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RESEARCH ARTICLE :

Resource use efficiency in wheat production: A comparative analysis

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SUMMARY : The present study entitled impact of farm pond's on farmer's economy in Amravati district: a comparative analysis. The study was undertaken to examine the impact of farm ponds on production of wheat crop. For the present study 40 beneficiary and 40 non-beneficiary farmers were selected from Morshi tahsil of Amravati district 5 villages from Morshi tahsil of Amravati district were selected randomly. From each village 8 beneficiary and 8 non-beneficiary farmers were selected randomly. The selected farmers were classified into three category *viz.*, small, medium and large according to their land holding. For calculating resource use efficiency Cobb-Douglas production function was used for estimation of data. Resource use efficiency for wheat production in case of beneficiary farmers, at overall level the regression co-efficient of bullock labour and manure were positively significant at ten per cent level and other remaining variable were found non-significant in wheat production. In case of beneficiary at overall level marginal value of product to the factor cost ratio of bullock labour, manure and crop protection was positive and greater than one that means there was increased the use of these inputs in desirable production of wheat crop. Marginal value of product to the factor cost ratio of human labour, seeds, fertilizer and irrigation were negative and less than one that means there was excess used of these inputs, hence, there should be reduction in use of these inputs for efficient wheat production.

KEY WORDS :
Wheat production, Farmers, Resource use efficiency

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BACKGROUND AND OBJECTIVES

A farm pond is a large hole dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. The size and depth depend on the amount of land available, the type of soil, the farmer's water requirements, the cost of excavation, and the possible uses of the excavated earth. Water from the farm pond is conveyed to the fields manually, by pumping, or by both methods. Farm pond size ranges 15×15×3 meter, 20×20×3 meter, 25×25×3 meter and 30×30×3 meter, respectively, according to size of land holding of a farmer. Morshi Tahsil of Amravati district is under a dry zone area whereas various watershed development

activities carried out to provide supplementary irrigation to the *Kharif* and *Rabi* crops, to increase the farmer income. The activities carried in the farm which has been selected under study. Farm pond is beneficiary to the farmer to provide adequate water to crops in *Rabi* season and recharging water table of land and also increase the water level of farm well.

RESOURCES AND METHODS

Estimation of resource use efficiency :

For examining the resource use efficiency Cobb-Douglas production function was used.

Cobb - Douglas function

$$Y = ax_1^{b1} x_2^{b2} x_3^{b3} x_4^{b4} x_5^{b5} x_6^{b6} X7^{b7} X8^{b8}$$

The function was fitted in logarithms. The transformed function is

$$\text{Log } Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 + b_6 \log x_6 + b_7 \log x_7 + b_8 \log x_8$$

where,

Y = Gross returns (Rs./ha)

X_1 = Area under crop (in ha)

X_2 = Human labour (Rs./ha)

X_3 = Bullock labour (Rs./ha)

X_4 = Seed (Rs./ha)

X_5 = Manures (Rs./ha)

X_6 = Fertilizer (Rs./ha)

X_7 = Irrigation (Rs./ha)

X_8 = Plant protection measures (Rs./ha)

a = Constant intercept which indicates the level of output when zero inputs are used.

b_1 to b_8 = Production elasticity of respective variables.

Resource use efficiency :

To calculate the resource use efficiency following formula was used.

$$Y = ax_1^{b1} x_2^{b2} x_3^{b3} \ldots\ldots\ldots\ldots x_n^{bn}$$

where,

Y = Output

$X_1, X_2, X_3 \ldots\ldots X_n$ = Independent variable.

$b_1, b_2, b_3 \ldots\ldots\ldots b_n$ = Elasticity

$b_1, b_2, b_3 \ldots\ldots\ldots b_n$ = Return to scale

$$\text{MPP} = \frac{\text{Change in total pyhsical product}}{\text{Change in input level}}$$

$$\text{MPP} = \frac{\Delta y}{\Delta xi}$$

where,

Δy = Change in total physical product.

Δxi = Change in I^{th} input level.

$$\text{MVP} = bi \frac{\text{Y (Geometric mean)}}{\text{XI (Geometric mean)}}$$

where,

$\overline{Y}$ = Geometric mean of Y

bi = The elasticity of output with respect to into x_i

$\overline{XI}$ = Geometric mean of xi.

OBSERVATIONS AND ANALYSIS

To accomplish the objective of resource use efficiency of wheat production for two models *i.e.* multiple linear regression model and Cobb- Douglas production function was fitted on the basis of highest R^2 value and number of significant variable, the result of Cobb Douglas production function incorporated in this section

In case of small size of beneficiary farmers, the regression co-efficients of all variables were not significant. In Cobb-Douglas production function the regression co-efficient directly shows the production function elasticity hence, human labour, bullock labour, seed, manure, fertilizer, irrigation and crop protection could not influence on wheat production significantly in beneficiary group of farmers. In case of medium size group, the regression co-efficient of all variables were not significant. In Cobb-Douglas production function the regression co-efficient directly shows the production function elasticity hence, human labour, bullock labour, seed, manure, fertilizer, irrigation and crop protection could not influence on wheat production significantly in beneficiary group of farmers. In case of large size group, human labour was positively significant at five per cent level, manure and irrigation was positively significant at ten per cent level. Bullock labour, fertilizer and crop protection were negatively significant at ten per cent level, respectively. At overall level bullock labour and manure were positively significant at ten per cent level and other remaining variable were found non-significant in wheat production (Table 1).

In case of small size group of non-beneficiary farmers, the regression co-efficient of all variables human labour, bullock labour, seeds, manure, fertilizer, irrigation and crop protection were found non-significant. They could not give the desired production from wheat. In case of medium size group, the regression co-efficient of all

variables human labour, bullock labour, seeds, manure, fertilizer, irrigation and crop protection were found non-significant. They could not give the desired production from wheat. In case of large size group of farmers the regression co-efficient of all variables human labour, bullock labour, seeds, manure, fertilizer, irrigation and crop protection were found non-significant. They could not give the desired production from wheat. At overall level, only fertilizer was positively significant at five per cent level and other remaining variables were found to be non-significant. They could not give the desired production from wheat (Table 1).

Marginal value product to factor cost ratio for wheat:

Table 2 revealed in case of small size group of beneficiary level marginal value of product to the factor cost ratio of area, human labour, fertilizer, irrigation and crop protection were negative and less than one that means this indicated the excess use of these inputs. Hence there should be reduction in use of these inputs for efficient wheat production. The MVP to factor cost ratio was positive and greater than one in case of bullock labour and manure that means there was increased use of these input in desirable production of wheat crop. In case of medium size of group, marginal value of product to the factor cost ratio of human labour, bullock labour, irrigation and crop protection were negative and less than one that means this indicated the excess use of these inputs. Hence, there should be reduction in use of these inputs for efficient wheat production.

The MVP to factor cost ratio was positive and greater than one in case of seeds, manure and fertilizer that means there was increased use of these input in desirable production of wheat crop. In case of large size group of farmers, human labour, seeds, manure and irrigation were positive and greater than one that means there was increased use of these input in desirable production of wheat crop. Marginal value of product to the factor cost ratio of bullock labour, fertilizer and crop protection was negative and less than one that means there was excess use of these inputs, hence, there should be reduction in use of these inputs for efficient wheat production. At overall level, bullock labour, manure and crop protection were positive and greater than one that means there was increased use of these inputs in desirable production of wheat crop. Marginal value of product to the factor cost ratio of human labour, seeds, fertilizer and irrigation were negative and less than one that means there was excess use of these inputs, hence there should be reduction in use of these inputs for efficient wheat production.

Table 1 : Cobb-Douglas production function for wheat

Sr. No.	Variables	Small		Medium		Large		Overall	
		B	NB	B	NB	B	NB	B	NB
1.	Constant (Intercept)	5.05	1.67	2.26	17.03	-3.17	5.33	3.38	3.64
		(1.22)	(1.97)	(1.00)	(6.38)	(0.48)	(2.08)	(0.34)	(0.46)
2.	Area (X_1)	-0.43	0.19	-0.08	-0.59	0.22	-0.32	-0.11***	-0.06
		(0.14)	(0.21)	(0.11)	(0.42)	(0.05)	(0.92)	(0.04)	(0.06)
3.	Human labour (X_2)	0.009	0.16	-0.01	-2.37	2.33**	-0.60	0.08	0.13
		(0.14)	(0.25)	(0.19)	(1.26)	(0.12)	(0.67)	(0.06)	(0.11)
4.	Bullock labour (X_3)	0.06	0.04	0.004	0.23	-0.22*	0.13	0.06*	0.005
		(0.02)	(0.07)	(0.08)	(0.21)	(0.03)	(0.30)	(0.03)	(0.03)
5.	Seed (X_4)	-0.04	0.13	0.54	-1.07	0.28	0.42	0.06	0.003
		(0.10)	(0.21)	(0.21)	(0.70)	(0.06)	(2.02)	(0.09)	(0.08)
6.	Manure (X_5)	0.07	0.10	0.04	-0.50	0.23*	-0.01	0.07*	0.04
		(0.03)	(0.09)	(0.06)	(0.35)	(0.02)	(0.27)	(0.02)	(0.03)
7.	Fertilizer (N+P+K) (X_6)	-0.04	0.27	0.28	0.12	-0.40*	-0.09	0.05	0.20**
		(0.11)	(0.34)	(0.18)	(0.24)	(0.03)	(1.50)	(0.07)	(0.08)
8.	Irrigation (X_7)	-0.21	0.27	-0.15	0.23	0.44*	0.09	-0.08	0.003
		(0.11)	(0.21)	(0.12)	(0.53)	(0.03)	(0.67)	(0.05)	(0.03)
9.	Crop protection (X8)	-0.03	-0.10	-0.07	0.08	-0.76*	-0.03	0.09	-0.12
		(0.05)	(0.13)	(0.17)	(0.32)	(0.07)	(0.61)	(0.06)	(0.06)
10.	R^2	0.9934	0.7348	0.9607	0.9446	0.9992	0.8624	0.9259	0.8574

(B-Beneficiary farmers, NB- Non beneficiary farmers) (Note ***, ** and * indicate significance of values at P=0.01, 0.05 and 0.1, respectively)
(Figure in parenthesis indicate the standard error)

In case of non-beneficiary small size group of farmers, marginal value product to factor cost ratio of bullock labour, seeds, manure, fertilizer and irrigation was positive and greater than one. The MVP to factor cost ratio was negative and less than one in case of human labour and crop protection that means there was excess used of these inputs, hence, there should be reduction in use of these inputs for efficient wheat production. In case of medium size group of farmers marginal value product to factor cost ratio of bullock labour, fertilizer, irrigation and crop protection were positive and greater than one that means there was increased use of these input in efficient wheat production. The MVP to factor cost ratio was negative and less than one in case of human labour, seed and manure that means there was excess use of these inputs, hence, there should be reduction in use of these inputs for efficient wheat production. In case of large size group of farmers, marginal value product to factor cost ratio of bullock labour, seeds and irrigation were positive and greater than one that means there was increased use of these input in efficient wheat production. The MVP to factor cost ratio was negative and less than one in case of human labour, manure, fertilizer and crop protection that means there was excess used of these inputs, hence, there should be reduction in use of these inputs for efficient wheat production. At overall level marginal value product to factor cost ratio of manure and fertilizer was positive and greater than one that means there was increased use of these input in efficient wheat production. The MVP to factor cost ratio was negative and less than one in case of human labour, bullock labour, seeds, irrigation and crop protection that means there was excess used of these inputs, hence there should be reduction in use of these inputs for efficient wheat production.

Marginal physical product to factor cost for wheat:

Marginal physical product to factor cost ratio indicates the change in total physical product to the change in input level of particular independent variable. It can be seen from Table 3 that marginal physical for change in area contributed to more change in production in all three categories *i.e.* small, medium, large and overall level.

Table 2 : Marginal value product to factor cost ratio for wheat

Sr. No.	Variables	MVP to factor cost							
		Small		Medium		Large		Overall	
		B	NB	B	NB	B	NB	B	NB
1.	Area (X_1)	-96104.6	40656.27	-6135.59	-42414.4	9541.95	-13830.7	-10366.1	-5765.3
2.	Human labour (X_2)	0.0412	0.7938	-0.0970	-19.5436	14.3867	-5.2785	0.5083	0.8998
3.	Bullock labour (X_3)	2.0817	1.5705	0.2520	1676.71	-11.1527	9.0512	3.0299	0.2836
4.	Seeds (X_4)	-0.5919	2.2321	7.0656	-15.4461	3.2883	6.0750	0.8118	0.0499
5.	Manure (X_5)	1.4524	2.3289	1.0676	-14.0506	5.1689	-0.5449	1.6519	1.2866
6.	Fertilizer (X_6)	-0.7029	4.5534	4.2853	2.5142	-4.6728	-1.4673	0.8515	3.5016
7.	Irrigation (X_7)	-5.5923	7.4144	-7.3959	10.2476	21.1759	3.6585	-3.4956	0.0807
8.	Crop protection (X_8)	-1.9280	-6.2402	-4.9648	7.3365	-44.1561	-2.6967	5.6815	-8.8185

B-Beneficiary farmers, NB- Non beneficiary farmers

Table 3 : Marginal physical product to factor cost for wheat

Sr. No.	Variables	MPP to factor cost							
		Small		Medium		Large		Overall	
		B	NB	B	NB	B	NB	B	NB
1.	Area (X_1)	65750	72875	13578.13	11187.5	8437.5	9333.33	16197.92	144010.7
2.	Human labour (X_2)	3.3935	2.4291	3.3423	3.4960	4.8991	5.376	2.1013	1.8134
3.	Bullock labour (X_3)	5.8444	6.4777	8.69	11.1875	9.6428	17.3333	7.775	8.07
4.	Seeds (X_4)	9.3928	12.1458	6.2668	6.9921	8.4375	6.0666	12.1484	16.8125
5.	Manure (X_5)	4.7245	5.83	4.345	4.475	3.375	3.7333	5.1833	5.0437
6.	Fertilizer (X_6)	12.5238	11.2984	3.5968	4.8430	6.4903	3.5897	9.9170	8.0059
7.	Irrigation (X_7)	8.6229	7.7733	7.4913	6.9921	8.3875	22.4	8.9221	8.9666
8.	Crop protection (X_8)	16.4375	19.4333	22.4741	16.7812	20.0211	17.8249	20.1077	21.6160

B-Beneficiary farmers, NB- Non beneficiary farmers

In case of beneficiary marginal physical product of area for small farmers were 65750, medium 13578.13, large 8437.5 and at overall level 16197.92, respectively. Among these marginal physical products of area was highest for small farmers. Marginal physical product of seed, human labour, bullock labour, fertilizer, irrigation manure and crop protection was very low as compared to area.

In case of non-beneficiary marginal physical product of area for small farmers were 72875, medium 11187.5, large 9333.33 and at overall level 144010.7. Among these marginal physical products of area was highest for at overall level. Marginal physical product of seed, human labour, bullock labour, fertilizer, irrigation manure and crop protection was very low as compared to area.

Thus, it can be stated that change in the level of input used changes the level of production output. Similar work to the related topic was also done by Meena, 2012; Paswan and Sinha, 2014; Deshmukh and Lunge, 2013; Pawar *et al.*, 2014; Ahmad *et al.*, 2014 and Biswas *et al.*, 2014.

Conclusion :

Resource use efficiency for wheat production in case of beneficiary farmers, at overall level the regression co-efficient of bullock labour and manure were positively significant at ten per cent level and other remaining variable were found non-significant in wheat production. In case of beneficiary at overall level marginal value of product to the factor cost ratio of bullock labour, manure and crop protection was positive and greater than one that means there was increased the use of these inputs in desirable production of wheat crop. Marginal value of product to the factor cost ratio of human labour, seeds, fertilizer and irrigation were negative and less than one that means there was excess used of these inputs, hence, there should be reduction in use of these inputs for efficient wheat production.

In case of non-beneficiary at overall level the regression co-efficient of only fertilizer was positively significant at five per cent level and other remaining variables were found to be non-significant. They could not give the desired production from wheat. In case of non-beneficiary at overall level of marginal value product to factor cost ratio of manure and fertilizer was positive and greater than one that means there was increased use of these input in efficient wheat production. The MVP to factor cost ratio was negative and less than one in case of human labour, bullock labour, seeds, irrigation and crop protection that means there was excess use of these inputs, hence, there should be reduction in use of these inputs for efficient wheat production.

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