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DETERMINATION OF RESOURCE PRODUCTIVITY AND RESOURCE USE EFFICIENCY IN SUGARCANE (PLANTED AND RATOON) PRODUCTION IN MEERUT DISTRICT OF UTTAR PRADESH

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Abstract- This study was carried out in Daurala and Hastinapur block of district Meerut during 2009-11. The study was based on 80 farmers (33 small +27 medium +20 large) which were selected randomly from sugarcane (planted and ratoon) cropping system in both blocks. The regression coefficient of human labour, micro nutrients, irrigation and seed, TMH, Human labour, irrigation was found statistically positive for planted sugarcane on small and large farmers respectively while in ratoon sugarcane human labour, manure and fertilizer (small farm), micro nutrient (medium farm) and human labour, manure and fertilizer and micro nutrient (large farm) was found statistically positive. However, R^2 values were found 0.503, 0.162 and 0.092 on small, medium and large farms respectively for planted sugarcane while for ratoon sugarcane R^2 values were found to be 0.271, 0.147 and 0.279 on small, medium and large farms respectively. The MVPs of human labour was highest on large farms and MVPs of irrigation was observed to be diminishing with the increase in the size of farms indicating that more of irrigation is being used per unit of land as the size of farms increase.

Keywords- Sugarcane Planted and Ratoon, Marginal Value of Productivity and Resource Use Efficiency.

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Introduction

Sugarcane crop has assumed special importance in the world trade. Out of 115 countries in sugarcane cultivation, India ranks first in terms of area (5.05 million hectares), production (285.03 million tones), and its productivity (64.55 tonnes per hectare) in 2008-09. The production, productivity and area of sugarcane have increased from 57.05 million tonnes to 285.03 million tones, productivity from 33.4 tonnes to 64.55 tonnes and area by 1.707 million hectare to 4.42 million hectare during 1950-51 to 2008-09 [1]. This increase in sugarcane production in the country may be attributed was to the increase in area under sugarcane and changes in sugarcane utilization pattern from Gur and khandsari. Among different states of the country, Uttar Pradesh stands first place in area (20.08 lakhs hectare) and production(50 per cent) of sugarcane(2008-09), followed by Maharastra, Tamilnadu, Karnataka, Gujarat and Andhra Pradesh occupying second, third, fourth and fifth places, respectively but in terms of productivity it ranks seventh.(See Appendix-2). In Uttar Pradesh, Meerut district occupies an important place in terms of area and production of sugarcane cultivation. It was grown on area of 132.320 thousand hectare, with its production of 84.02 lakhs metric tonnes and productivity 69.54 tones/hectare (2007-08). Sugarcane is an intensive input utilization varies with the region to region and farmer to farmers. Input price is continuously increased. Besides that farmers are facing the problem of input availability at proper time, inadequate quantity and with time taking marketing process of the cane untimely and late payment of the produce by the sugar mills.

MaterialsandMethods

The present study was conducted in Meerut district of Western Uttar Pradesh which has important place in sugarcane cultivation in western Uttar Pradesh. Two blocks Daurala and Hastinapur were selected purposively on the basis of highest area under sugarcane. Random sampling technique was used to select villages and the sugarcane growers. From each block two villages were selected randomly. Therefore, a total four villages were selected for the selection of respondents from two blocks. A separate list of all the sugarcane growers of each selected village was prepared along with their cultivated area and categorized into small (below 2 hectare), medium (2-4 hectares) and large (above 4 hectares). From the list of the sugarcane grower, 20 growers from each village and a total of 80 sugarcane growers were selected in probability proportion to their population.

Estimation of resource use efficiency and marginal value productivity

(a) Estimation of resource use efficiency

The Cobb-Douglas production function was used to examine the resources use efficiency in the production of sugarcane[2 & 3]. Production function was fitted separately for all the three categories of farms for sugarcane planted and sugarcane ratoon crops. The Cobb-Douglas production function of the following form was fitted:

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6} \text{ --------- } X_n^{bn}e^u$$

Where:

Y = output (in quintels)

X_1= human labour, X_2= total machine hours, X_3 = seed, X_4 = manure and fertilizer,

X_5 = micro-nutrient, X_6 = no. of irrigation u=error term e=natural logarithm

b_1, b_2, b_3, b_4, b_5, b_6,……b_n are the partial regression coefficients (elasticity of production) of the explanatory variables.

(b) Estimation of marginal value productivity

MVPs gives the expected addition to the output caused by an addition of one unit of factor input while other inputs are held constant enables comparison of relative efficiency of resource use among various categories of farms. MVP of different resources were calculated by multiplying the marginal physical product of the i^{th} input by the unit price of the output. Mathematically it can be expressed as:

$$MVPx_i = b_i \frac{\bar{Y}_i}{\bar{X}_i} (P_y)$$

Where:

$MVPx_i$ =marginal physical product of i^{th} input

Y = Geometric mean of output

X_i = Geometric mean of i^{th} explanatory variables

b_i = Regression coefficient of i^{th} explanatory variables (i= 1, 2, 3, 4,5 ,6,----- n)

P_y= Price of output per unit (Rs.)

(c)Estimation of resource use efficiency

In order to examine the resource use efficiency, the marginal value products of resources were compared with their respective marginal factor cost. The input costs of different resources were worked out by taking per unit charges of the respective resources by following formula:

$$MIC_{xi} = P_{xi}$$

Where:

MIC_{xi}=marginal input cost of i^{th} input

Pxi = Factor price of i^{th} input

MVP/MVP >1 utilization of resources

MVP/MVP =1 optimal use of resources

MVP/MVP <1 excess use of resources

Result and discussion

Cobb-Douglas production function was used to identify the factors affecting the production of sugarcane (planted and ratoon) and to examine the resource use efficiency. The discussion of the results of this analysis is made in the following sub-sections.

Regression Coefficients and Coefficient of Multiple Determinations:

Sugarcane (planted)

[Table-1.0] shows the regression coefficient and coefficients of multiple determinations in the fitted production function for sugarcane (planted) in small, medium and large farms. Before fitting production function multicolinearity was determine by correlation matrix. Expenditure on plant protection measure and total human labour days were highly correlated with manure and fertilizer. Hence, in order to remove these variables were dropped in the production functions.

The regression coefficient of human labourday was found to be positive and statistically significant at 1 per cent level of significance on small and large farms. The regression coefficient of total machine hours was found to be negative for small farms and positive for on medium and large farms and statistically significant. The elasticity coefficient of expenditure on total machine hours (TMH) on medium and large farms was 0.061 and 0.48 which indicate that 1 per cent increase in TMH would increase the output by 0.06 and 0.48 per cent respectively same was reported by [4].

The elasticity coefficients of seed turned out to be positive in case of large farms and negative on small and medium farms. However, it was found to be statistically significant at 1 per cent level only in case of large farms indicating that 1 per cent increase in seed qtl./hect., keeping other variables constant would lead to an increase in the yield of sugarcane by 0.050 per cent. The regression coefficient of expenditure on manure and fertilizer was found to be positive and found statistically significant ay 1 per cent level on large farms and negative insignificant on small and medium farms indicating that 1 percent increase in expenditure on manure and fertilizer would bring out an increase in the output was 0.113 per cent on large farms and in case of small and medium increase in 1 per cent on expenditure the output decrease by 1.33 per cent to -0.273 per cent respectively.

The regression coefficient of expenditure on micro-nutrient (Zn) was found positive and statistically significant at 1 per cent level in case of small farms and negative and insignificant in case of medium and large farms, indicating that 1 per cent increase in expenditure on micro nutrient would increase the output by 0.001 per cent. The coefficient of expenditure on irrigation was observed to be negative in the case of medium farms and positive in case of small and large farms, and was statistically significant at 1 per cent level. The negative regression coefficients for, medium farms indicates, that the irrigation is being used in excess on these farms. While on small and large farms the regression coefficient indicates that 1 per cent increase in expenditure on irrigation would lead to an increase the output to the extent of 0.202 and 0.009 per cent in the respective category same trend was reported by Gangwar [5]. The value of the coefficient of multiple determinations (R square) on small, medium and large farms was 0.503, 0.162 and 0.092 respectively. The value of R square from the fitted production function shows that 50.3 per cent, 16.20 per cent, and 9.20 per cent of variation in the total output, respectively on these size of farms was explained by the variables included in the equation, while rest of the variation in the yields was explained by those factors which had not been taken into consideration and/or could be accountable to dummy variable.

Table-1.0 *Regression Coefficient and Coefficient of Multiple Determination (R square) for Sugarcane Planted*

Farms	Intercepts	Human labour (days)	Total machine hrs	Seed (qtl./ha)	Manu. Andfer (kg/hect.)	Micro-nutrient (kg/hect)	No. of Irri.	R^2
Small	2.852 (0.624)	0.358*** (0.145)	-0.798 (0.214)	-0.300 (0.256)	-0.133 (0.135)	0.001*** (0.002)	0.202*** (0.064)	0.503
Medium	3.851 (0.914)	-0.003 (0.198)	0.061*** (0.154)	-0.057 (0.358)	-0.273 (0.175)	-0.002 (0.0036)	-0.024 (0.209)	0.162
Large	2.019* (1.044)	0.038*** (0.091)	0.048*** (0.127)	0.050*** (0.230)	0.133*** (0.162)	-0.0007 (0.007)	0.009*** (0.087)	0.092

(*significant at 10 per cent level, ** significant at 5 per cent level, *** significant at 1 per cent level)

Sugarcane (ratoon)

The regression coefficients for the fitted production function for sugarcane (ratoon) along with the coefficients of multiple determinations are given in [Table-1.1] in the case of all categories of farms. In ratoon crop the use of seed and TMH (total machine hours) is zero so these are dropped from the fitted production function from respective group of farms. The regression coefficient on expenditure on human labour was found to be positive and statistically significant at 1 per cent level in the small and large farms. Which indicate that would increase in 1 per cent expenditure on human labour would increase the output by 0.054 and 0.097 per cent respectively. The regression coefficient of expenditure on manure and fertilizer was found to be positive as well as statistically significant at 1 per cent level in case of small and large farms. The value of coefficient explained that the yield would increase by 0.424 and 0.097 if we increase the input by 1 per cent in the respective category. The coefficient of this resource was found to be negative on medium farms. The elasticity coefficient of expenditure on irrigation was positive and statistically significant at 1 per cent level in the case of small farms, indicating that 1 per cent increase in expenditure on irrigation would bring an increase of 0.097 per cent in the production. The regression coefficient was negative -0.125 and -0.139 on medium and large farms respectively. The regression coefficient of expenditure on micro-nutrient turned out be negative in case of small farms and positive and statistically

significant at 1 per cent level in case of medium and large farms, indicating that 1 per cent increase the expenditure on micro nutrient (Zn) 0.001 and 0.002 per cent increase in output of sugarcane ratoon at geometric mean level.

The value of the coefficient of multiple determinations (R square) on small, medium and large farms was 0.271, 0.147 and 0.279 respectively. Which means that 27.10 per cent, 14.70 per cent, and 27.90 per cent variation in the total value of output was explained by the independent variables considered in the function, respectively? Whereas rest of the variation in the total output would be attributed to factors exogenous to the function

Table-1.1 *Regression Coefficient and Coefficient of Multiple Determinations (R square) for Sugarcane Ratoon*

Farms	Intercepts	Human labour (days)	Manure and fertilizer(value)	Micro-nutrient (kg/hect.)	No. of irrigation	R^2
Small	1.198*** (0.833)	0.054*** (0.061)	0.424*** (0.236)	-0.004 (0.002)	0.097*** (0.075)	0.271
Medium	3.319 (0.537)	-0.070 (0.093)	-0.033 (0.161)	0.001*** (0.001)	-0.125 (0.102)	0.147
Large	2.576* (1.515)	0.097*** (0.060)	0.073*** (0.446)	0.002*** (0.001)	-0.139 (0.139)	0.279

(*significant at 10 per cent level, ** significant at 5 per cent level, *** significant at 1 per cent level)

Marginal value productivity of various resources

The most profitable farm organization results from adding each resource until the added gross income covers its added cost. Thus, when the added return was less than the added cost of resources, too much if resources was being used and when added return is greater than the added cost the resource use is less than the optimum level.

In order to examine the resource use efficiency in crop production, the difference between marginal value productivity and their factor input price, i.e. marginal factor cost, were worked out for each of the resource considered in the production function. The economic interpretation of marginal value productivity has been made with respect to only those variables whose elasticity coefficients were found to be statistically significant.

Sugarcane (planted)

The marginal value productivity (MVPs) of different resource used in sugarcane (planted) for all size group is given in the [Table-1.3], the examination of the table indicates that the marginal value productivity of human labour (days), micro-nutrient (kg/hect.) and irrigation (no.) was 1.039, 0.042 and 13.48 respectively in case of small farms which indicates the increase in one unit human labour, micronutrient, and irrigation, at their geometric mean level, would increase the output by 1.039, 0.042 and 13.48 quintal respectively. The high marginal value productivity of irrigation on small farms is due to low level use of the resource. While over utilization of the TMH, seed, manure and fertilizer was observed. Perusal of table 5.10 further indicates that the marginal value productivity (MVPs) of utilization of TMH was 1.52 of medium farms. Which indicates that increase one unit on TMH at their geometric mean level would increase the output by 1.52. The MVP of human labour, seed, manure and fertilizer, micro-nutrient and number of irrigation indicate that one unit utilization of these input would contribute negatively to output by 0.009, 0.614, 0.018, 0.07 and 1.14 quintals respectively same study was done earlier by Malik and Singh [6].

The marginal value productivity (MVPs) of human labour, TMH, seed, manure and fertilizer, and no. of irrigation, turned out to be 0127, 1.41, 0.605, 0.009 and 0.627 respectively. In case of large farms, micro-nutrient indicate that one unit increase on it decrease the output unit by 0.024.

Moreover, the inter-farm size group comparison of the marginal value productivity (MVPs) of the resources whose coefficient were statistically significant on more than one size group of farms shows that the marginal value productivity (MVPs) of irrigation was higher on small farms as compared to large farms which reveals the fact that large farms were relatively using more no. of irrigation. Further, the marginal value productivity (MVPs) of TMH has observed to be highest on medium farms (1.529) and lowest on small farms (.-20.6) in case of large farms it was 1.413 same was done by Asmatoddin *et al.* [7].

Table-1.3 *Marginal Value Productivity (M V P) of the Resources for Sugarcane Planted*

Sl. No	Particulars	Resources					
		Human labour (days)	Total machine hrs.	Seed (qtl/hect.)	M. &F. (kg/hect.)	M.N. (kg/hect)	No. of irri.
Small							
A	MVPs	1.039	-20.5	-3.19	-0.010	0.042	13.68
B	Price of input	150	275	205.0	13.17	70.0	267.0
C	S.E. of M.V.P	0.420	5.498	2.721	0.010	0.084	4.27
D	Calculated 't' value	2.47*	-0.372	-1.72	-0.984	0.387***	3.132
Medium							
A	MVPs	-0.009	1.529	-0.614	-0.018	0.076	-1.417
B	Price of input	150	275	205.0	13.17	70.0	267.0
C	S.E. of M.V.P	0.609	3.936	3.85	0.01	0.138	12.34
D	Calculated 't' value	-0.016	0.395***	-0.160	-1.55	-0.688	-0.117
Large							
A	MVPs	0.127	1.413	0.605	0.009	-0.024	0.625
B	Price of input	150	275	205.0	13.17	70.0	267.0
C	S.E. of M.V.P	0.304	3.74	2.78	0.011	0.255	6.06
D	Calculated 't' value	0.417***	0.384***	0.217***	0.824***	-0.516	0.11***

(*significant at 10 per cent level, ** significant at 5 per cent level, *** significant at 1 per cent level)

Sugarcane (ratoon)

The marginal value products (MVPs) of different resources used in sugarcane (Ratoon) for all categories group of farms are given in [Table-1.4]. In case of small farms, the marginal value productivity of human labour, manure and fertilizer and irrigation was estimated as 0.207,.0.113 and 7.43 respectively. Which indicate that one unit increase of these resources would increase the output unit was 0.207, 0.113 and 7.43 respectively.

In case of medium farmers the marginal value productivity (MVPs) of human labour, no. of irrigation and manure and fertilizer were found -0.20, -0.081 and -8.62 respectively, indicating their by that one unit increase these resources would decrease the output unit of the crop by -0.20,-0.081 and -8.62 respectively.

In case of large farms, the marginal value productivity (MVPs) of human labour manure and fertilizer, micro-nutrient and irrigation was found to be 0.39, 0.017, 0.96 and -8.48 respectively. This indicates that utilization of one unit increase in the human labour, manure and fertilizer, micro-nutrient and irrigation would increase the gross return by 0.39, 0.017 and 0.096, and -8.48 quintals respectively same reported by Singh*et al.* [8].

Further, the comparison of the marginal value productivity (MVPs) of various resources having significant bearing on the output across the farms size groups levels that the marginal value productivity (MVPs) of a unit use of human labour was highest on large farms and lowest on medium farms, and the small farms stand in between these two in this regard. The marginal value productivity (MVPs) of irrigation was observed to be diminishing with the increase in the size of farms indicating that more no. of irrigation is being used per unit of land as the size of farms increase. Finally, the marginal value productivity (MVPs) of human labour was found considerably high on large farms as compared to the small and medium farms.

Table-1.4 *Marginal Value Productivity (M V P) of the Resources for Sugarcane Ratoon*

Sl. No	Particulars	Resources			
		Human labour (days)	M. &F. (kg/hect)	M.N. (kg/hect)	No. of irrigation
		1. Small			
A	MVPs	0.207	0.113	-0.243	7.43
B	Price of input	150	13.17	70.0	267.0
C	S.E. of M.V.P	0.233	0.063	0.121	5.75
D	Calculated 't' value	-0.896	1.796**	-1.72	1.29***
		2. Medium			
A	MVPs	-0.206	-0.081	0.069	-8.62
B	Price of input	150	13.17	70.0	267.0
C	S.E. of M.V.P	0.274	0.039	0.05	7.06
D	Calculated 't' value	-0.762	-0.205	0.62***	-1.22
		3. Large			
A	MVPs	0.393	0.017	0.096	-8.48
B	Price of input	150	13.17	70.0	267.0
C	S.E. of M.V.P	0.243	0.105	0.048	8.48
D	Calculated 't' value	1.606***	0.163***	1.58***	-0.98

(*significant at 10 per cent level,** significant at 5 per cent level ,*** significant at 1 per cent level)

Conclusion

In case of sugarcane (planted), the coefficient of human labour, micro-nutrient, irrigation was found to be positive and statistically significant at 1% level on small size group of farms. The coefficient of TMH was found to be positive and statistically significant but utilization of human labour, Seed, micro-nutrient and irrigation turned out to be negative on medium size farms. The coefficient of human labour, seed, TMH, and irrigation was found positive and statistically significant at 1 per cent level on large farms. The R^2 values were found 0.503, 0.162 and 0.092 on small, medium and large farms respectively and 0.503 in case of small indicated that the production function best fitted production function. The interfarm size group comparison of the marginal value productivity (MVPs) of the resources, whose coefficient were statistically significant on more than one size group of farms shows that the marginal value productivity (MVPs) of unit on irrigation (13.48) is higher on small farms as compared to large farms which reveals the fact that large farms are relatively using more no. of irrigation. Further, the marginal value productivity (MVPs) of unit use of TMH was observed to be highest on medium farms (1.529) and lowest on large farms (1.41) and in case of small farms it was Rs.-20.5.

In case of sugarcane (ratoon) regression coefficient of human labour, manure and fertilizer and irrigation was positive and statistically significant at 1 per cent level and utilization of micro-nutrient was turned out to be negative on small size of farms. On medium size farms utilization of micro-nutrient was found positive and statistically significant. The utilization of human labour, manure and fertilizer and micro-nutrient was positive and statistically significant at 1% level but utilization of irrigation was negative on the large farms. The R^2 values was found to be 0.271, 0.147 and 0.279 on small, medium and large farms respectively and 0.279 in case of large indicated that the production function best fitted production function. Within comparison of the marginal value productivity (MVPs) of various resources having significant bearing on the output across the farms size groups levels that the marginal value productivity (MVPs) of a unit spent on human labour was highest on large farms and lowest on medium farms, and the small farms stands in between these two in this regard. The marginal value productivity (MVPs) of irrigation was observed to be diminishing with the increase in the size of farms indicating that more of irrigation is being used per unit of land as the size of farms increase. Finally, the marginal value productivity (MVPs) of human labour was found considerably high on large farms as compared to the small and medium farms.

Conflict of Interest: None declared

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