**Resource use efficiency of irrigated farms in Borunda Tube-Well command area, Rajasthan**

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**ABSTRACT**

This study was initiated to document the comparative use-pattern of resources in arid areas where water has recently been made available. The results revealed that whereas, water and tractor use could be profitably used, labour, land and nitrogenous fertilizers could generate profitable use only if the intensity of cropping is increased.

**INTRODUCTION**

Availability of fresh water in desert areas is a crucial input for augmentation of crop production. The Borunda Tube-well command area has been one of the successful demonstrations of tapping ground water resources in arid areas. It is, therefore, natural to expect the crop sector to undergo substantial changes in the pattern of resource structure and its consequential use. Quantification of the resource use pattern, return to scale and pattern of production for the recently irrigated areas becomes important because the water made available from the aquifers has a tremendous drag on the public and private sectors. Further, the resources like fertilizers, seeds, land improvements and machinery use, are usually complementary to the water.

Many attempts in recent past have been geared to cover the aspects of resource use (Hopper, 1967; Saini, 1969; Krishna, 1964; Rao, 1968; Sankhayan and Sirohi, 1971; Desai, 1973; Singh and Pandey, 1971; Subramanium, 1967) which vastly vary in climatological and physiographic features, that are bestowed upon desert areas. This study is, thus, an attempt to quantify the resource use patterns and its allocational efficiency for the irrigated farms in the Borunda Tube-well command areas.

**MATERIAL AND METHODS**

The study is principally based on the data of farm management investigation of 25 irrigated farms from five villages viz., Borunda, Hariadhana, Ransigaon,
Bhagasani and Sambadia for the year 1972-73. The data were collected in two rounds for the 25 farm families on the production performance and extent of resource use by canvassing a specially prepared schedule under the project, "Survey of Existing Socio-Economic conditions, cultural practices and working out the economics of cost of cultivation of important crops in Borunda Tube-well command area".

The Model:

A single long-linear function of the Cobb-Douglas type was employed to study the magnitudes of resource use efficiency for the different inputs.

\[ Y = a x_1^{b_1} x_2^{b_2} \ldots \ldots x_n^{b_n} (i) \]

Where 'a' is intercept, and \( b_1, b_2, \ldots, b_n \) are Regression coefficients. Using the generalised equation with the five measured inputs, the elasticity and productivity coefficients of land \((x_1)\), Human labour \((x_2)\), Irrigation \((x_3)\), Nitrogenous fertilizers \((x_4)\) and Tractor use \((x_5)\) were estimated at aggregate farm level.

Gross value of output in Rs. \((Y)\) : The gross value of output was arrived at by converting the total marketable surplus by the prices received on the instalment sales of the produce throughout the year. To this, the value of retained produce estimated at the current prices was added.

Land in Ha \((x_1)\) : The total availability of land per farm family was found to be at variance with the actual cropped area. The inclusion of total available land was rejected in favour of cropped area for the reference year, for the fear of under-valuation (Sethuraman, 1971) of the productivity of the crop.

Human Labour in Man Days \((x_2)\) : The information on the labour days used for each crop was collected for the year under consideration. From which the bullock and attached human labour were substracted to avoid the problem of multicolinearity (Singh, 1975) between the complementary forms of labour.

Irrigation in Cu.m. \((x_3)\) : The measurement of irrigation water presented some problems. In order to minimise the arbitrariness of this measure the information on number of irrigations for each crop was converted into cubic-metres of water on

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* All India Coordinated Project on New Cropping Patterns and Water use in Command Areas (I.C.A.R.).
the assumption that 7 (hybrid bajra seed production, wheat, cumin and rai), 5 (chillies) hectare cm irrigation was given on the farms by following Singh and Patel (1973).

**Nitrogenous fertilizer in kg \( (x_4) \)**: The quantity of nitrogen supply through different sources to different crops were arrived at by summing the nitrogen content of the organic and inorganic fertilizers applied on the farm for the year under consideration.

**Draft-Power in tractor use hrs \( (x_5) \)**: This included the tractor hours with driver used on all the crop enterprises in a given year. To this the standardised bullock hours were added.

### RESULTS AND DISCUSSION

The **production function**: The estimation of Cobb-Douglas production function from the specification described earlier came out to be of the following magnitude:

\[
Y = 0.00054 X_1 - 0.0511 \text{(N.S.)} 0.1718 X_2 + 2.3726 X_3 + 1.660 X_4 - 0.0521 X_5
\]

\( R^2 = 0.9531 \)

* Significant at 5 per cent level.
** Significant at 1 per cent level.
NS Not significant.

A perusal of the function generated reveals that but for irrigation and tractor use the contribution to value of produce by cropped area, human labour and nitrogenous fertilizer is negative. It seems that lack of intensive use of cropped area, coupled by excessive use of human labour and fertilizer had suppressing effect on the value realization of the agricultural production. It is obvious from the high magnitude of coefficient of multiple determination \( R^2 = 0.9531 \) that most of the variations in gross value of the produce is positively explainable by the significant factors of production, viz., water and mechanization. Since coefficient of multiple determination \( R^2 \) has a mathematical property to necessarily register increase with increase in number of independent variants, another summary statistic defined on the basis of residual variance, the adjusted coefficient of multiple determination, \( R^4 \), which is independent of increase in \( R^2 \) due to addition of variate was computed following Rao and Miller (1972). The results, however, did not significantly change \( R^4 = 0.9503 \) as against \( R^2 = 0.9531 \). From the standard error of the coefficient, the stability of constants was found to be reassured excepting in case of fertilizer use. Finally, the computation of standard partial regression coefficients \( B.S. \) which would enable to measure the comparative weight attributable to each of the independent variants were computed following Johnson (1961).

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* Personal communication from Dr. B. L. Jain, Soil Physicist of this Institute.
** The standardisation of bullock hours were made on the basis of the market demand for the two inputs during the year under consideration.
As expected, only irrigation and tractor use contributed significantly to the variations explained in gross value of production (coefficients for $x_1$, $x_2$, $x_3$, $x_4$ and $x_5$ came out to be $-0.3756$, $-0.9807$, $+2.2087$, $-0.0487$ and $0.1320$ respectively).

The average and marginal value productivity coefficient of factors employed in crop production was considered with a view to ascertain the most profitable avenues of resource use. The same at geometric mean level, are furnished in table 1.

Table 1. Factor productivity Coefficients of sample farms (1972–73)

<table>
<thead>
<tr>
<th>Factor-input</th>
<th>Average value productivity at Geometric mean level (Rs/Unit)</th>
<th>Marginal value productivity at Geometric mean level (Rs/unit)</th>
<th>MVPx/Px</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land in Ha ($x_1$)</td>
<td>1662.98</td>
<td>-704.47</td>
<td>-0.2310</td>
</tr>
<tr>
<td>Human labour in man days ($x_2$)</td>
<td>24.33</td>
<td>-28.37</td>
<td>-11.2698</td>
</tr>
<tr>
<td>Irrigation in Cu.m. of water ($x_3$)</td>
<td>0.40</td>
<td>0.93</td>
<td>7.5301</td>
</tr>
<tr>
<td>Fertilizer in N kg ($x_4$)</td>
<td>76.99</td>
<td>-3.93</td>
<td>-1.5179</td>
</tr>
<tr>
<td>Draft use in tractor use hrs ($x_5$)</td>
<td>154.68</td>
<td>26.57</td>
<td>1.5751</td>
</tr>
</tbody>
</table>

It can be seen from table 1 that land has highest value of average productivity, followed by tractor use, fertilizer, human labour and irrigation. However, the marginal value productivity shows that returns to the additional unit of land, human labour and fertilizer, will be a losing proposition to employ these resources. Highest doses of irrigation coupled with increased intensity of tractor use on the other hand are likely to increase the economy in crop production. The coefficients are indicative of the facts that more water and more mechanisation and not any additional land, human labour and nitrogenous fertilizer will yield fruitful results in desert areas which have only recently undergone a transformation owing to provision of irrigation.

Returns of scale aim to locate the behaviour of change of total returns when all the factors of production are changed simultaneously in the same proportion.
However, since it is not possible for a farm operator to have control over all the resources, the economic returns to scale are generally worked out including only those factors which are controlled by the entrepreneur.

In order to examine the nature of returns to scale the log-linear production function was again resorted to. From the examination of the function it became obvious that incidental to same intensity of land use, an hectare of additional land will generate loss of 42 paise, addition of one man day of human labour will suppress the total return by Rs. 1.16 and additional unit of one kg. of N will end up in a loss of Rs. 0.05. The sum of the elasticities for this function was rather close to unity (0.9040). The result reveals that in their zeal to out with the game-theoretic effect of climatic parameters, the irrigated farms in Borunda Tube-well command area over used human labour days, land and fertilizer.

**Optimum Resource Use Efficiency:**

When compared with the factor costs, the marginal value productivity of the factor should be able to provide some guidelines for optimal efficient resource use. Conceptually, the ratio between marginal value productivity and price should be close to unity for the most efficient resource use. Judging on this score, only tractor use hour was found to be most efficiently allocated ($MVP_{x_1}/P_{x_1} = 1.575$) followed by irrigation ($MVP_{x_3}/P_{x_3} = 7.530$). The negative ratio for human labour nitrogenous fertilizer and land indicate that an average farmer of the Borunda Tube-well command area will be wise to curtail the average labour employment by 11 per cent, fertilizer cost by 1.50 per cent and land by 0.23 per cent.

**CONCLUSION AND POLICY IMPLICATIONS**

The resource use analysis of farms in Borunda Tube-well command area reveals significantly that in the year under consideration, farmers tended to over use labour, land and nitrogenous fertilizer. Any concerted efforts on the part of the planners to regulate the use of those inputs would go a long way to resolve this dilemma of over use. Since the labour use cannot be directly controlled, vigorous campaign by extension personnel to introduce new cash crops like castor, sunflower and safflower for increasing productive labour use, intensity on hitherto less intensive land use will be a desirable policy.

Another policy conclusion which has far-reaching implication is distribu-
tional aspect of water use. It seems that water is more evenly distributed between owner operators and beneficiaries the sagging effect of uneven crop-performance can be mopped out.
Finally, the study has ample grounds which call for regulation of the supply of crucial input like nitrogenous fertilizer to prevent harmful effects of overdosing the crops by sample farmers in these areas.

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REFERENCES


