure and size (in acres)</th>
<th>Ratio of Marginal Value Product to Factor Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Land</td>
<td>Bio-Chemical Input</td>
</tr>
<tr>
<td>1. All Farms</td>
<td>2.99</td>
<td>-1.41</td>
</tr>
<tr>
<td>2. Own Farms</td>
<td>3.06</td>
<td>-0.98</td>
</tr>
<tr>
<td>3. Own Holdings</td>
<td>2.10</td>
<td>-1.70</td>
</tr>
<tr>
<td>4. Tenant Farms</td>
<td>2.89</td>
<td>2.24</td>
</tr>
<tr>
<td>5. Tenant Holdings</td>
<td>3.74</td>
<td>0.33</td>
</tr>
<tr>
<td>6. Up to 2 acres</td>
<td>3.22</td>
<td>-1.58</td>
</tr>
<tr>
<td>7. 2 - 4 acres</td>
<td>2.85</td>
<td>-1.31</td>
</tr>
<tr>
<td>8. 4 - 6 acres</td>
<td>2.32</td>
<td>-0.95</td>
</tr>
<tr>
<td>9. Above 6 acres</td>
<td>2.54</td>
<td>-1.66</td>
</tr>
</tbody>
</table>

Source: Primary Data.
Table V-7 reveals that the ratio of marginal returns to factor cost for land is positive and greater than unity for all farms irrespective of tenurial and size-wise classification. It indicates the importance of land as a basic factor of production in agriculture. Since the marginal contribution of land is greater than the price paid for it, there is scope for further expansion of area under cultivation and for intensive cultivation. At present the land is under utilized in the study area. Since the land under consideration is less futile by nature, there is no double cropping. Absence of canal irrigation and non-availability of agricultural labour are the causes for the under-utilisation of land.

The ratio of marginal returns to bio-chemical input cost is less than unity for all observations except tenant farms. Hence it has been concluded that the application of bio-chemical input is uneconomical in all types of farms except tenant farms. Usage of hybrid varieties of seed and application of more pesticides are the causes for the extensive use of bio-chemical inputs. However, the tenant farms under utilise the bio-chemical input potentialities considerably.

With regard to labour use, the marginal return is greater than unity for all the farms except tenant farms and tenant holdings. It holds good for farms of all sizes also. So, there exists the possibility for increased use of labour. But, the non-availability of labour force at the required time and their demand for higher wages restrict the use of labour considerably in farm activities. It is worth mentioning here that the labourers employed in tenant
farms do not utilize their services on par with the wages received by them. However, as the services of labour in agriculture cannot be totally replaced by some other factors, labour is employed in agriculture whenever needed.

The marginal contribution of capital when compared with its price is very low for all farms except own holdings. It implies that there is an over dosage of capital input than the required level. Since the services of capital inputs are available in divisible forms and it is relatively cheaper than labour input, it is widely used in farm operations. The own holdings gainfully allocate their capital input as the marginal return of capital input is greater than the price for it.

**Measurement of Technical Efficiency**

Having identified the quantifiable and non-quantifiable determinants of technical efficiency, an attempt has been made to estimate the technical efficiency of the farms in the study area. Technical efficiency is measured as the ratio between actual and potential output of a production unit.

\[
\text{TE} = \frac{\text{Actual Output}}{\text{Potential Output}}
\]

In this study area, all farmers irrespective of the tenure confirm that the potential output of an acre is 48 bags of paddy but the actual output is only 24 bags.

So, Technical Efficiency = \( \frac{24}{48} = 0.5 \)
This shows that the farms are not getting maximum output by the use of the inputs they have. The study on allocative efficiency and determinants of farm efficiency show the inputs land and labour are not fully utilized to maximise the output and the demographic factors age, education, family size and experience have no significant positive impact on efficiency. Only the extension contact influences farm efficiency. Hence, the technical efficiency is low.

PART III

RETURNS TO SCALE

Returns to scale shows the performance of the farms in utilizing the available resources. It is much important for identifying the un-utilised farm potential. So, an attempt has been made to anlayse the returns to scale in this study.

Returns to scale explains the change in total returns when all factor inputs are altered simultaneously in the same proportion. On the basis of efficiency and farm size - productivity relationship, either increasing or decreasing or constant returns to scale may exist. The size-productivity relationship very well exhibits the scale efficiency of farms.

The Cobb-Douglas production function has been employed to examine the nature of returns to scale prevailing in the study area. The resultant regression co-efficients indicate the elasticities of production of different farm inputs. The sum of those regression co-efficients specify returns
to scale. When the sum of b's is equal to one, it is a case of constant returns to scale, when the sum of b's is less than one, it shows decreasing returns to scale and if the sum of b's is more than one it implies the operation of increasing returns to scale.

With regard to Indian Agriculture, the previous studies disclose that constant returns to scale is commonly prevailing.

Table V-8 exhibits the co-efficients of farm production function and returns to scale.
Table V-8

Co-efficients of Farm Production Function and Returns to Scale

<table>
<thead>
<tr>
<th>Regression Equation</th>
<th>Farms Classification</th>
<th>N</th>
<th>Constant Log</th>
<th>Regression Co-efficients</th>
<th>R²</th>
<th>Sum of Regression Co-efficients</th>
<th>Deviation from Unity</th>
<th>Returns to Scale indicated by 't' Test</th>
<th>'F' Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All Farms</td>
<td>285</td>
<td>11.955**</td>
<td>(0.442)</td>
<td>0.885**</td>
<td>(0.055)</td>
<td>-0.210**</td>
<td>(0.038)</td>
<td>0.408**</td>
</tr>
<tr>
<td>2</td>
<td>Own Farms</td>
<td>130</td>
<td>12.873**</td>
<td>(0.520)</td>
<td>0.951**</td>
<td>(0.061)</td>
<td>-0.175**</td>
<td>(0.056)</td>
<td>0.502**</td>
</tr>
<tr>
<td>3</td>
<td>Own Holdings</td>
<td>45</td>
<td>7.626**</td>
<td>(1.672)</td>
<td>0.546*</td>
<td>(0.246)</td>
<td>-0.217</td>
<td>(0.203)</td>
<td>0.131</td>
</tr>
<tr>
<td>4</td>
<td>Tenant Farms</td>
<td>65</td>
<td>7.901**</td>
<td>(1.372)</td>
<td>0.920**</td>
<td>(0.161)</td>
<td>0.295*</td>
<td>(0.136)</td>
<td>-0.247*</td>
</tr>
<tr>
<td>5</td>
<td>Tenant Holdings</td>
<td>45</td>
<td>10.203**</td>
<td>(0.431)</td>
<td>0.974**</td>
<td>(0.060)</td>
<td>0.041</td>
<td>(0.045)</td>
<td>-0.056</td>
</tr>
<tr>
<td>6</td>
<td>Upto 2 acres</td>
<td>116</td>
<td>12.215**</td>
<td>(0.682)</td>
<td>0.925**</td>
<td>(0.079)</td>
<td>-0.264**</td>
<td>(0.061)</td>
<td>0.389**</td>
</tr>
<tr>
<td>7</td>
<td>2 - 4 acres</td>
<td>92</td>
<td>11.804**</td>
<td>(1.141)</td>
<td>0.850**</td>
<td>(0.161)</td>
<td>-0.179**</td>
<td>(0.087)</td>
<td>0.397**</td>
</tr>
<tr>
<td>8</td>
<td>4 - 6 acres</td>
<td>51</td>
<td>10.733**</td>
<td>(0.931)</td>
<td>0.702**</td>
<td>(0.136)</td>
<td>-0.129</td>
<td>(0.091)</td>
<td>0.432**</td>
</tr>
<tr>
<td>9</td>
<td>Above 6 acres</td>
<td>26</td>
<td>12.249**</td>
<td>(2.199)</td>
<td>0.795**</td>
<td>(0.379)</td>
<td>-0.247*</td>
<td>(0.110)</td>
<td>0.513**</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level.  ** Significant at 0.01 level.  
Figures in the parentheses below R² are  R²  values.
Source : Primary Data.
The above table reveals that the sum of regression co-efficients for all the equations is positive and closer to unity. The tenure wise and size wise classification also reveal the same result. More specifically, the sum of regression equation for tenant farm is exactly equal to one. Hence it has been inferred that constant returns to scale is prevailing in paddy production in the study area irrespective of farm size and type of tenure. This finding is in accordance with the findings of some previous studies also. So, the fourth hypothesis that constant returns to scale is in operation in the agricultural production process has been proved correct.

Constant returns to scale implies that there is no technological basis for the inverse relationship.

The co-existence of large and small farms in the study area neutralizes the positive and negative effects of scale operation and thus leads to a corresponding increase in the volume of output in relation to the increased volume of input. And so constant returns to scale prevails.

The positive farm size-productivity relationship established in the study area also explains the existence of constant returns to scale.

The divisibility of factor inputs like bio-chemical inputs, services of labour and capital units are also the causes for constant returns to scale.
Conclusions

1. Extension contact significantly influences farm productivity of all type of farms. It is the most important determinant of farm productivity. Therefore, the second hypothesis is proved correct.

2. The extension services are available to all type of farmers.

3. Farmers even though possess formal education, they lack specialized technical knowledge related to agriculture. This technical gap has been compensated by enhanced extension contact.

4. The older farmers of own farms are more conservative in nature and so less willing to adopt new farm practices. This has resulted in lower efficiency of own farms.

5. Age, education and family size are not supportive of augmenting productivity of own farms. Extension contact is the lone significant factor in determining the productivity of own farms.

6. Relative in-efficiency of tenant farms is due to insignificant influence of education and experience.

7. Education plays a dominant role in promoting agricultural productivity of own holdings.

8. Farming experience has no relevance for productivity gain for the farmers of own holdings in the study area.

9. The combination of age, education, extension contact and family size make a favourable impact on the productivity of own holdings.
Therefore the third hypothesis that age, education, farming experience and family size affect farm's productivity positively is partly correct.

10. Since all factors positively influence farm productivity, the per acre production of tenant holdings is on par with the own holdings.

11. This study has proved that a farm in an agriculturally backward area can also produce a reasonable level of output from a given set of inputs.

12. In the study area, the available infrastructure is not fully conducive for agricultural growth.

13. The Government policies and programmes become in-effective in the study area because of their defective implementation.

14. The farm measuring 4-5 acres provides a reasonable share to the farmers over and above the cost of production. Therefore, the economic size of farm in the study area is 4-5 acres.

15. The widespread decline in water tables forces competitive deepening and installation of more powerful pumps. This further depletes the ground water reserves.

16. The marginal returns of land is greater than its price for all types and all sizes of farms. So, there is scope for intensive cultivation of land and for the extension of area under cultivation. However, the intensive use of land is restricted by the absence of canal irrigation and non-availability of agricultural labour at required time.
17. The application of bio-chemical input is uneconomical in all types of farms except in tenant farms. The tenant farms under-utilises its bio-chemical input potentialities.

18. There is ample scope for employing more labour in farm operations in the selected area. But, the non-availability of labour force at the required time and their demand for higher wages during peak season restrict the labour use considerably. The marginal return to factor cost is too low for the tenant farms.

19. Over dosage of capital input is found in all the farms except in own holdings. Relative cheapness of capital services and their divisible nature facilitates larger application. The marginal return of capital input is greater than its price for own holdings and hence they gainfully allocate their capital input.

20. There is scope for increasing the farm income through the re-allocation of the two available resources namely, land and labour.

21. The technical efficiency of farmers in the study area is low. The actual output is one half of the potential output. This is because of the under-utilisation of land and labour. Further, age, education, farming experience and family size have no influence on farm efficiency. Only extension contact is found to have positive influence on farm efficiency.

22. Constant returns to scale is prevailing in the production of paddy in the study area irrespective of farm size and type of tenure. Therefore the fourth hypothesis is proved correct.
23. The co-existence of large and small farms in the study area neutralizes the positive and negative effects of scale operation and so constant returns to scale prevail.

24. The established positive farm size – productivity relationship, the divisibility of factor inputs like bio-chemical inputs, labour and capital units are the causes for constant returns to scale.
Notes and References


27. See Chapter IV, P.126.


29. Marginal Value Product represents the expected increase in the value of total output resulting from the use of one additional unit of a particular input.


31. Marginal Productivity of each factor input can be obtained by multiplying the elasticity coefficient of the particular factor input by the average productivity of that factor. Average productivity is the ratio between geometric mean of the output and the geometric mean of that specific input.

32. The prevailing rental value of land is Rs.6780/= per acre.

33. The wage for an eight hour man day is Rs.300/=.


