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Resource Use Efficiency on Potato Farms in Azamgarh District of Eastern Uttar Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study was carried out in Pawai block of Azamgarh district and five villages were selected randomly. A total number of 100 respondents were taken from the sleeted villages following the proportionate random sampling. The respondents were categorized as marginal (48), small (29) and medium (23) the data pertained to the agriculture year 2016-2017. The average holding size on overall farms was 1.553 ha and cropping intensity was 217.92 per cent. Cropping intensity was inversely related with the size of farms. The per farm average investment on overall farm came to Rs.242208.79 and maximum share was under the head of building i.e. 57.00 per cent followed by farm machinery and livestock share. The overall average cost of cultivation (C_3) per hectare was Rs. 78154.62 and Gross income came to Rs. 123527.20, which offers a net income of Rs. 45372.50. Among the various resources considered under study the cost of seed showed

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significant relationship at 1 per cent level of probability in marginal category of farms and it was significantly associated at 5 per cent probability level in small and medium size group of farms. Another factor of production i.e. manures and fertilizer was found significantly associated with dependent variable at 1 per cent level probability in all farm situations. The sum of elasticity shows that potato cultivation was characterized as decreasing return to scale and positive value of marginal product indicate towards the further scope of expenditure on input to earn more than the cost. Problem related with hired human labour and technical knowledge were notice at 1st and 2nd rank by the sample farmers.

Keywords: Resource use efficiency; per hectare investment; input-output relationship; Cost and return; MVP.

1. INTRODUCTION

Potato is well known as the king of vegetable has emerged as the most important food crop of India. Potato acclaimed around globe as the power house of energy. It is the world's third most important food crop after wheat and rice with a production of 329.56 million tones fresh weight produced from 18.33 million hectare area (2009-10).The potato is a crop which has always been the 'poor man's friend. Potato is being cultivated in the country for the last more than 300 years. For vegetable purposes it has become one the most popular crop in this country. Potato is an economical food; it provides a source of energy to the human diet. Potato is a rich source of starch vitamins especially C and B and minerals [1,2]. It contains 20.6 per cent carbohydrate, 2.1per cent protein, 0.3 per cent fat, 1.1 per cent crude fiber and 0.9 per cent ash. Potato also contains a good amount of essential amino acid like Lucien, tryptophan and isoleucine etc.

Major portion of the requirement of vegetable is covered by potato crop and its production has been increasing every year. Most of the farmer likes to grow the potato crop because of its high profitability; as a result, the area of potato crop is increasing rapidly. The demand of potato is too much high than the other vegetable [3,4]. The role of potato is more significant in the total farm production of India. It gives more employment to the people in comparison to other vegetable crops and its export in big quantity also helps to increase national income.

Potato is also used for the production of dextrin and glucose. As a food product itself, potato is converted into dried products such 'potato chips', 'sliced or shredded potatoes'. In monetary terms potato has contributed considerably to the national economy. In Utter Pradesh potato is grown in 5.05 lakh ha. with a production of 11.1 million tones. It plays an important role in the state's economy and wellbeing of the farmers. Although potato productivity in the state ranks 3rd next to Gujrat and West Bengal, there is still a wide gap between the actual (21-27 t/ha.) and potential yields (40-45 t/ha.).

In Azamgarh district of eastern Uttar Pradesh potato occupies an area of 4744 hectares and its productivity was 298.62 q/ha. The total production was 47122 milliontonnes. (District statistical bulletin 20014-15).

2. METHODOLOGY

This section deals with method and materials of the study. The method of data collection and techniques used for analysis are the major parts of methodology. Its conceptual description is clearly mentioned below.

2.1 Sampling Design

The purposive cum Random sampling design was used for the selection of district, Block, Villages and Respondents. Azamgarh district of Uttar Pradesh was selected purposively in order to avoid operational inconvenience of investigator. Out of 22 blocks of selected district, Pawai block was selected randomly for the study. A list of all villages of selected block was prepared separately along with their area under potato cultivation. Five villages: Saraipul, Khairuddinpur, Bagbahar, Dhudhuri and Bhukhali were selected randomly. The selection of respondent a separate lists of Potato growers of selected villages was prepared along with their size of holding and further it was grouped into three categories i.e. marginal farmer (below 1 ha), small farmer (1-2 ha), and medium farmer (2-4ha). Finally, 100 Potato growers were selected randomly in proportion to their number

of universe in each size groups. Primary data was collected through personal interview, pre structured and pre-tested schedule. Secondary data was taken from the official records available at block, tehsil, and district offices. The data were collected for the agricultural year 2016-17. The primary data were collected by survey method through personal interview on well-structured and pre tested schedule, while secondary data were collected from books, journals, report and records of the district and block headquarters.

2.2 Analysis of Data

Both the tabular and functional analysis was used.

2.2.1 Weighted average

Weighted Average was worked out for interpretation of data with the help of following formula.

$$\text{Weighted Avergae} = \frac{\sum W_i X_i}{\sum W_i}$$

Where,

X_i =variable
W_i =Weights of variable

2.2.2 Regression analysis

To study the resource use efficiency in Potato production, various forms of production function have been deals with. However, Cobb-Douglas production function was found most fit to the data.

2.2.3 Cobb Douglas production function

The mathematical form of Cobb Douglas production function is:

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}e^{\mu}$$

Where

Y= Per hectare output (Rs/ha)
X_1= Seed (Rs/ha)
X_2= Irrigation charge (Rs/ha)
X_3=Manure and fertilizers (Rs/ha)
X_4= Plant protection charges (Rs/ha)
X_5= Human labour Charge (Rs/ha)

b_i (i=1,2,3,4,5)=Elasticity coefficient of the respective input variables

e=Error term or disturbance term
μ=Random variables

2.2.4 Estimation of marginal value product

The marginal value product of inputs was estimated by following formula;

$$MVP\ (X_j) = \frac{b_j \bar{Y}}{\bar{X}_j}$$

Where,

b_j =Production elasticity with respect to X_j
Y=Geometric mean of the dependent variable (Y)
X_j=Geometric mean value of X_j independent variable
MVP_j=marginal value production J^{th} input
j=1, 2, 3, 4, 5, variable

2.3 Significance Tests of the Sample Regression Coefficients

Having estimated the elasticity coefficient, it is desirable to ascertain the reliability of these estimates. The most commonly used "t" test was applied to ascertain whether the sample production elasticity coefficient, b_j is significantly different from zero or not at some specified probability level.

$$'t'\,cal = \frac{bj}{S.E\ of\ bj}$$

If calculated 't' value is greater than table value of "t" at specified probability level at 'n-k-1' degree of freedom, b_j is said to be statistically and significantly different from zero 'k' is number of independent factors and 'n' is sample size.

$$F = \frac{\text{Regression mean square}}{\text{Error mean square}} = \frac{\left(SSR/K\right)}{\Sigma e^2/(n-k-1)}$$

M. V. P. of j^{th} input factor was tested using the following formula

$t=MVP_j/S.E.\ of\ MVP_{ji}$
S.E. of MVP_j= (Y/X) standard error of b_j

3. RESULTS AND DISCUSSION

3.1 Per Hectare Investment

The per hectare investment on farm assets on different size group of sample farms are presented in Table 1. It is depicted from the table that per hectare average investment on building was higher on marginal Farms.

(Rs.164928.90) followed by small farms (Rs. 88871.71) and medium farms (Rs.56132.14).Per hectare investment on implements and machinery (minor and major implements) were found to Rs. 54173.52, Rs. 41739.52 and Rs. 61118.45 on small, medium and marginal size group of farmers respectively. Per hectare investment on livestock came to Rs. 97479.48, Rs. 14941.17 and Rs. 8377.68 on marginal, small and medium size of farms respectively. The total average investment per hectare came to Rs. 268526.80 at marginal farms followed by small farms Rs. 157986.10 and medium farms Rs. 106249.30 respectively.

The per hectare average investment on over all farms came to Rs. 117849.06 for building Rs. 28247.27 for implement and machinery and Rs. 53049.96 for live stock.

It is concluded from the table that per hectare investment on building and live stock was higher on the marginal farms as compared other size group of farms. But in case of implement & machinery (minor and major implement) it was maximum on medium size of farms followed by small and marginal farms respectively. High investment on farms assets at marginal farms shows the more investment per unit area as marginal farmers are the owner of uneconomic holding.

3.2 Measure of Cost and Return of Potato Crop in Study Area

Per hectare costs and income from the cultivation of potato crop on different categories of farm were worked out and present in Table: 2 the per hectare cost "C_3" was worked to Rs.75886.53 on marginal, Rs. 79847.31 on small and Rs.80753.77 on medium farms with an overall average of Rs.78154.62 respectively. This was because of the fact that use of variable inputs and investment cost comparatively decreased with the increase in farm size.

Table 1. Per hectare investment on various assets on different size group of farms (Rs.)

S. N.	Particulars	Marginal	Small	Medium	Overall average
1.	Building	164928.90 (61.41)	88871.71 (56.25)	56132.14 (52.83)	117849.06 (59.17)
a.	Residential	157714.50 (58.73)	84580.81 (53.53)	53387.21 (50.24)	112510.45 (56.49)
b.	Cattle shed	7214.32 (2.68)	4290.57 (2.71)	2744.92 (2.58)	5338.47 (2.68)
2.	Machinery& implements	6118.45 (2.27)	54173.52 (34.29)	41739.52 (39.28)	28247.27 (14.18)
a.	Minor	414.49 (0.15)	207.80 (0.13)	105.70 (0.09)	283.53 (0.14)
b.	Major	5703.95 (2.12)	53965.72 (34.15)	41633.81 (39.18)	27963.54 (14.04)
3.	Live stock	97479.48 (36.30)	14941.17 (09.45)	8377.68 (7.88)	53049.96 (26.63)
a.	Drought animal	4965.75 (1.85)	858.68 (0.54)	509.23 (0.47)	2749.70 (1.38)
b.	Milch animal	92513.72 (34.45)	14082.48 (8.91)	7868.45 (7.40)	50300.25 (25.25)
Total		268526.80 (100)	157986.10 (100)	106249.30 (100)	199146.18 (100)

Note: Figures in parentheses indicate percentage to the total

Table 2. Costs and income measures of potato crop in the study area. (Rs./ha.)

S.N.	Particulars	Marginal	Small	Medium	Overall average
1.	Cost A1/A2	47430.81	52871.17	56464.20	51086.19
2.	Cost B1	48078.35	53576.47	57190.30	51768.55
3.	Cost B2	54078.35	59576.47	63190.30	57768.55
4.	Cost C1	62987.75	66588.47	67412.52	65049.66
5.	Cost C2	68987.75	72588.47	73412.52	71049.66
6.	Cost C3	75886.53	79847.31	80753.77	78154.62
7.	Gross income	125325.00	122750.00	120755.00	123527.20
8.	Net income	49438.42	42902.69	40001.23	45372.50
9.	Family labour income	71246.65	63173.53	57564.70	65758.60
10.	Farm business income	77894.19	69878.83	64290.80	72440.96
11.	Yield (q.)	250.65	245.50	241.51	247.05
12.	Input- output ratio				
a.	On the basis of cost A1/A2 basis	1:2.64	1:2.32	1:2.13	1:2.42
b.	On the basis of cost B1	1:2.60	1:2.29	1:2.11	1:2.39
c.	On the basis of cost B2	1:2.31	1:2.06	1:1.91	1:2.14
d.	On the basis of cost C1	1:1.98	1:1.84	1:1.79	1:1.89
e.	On the basis of cost C2	1:1.81	1:1.69	1:1.64	1:1.73
f.	On the basis of cost c3	1:1.65	1:1.53	1:1.49	1:1.57

Note: Figures in parentheses indicate percentage to the total

Per hectare gross income came to Rs. 123527.20 on overall average of farms. Per hectare gross income was maximum on small farms that was Rs. 125325.00 followed medium and marginal size group of farms i.e. Rs.122750.00 and Rs. 120750.00 respectively. On an overall average net income, family labour income and farm business income were worked out to Rs.45372.50, Rs.65758.60 and Rs.72440.40 per ha respectively.

Output-input ratio on marginal, small and medium farms was 1.65, 1.53, and 1.49 on cost C_3. In respect of overall average of farm, input-output ratio were 2.42, 2.39, 2.14, 1.89, 1.73 and 1.57 on basis of cost $A_{1/}A_2$, B_1, B_2, C_1, C_2 and cost C_3 respectively. It may be concluded that output input ratio had the positive relationship with size of farms.

3.3 Resource Use Efficiency

The production function analysis was carried out to determine the efficiency of various resources (seed, irrigation, manure & fertilizer, plant protection and human labour) used in the production of potato. Cobb-Douglas production function was found best fit to the data, and applied for the analysis.

3.3.1 Elasticity of production

The estimated value of elasticity of production, standard error, co efficient of multiple determinations (R^2) and returns to scale for potato production by different size group of farms are given in Table 3. It is revealed from the Table that co efficient of multiple determinations (R^2) of marginal, small and medium size groups farms were 0.95981, 0.92027 and 0.94132 respectively. The co efficient of multiple determination of marginal, small and medium size group of farms of all four independent variables viz. Seed, manure & fertilizer, irrigation and human labour indicate 95.98, 94.13, and 92.02 per cent variation in dependent variable respectively.

Out of four independent variables seed and manure & fertilizer were found statistically significant at 1% level of probability in case of marginal size group of farms. In case of small and medium size group of farms seed had significant relationship at 5% level of probability and manure and fertilizer was significantly associated with yield at 1 percent probability level.

Returns to scale in case of marginal, small and medium size group of farms were 0.93583, 0.91040 and 0.903033 respectively. Returns to scale in all three categories of the farms were found less than unity. It indicates the production of potato is characterized by decreasing returns to scale on the each farm situation. It is therefore inferred that increasing all the factors by 1% simultaneously results in increase of the return by less than one per cent.

Table 3. Resource use efficiency in potato on different size group of sample farms

Size group of farms	Production elasticity					Sum of elasticities return to scale	R^2
	(X_1)	(X_2)	(X_3)	(X_4)	(X_5)		
Marginal	0.128557 (0.53795)	0.22803** (0.05034)	0.06743 (0.0802)	0.21052** (0.07166)	0.301281** (0.04150)	0.93583	0.95981
Small	0.09375 (0.15477)	0.24568** (0.06922)	0.02432 (0.11534)	0.24160 (0.143854)	0.306148** (0.06863)	0.91040	0.92027
Medium	0.10538 (0.14175)	0.20099** (0.05128)	0.079442 (0.12198)	0.221641 (0.21947)	0.295570** (0.07014)	0.903033	0.94132

*** Significant at 1percent level of probability.*

**Significant at 5 percent level of probability. X_1, X_2, X_3, X_4 and X_5 stand for seed, irrigation, manure and fertilizers, plant protection and human labour (Rs.) respectively*

Table 4. Marginal value productivity (MVP) of included factors in production process of potato

Size group of farms	Marginal value productivity of inputs				
	(X_1)	(X_2)	(X_3)	(X_4)	(X_5)
Marginal	2.24401	5.0559	11.63266	5.00655	24.74921
Small	1.65420	5.38720	4.18420	5.74426	25.05622
Medium	1.877619	4.35820	13.62666	5.259034	24.21540

X_1, X_2, X_3, X_4 and X_5 stand for, seed, irrigation, manure and fertilizers, plant protection and human labour (Rs.) respectively

3.4 Marginal Value Productivity

The marginal value productivity of different input factors are also presented in Table 4. It is depicted from the table that in case of all the three categories of farms, for all the four independent variable i.e. seed, manure & fertilizer, irrigation and human labour the marginal value of productivity to factor cost were found positive, indicating that there is future scope for increasing the investment on all these factor in each farm situation to realize more return than the existing use of input.

4. CONCLUSION

The overall average per hectare cost of cultivation came to Rs. 78154.62 It was higher on marginal farms (Rs.75886.53) followed by small (Rs.79847.31) and medium i.e. Rs. 80753.77 respectively. Rise in per hectare cost in marginal category of farms was noticed due to heavy expenditure on total human labour and other inputs. The total cost of cultivation was constituted by 33.74% of total human labour followed by seed 19.80, manure and fertilizer and rental value of land, irrigation, machinery charges chemicals & plant protection corresponding to 9.28, 7.67, 10.13, 7.14 and 0.68 per cent respectively. The per hectare gross income came to Rs. 123527.20 on overall average of farms. It was maximum on small farms than that of medium farms and marginal farms. On an overall average net income, family labour income and farm business income were worked out to Rs.45372.50, Rs.65758.60 and Rs.72440.96 respectively.

The efficiency of different resources used in potato cultivation at different size group of farms were also analyzed and found that the potato cultivation was characterized by decreasing returns to scale. Out of four independent variables i.e. seed, manure and fertilizer, irrigation and human labour, seed cost had the significant association with dependent variable at 1 per cent probability level in marginal category at 5 per cent level of probability in small and medium size group farms. Second most important factor of production i.e. x_2 was manure and fertilizer which had the significant association with yield at 1 per cent level of probability in all categories of farm size. Rest two variables did not show any relationship with dependent variable.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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