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Assessment of Resource Use Efficiency of Agricultural Farms in Command Area of Puri District of Odisha, India

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A B S T R A C T

Command Area Development project needs to actualize the vast untapped growth potential in agriculture, strengthen rural infrastructure, to support the development, promote the value addition, accelerate the growth of agri-business, generate employment in rural areas, secure a fair standard of living for the farmers and agricultural workers and their families, discourage the migration to urban areas and face challenges arising out economic liberalization and globalization. Multi stage random sampling technique was adopted for this study to select the ultimate unit of sample farmers Pipili block of Puri district was purposively selected as it was under command area development programme. So far as the resource use efficiently is concerned, a comparative study between beneficiary and non-beneficiary farmers showed that the independent variable inputs like human labour, manures and fertilizer of irrigation etc. had a positive impacts towards the crop yield as well as to goods income of the beneficiary farmers, Where as in non-beneficiary farmers, except manures and fertilizers other variable did not have much influence over the gross income. It is obvious that irrigation facilities in the command area might have provided better scope for efficient utilization of the variable resource which would enhance income of the respondents. So the hypotheses i.e. the resources are equally efficient in beneficiary and non-beneficiary farmers of different location is rejected.

Introduction

Command Area Development project needs to actualize the vast untapped growth potential in agriculture, strengthen rural infrastructure, to support the development, promote the value addition, accelerate the growth of agri-business, generate employment in rural areas, secure a fair standard of living for the farmers and agricultural workers and their families, discourage the migration to urban areas and face challenges arising out economical liberalization and globalization. Irrigation has a major role in enhancing agricultural production. Sustainability of irrigated agriculture and maximization of benefits from this sector through efficient environment friendly irrigation management now assumes much more significance than at any time in the past. Full resource value of water-economy, social, cultural and environmental, needs to be recognized in irrigation water management.

Definitive action is called for to harness the available water resources while also protecting & conserving them. At the time of independence, India had a net irrigated area of 19.4 million hectare (m. ha.). Ever since independence, India had followed a scientific and rational approach for development of irrigation resources. Consequently, total irrigation potential of 108.2 million hectare (m. ha) which consists of 42.4 million hectares under major and medium irrigation and the remaining 60,4 million hectares under minor irrigation has been created till end of 10th Five Year Plan Unfortunately, there has been a large gap in utilisation of created potential. At the end of Tenth plan, total utilisation of irrigation potential was to the extent of 87.2 million hectares as against the total created potential of 102.8 million hectares showing a gap of 15.6 million hectares. There is a lag of about 15.6 m. ha between potential created (102.8 m.ha.) and potential utilized (87.2 m. ha.). The gap in irrigation utilization was mostly in tail end localized areas of irrigation projects. By improving utilization, both productivity and equity goals would be served. The CAD concept was for all integrated area development programme with an attempt to synchronize systematically various activities under one roof to facilitate optimum productivity in irrigated agriculture for overall development through optimum utilization of irrigation potential created.

Materials and Methods

Multi stage random sampling technique was adopted for this study to select the ultimate unit of sample farmers Pipili block of Puri district was purposively selected as it was under command area development programme. In the first stage Delang distributary of Sakhigopal branch canal was selected at random as it covered most of the area of Pipili block. In the second stage, from among the minors and sub-minors of Delang distributary Kandajharia minor was selected randomly. All the villages having irrigation facilities by Kandjharia minor irrigation system of command area development project were listed and two villages from each of three locations i.e. head, middle and tail reaches of Kandajharia minor were selected randomly. Lastly the beneficiary and non-beneficiary farmers of villages Kanjharia and Matiapada in the head region, Kandapada and Kunjar in the middle region and Harianta and Krushnapur in the tail region were enlisted. In the final stage 15 farmers from each group of beneficiary and non-beneficiary were then randomly selected from each of the three locations. Thus in all 45 beneficiary farmers (i.e. 15 each in head, middle and tail end) and non-beneficiary farmers (i.e. 15 each in head, middle and tail) and were selected randomly for the product study. In estimating the total expenditure on crop production, the imputed cost of family labour and inputs such as manures and seeds provided by the households was excluded. Thus the estimated expenditure on crop production includes only paid-out cost. The elements included in estimating the cost of production are, hired human labour, bullock labour, seeds, manures and fertilizers, pesticides, irrigation charges, implements and machineries, land revenue, interest on working capital, rent paid for leased in land etc.

Gross farm income was estimated by multiplying output of different crops by their respective market prices prevalent in the area. Then by adding the value of all receipts, the gross farm income was arrived at in respect of beneficiary and non-beneficiary farmers. Subsequently, the estimated cost of production was subtracted from the estimated gross farm income to derive net farm income. Incremental income (or additional income) in this study is defined as the difference or rather excess of net income earned by the beneficiary farmers over the non-beneficiaries.

Test of significance

To analyse the significant difference between the mean yield of some selected crops, per hectare expenditure and not Income 't' test of the following type was carried out:

$$t = \frac{m_1 - m_2}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$S = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}}$$

Where,

m_1 = mean of the 1st sample (Beneficiary)
m_2 = mean of the 2nd sample (Non-beneficiary)
S_1 = Standard deviation of the 1st sample
S_2 = Standard derivation of the 2nd sample
S = Pooled sample standard deviation
n_1 = Total respondents of the 1st sample
n_2 = Total respondents of the 2nd sample

Cobb-Douglas production function

The main objective of the this analysis to estimate the efficiency of the variable factor inputs like human labour, manure and fertilizers and irrigation etc towards the gross income of the beneficiary and non-beneficiary sample farmers of the command area.

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

Where

Y = Gross Income from crop production

X_1 = Per hectare expenditure on human labour in rupees
X_2 = Per hectare expenditure on bullock labour

X_3 = Per hectare expenditure on manures and fertilizers in rupees

X_4 = Per hectare expenditure on irrigation in rupees

X_5 = Per hectare expenditure on plant protection in rupees

a = Intercept

b_1, b_2, b_3, b_4 and b_5 are regression coefficients or production elasticities.

For testing statistical significance of the regression coefficients of the production elasticities 'A' values were calculated by using the following formula.

$$t = \frac{\mathbf{b}_i}{S.E.\ of\ \ b_i}$$

Where,

b_i = Regression coefficient of input

S.E. = Standard Error

Multiple regression analysis

In order to make a quantitative impact of different factors influencing the increase in the labour days of beneficiary sample farmers over the non-beneficiary a multiple regression analysis of the following type was used.

$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3$

Where

Y = Difference in per hectare total human labour days employed in farm operations between the beneficiary and non-beneficiary farmers.
X_1 = Difference in gross cropped area in hectare

X_2 = Difference in irrigated area in hectare

X_3 = Difference in the expenditure on new technology (HYV seeds, manures, fertilizers plant protection measures) in rupees.

a = Intercept

b_1, b_2, and b_3 were the regression coefficients.

Results and Discussions

Resource use efficiency

It is necessary to study the efficient resource allocation like, labour, manures fertilizer, and Irrigation etc. in crop production for maximization of the farm income. For this Cobb-Douglass type of production function of this following form was sued in the study. Zero order correlation matrix for all the independent variables were worked out for testing the existence of multi co-linearity. Since there were no such problems there steps were taken for regression analysis.

The estimates of the regression coefficient and other related statistics for the beneficiary farmers of head, middle and tail reach of the command area was presented in Table 1. It may be noted that this regression coefficients associated with human labour, was 0.251 in head reach and 0.341 in middle reach which was positive and significant at 5 percent level of probability. The regression coefficient associated with manures and fertilizer was 0.368, 0.382 and 0.312 in the head, middle and tail end respectively. These values are highly significant at 1 percent level of probability in head and middle reach but it was significant at 5% level of probability in the tail end of the command area. The estimated coefficients associated with irrigation were 0.144, 0.145 and 0.106 in the head, middle and tail reaches of the beneficiary farmers. In all the cases the coefficients were significant. From this it was evident that the regression coefficients associated with human labour manures, fertilizers and irrigation etc. were found to be positive and statistically significant indicating that these resources contributed significantly in the increase in gross income from crop production in different locations of the beneficiary farmers. The magnitude of R^2 i.e. coefficient of multiple determination was 0.78 in the head region which would imply that 78% variation in income of the beneficiary farmers of the head region was explained by the independent variables like labour, manures and fertilizers and irrigation etc.

The regression coefficients and other related statistics for the non-beneficiary farmers of the command area was presented in Table 2. The regression coefficient associated with manures and fertilizers was 0.216, 0.246 and 0.219 in the head, middle and tail region respectively. These coefficients were positive and statistically significant at 5% level of probability indicating that this resource was having positive influence over the gross income. The regression coefficient associated with plant protection chemicals was 0.214 in the head region and 0.312 in the middle region and these are significant at 5% level of probability. The magnitude of coefficient of multiple determinations (R^2) was 0.72, 0.77 and 0.74 in the head, middle and tail reaches of the command area respectively. So far as the resource use efficiently is concerned, a comparative study between beneficiary and non-beneficiary farmers showed that the independent variable inputs like human labour, manures and fertilizer of irrigation etc. had a positive impacts towards the crop yield as well as to goods income of the beneficiary farmers, Where as in non-beneficiary farmers, except manures and fertilizers other variable did not have much influence over the gross income.

Table.1 Regression coefficient (b_i), standard error (S.E.), test of significance (t), coefficient of multiple determinations (R^2) obtained for beneficiary farmers

ITEMS	PARAMETERS	HEAD	MIDDLE	TAIL
Human Labour X_1	b_1	0.251*	0.341*	0.275
	SE	0.089	0.121	0.103
	t	2.819	2.818	2.669
Bullock Labour X_2	b_2	0.164	0.263	0.134*
	SE	0.093	0.191	0.047
	t	1.761	1.376	2.851
Manure & Fertilizers X_3	b_3	0.368**	0.382**	0.312*
	SE	0.113	0.118	0.104
	t	3.264	3.237	3.058
Irrigation X_4	b_4	0.144**	0.145*	0.106*
	SE	0.044	0.049	0.037
	t	3.305	2.959	2.864
Plant Protection Chemicals X_5	b_5	0.118	0.161	0.205*
	SE	0.110	0.110	0.071
	t	1.064	1.463	2.882
Coefficient of Multiple determination	R^2	0.78	0.74	0.79

* Significant at 5% level of probability
** Significant at 1% level of probability

Table.2 Regression coefficient (b_i), standard error (S.E.), test of significance (t), coefficient of multiple determinations (R^2) obtained for non-beneficiary farmers

ITEMS	PARAMETERS	HEAD	MIDDLE	TAIL
Human Labour X_1	b_1	0.251	0.296*	0.312
	SE	0.141	0.102	0.128
	t	1.780	2.901	2.437
Bullock Labour X_2	b_2	0.148	0.129	0.134
	SE	0.156	0.079	0.086
	t	0.947	1.632	1.558
Manure & Fertilizers X_3	b_3	0.215*	0.246*	0.219*
	SE	0.077	0.086	0.077
	t	2.805	2.860	2.844
Irrigation X_4	b_4	0.145	0.093	0.126
	SE	0.120	0.078	0.100
	t	1.208	1.256	1.240
Plant Protection Chemicals X_5	b_5	0.214*	0.312*	0.148
	SE	0.073	0.110	0.076
	t	2.931	2.836	1.947
Coefficient of Multiple determination	R^2	0.72	0.77	0.74

* Significant at 5% level of probability
** Significant at 1% level of probability

Table.3 Extent of per hectare labour Utilization (in mandays) in the command area

Location	Beneficiary	Non-beneficiary	Difference	Percent change
Head	189.09	138.83	50.26	36.20
Middle	190.45	126.08	64.37	51.05
Tail	153.37	120.12	33.25	27.68

Table.4 Regression coefficients and other related statistics

ITEMS	PARAMETERS	HEAD	MIDDLE	TAIL
Difference in gross cropped area in ha. X_1	b_1	0.216**	0.186*	0.22*
	SE	0.067	0.078	0.100
	t	3.22	2.384	2.21
Difference in irrigated area in ha. X_2	b_2	0.188**	0.206**	0.212**
	SE	0.060	0.068	0.073
	t	3.133	3.029	2.904
Difference in the expenditure on new technology X_3	b_3	0.168*	0.194*	0.179*
	SE	0.064	0.080	0.075
	t	2.625	2.425	2.386
Coefficient of Multiple determination	R^2	0.57	0.61	0.54

* Significant at 5% level of probability
** Significant at 1% level of probability

It is obvious that irrigation facilities in the command area might have provided better scope for efficient utilization of the variable resource which would enhance income of the respondents. So the hypotheses i.e. the resources are equally efficient in beneficiary and non-beneficiary farmers of different location is rejected.

Level of employment

The extent of employment of human labour on farms depends upon the intensity of cropping, degree of adoption of modern technology, nature of crops grown and the area under them. An attempt has been made here to examine the impact of all these changes that were brought about as a result of the improvement in the provision of irrigation on the employment of human labour on both the beneficiary and non-beneficiary farms in the command area.

The employment of human labour (in man days) both in beneficiary and non-beneficiary farms under different situations in the command area is presented in Table 3. In case of beneficiary farms, the human labour employment per hectare in head, middle and tail zones, reached a level of 189.09, 190.45 and 153.37 labour days as against 138.83, 126.08 and 120.12 labour days in case of non-beneficiary farms respectively. The percentage increase in the employment of human labour in these three zones, thus accounted to 36.20, 51.05 and 27.68 per cent respectively. Thus the beneficiaries in all three zones achieved a higher level of employment, compared to the non-beneficiaries in the command area. The difference in labour days between the two farms categories could be partly due to irrigation operations itself and partly due to other operations which have a close bearing on irrigation. Such operations may be

accounted for by the use of strategic inputs like, HYV seeds, fertilizers, pesticides change in the cropping pattern and area covered under different crops. The order to make quantitative estimates of the relative impact of these different factors in the increase in labour days in case of beneficiary farms over non-beneficiary farms, a multiple regression analysis was carried out. Linear function was used for the regression analysis. The equation developed for the present analysis is as follows:

$Y = a + b_1x_1 + b_2x_2 + b_3x_3$

Where,

Y = Difference in total human labour days (man equivalent days) between beneficiary and non-beneficiary farms.

X_1 = Difference in gross cropped area (in hectares)

X_2 = Difference in irrigated area (in hectares)

X_3 = Difference in the expenditure on new technology (i.e. HYV seeds, fertilizers, plant protection) per hectare in rupees.

Zero order correlation matrices indicate the absence of multi-collinearity. Results of the regression analysis are presented and discussed below.

It may be noted from the Table 4 that about 54-61 percent of the total variation in the dependent variable was explained by all the independent variables included in the equation. As may be seen from the table that, the regression coefficients associated with gross cropped area, area under irrigation and expenditure on new technology were found to be positive and statistically significant, indicating thereby their positive impact on the level of laour employment. In other words, one unit increase in the gross cropped area and area under irrigation would increase labour employment by about 0.216 and 0.188 man days respectively in the head region.

In all the locations the regression coefficients associated with their independent variables were also significant. Thus, to conclude, the impact of irrigation on employment at the farm level was quite obvious. It may however be pointed out that, mere assured water supply through canal irrigation would not be itself induce the farmers to increase their employment potential but the employment potential would be higher, if there is an simultaneous improvement in the cropping pattern as also in the intensity of input use. So from the overall findings of this section, there is a scope to accept the hypothesis that the income and employment level of beneficiary farmers have increased significantly as compared to non-beneficiary farmers in the command area. So far as the resource use efficiently is concerned, a comparative study between beneficiary and non-beneficiary farmers showed that the independent variable inputs like human labour, manures and fertilizer of irrigation etc. had a positive impacts towards the crop yield as well as to goods income of the beneficiary farmers, Where as in non-beneficiary farmers, except manures and fertilizers other variable did not have much influence over the gross income. It is obvious that irrigation facilities in the command area might have provided better scope for efficient utilization of the variable resource which would enhance income of the respondents. So the hypotheses i.e. the resources are equally efficient in beneficiary and non-beneficiary farmers of different location is rejected.

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