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Resource use efficiency for sugarcane production in Kolhapur district of Maharashtra

A. B. BINDAGE[1] AND R. R. PATEL[2]

Department of Agril. Economics, C. P. College of Agriculture,
S. D. Agricultural University, Sardarkrushinagar - 385 506 (Gujarat)

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ABSTRACT

Farm credit is a strategic input. Kisan Credit Card (KCC) aims at providing timely and adequate credit to the farmers in a cost effective and flexible manner. In addition to credit for crop production, the scheme provides credit for ancillary activities. The scheme is being implemented in the country by all the banks from the year 1998-99. The present study was undertaken with an objective to analyse the resource use efficiency in production of Sugarcane. The study used primary data on all variables like labour, seeds, fertilizer, irrigation ,bullock, machinery and insecticide from randomly selected 60 KCC and 60 non-KCC sample farmers. The data pertained to the crop year 2010-11. The return to scale for KCC and non KCC are 0.941953 and 0.938838, respectively.

Key words : Resources, marginal value product, resource use efficiency, return to scale.

Kisan Credit Card scheme is a landmark in the history of rural credit in India. The mechanism of credit cards has been one of the key products developed to expand the outreach of banks and simplify the credit delivery system. The announcement relating to the introduction of Kisan Credit Card scheme was made by the Union Finance Minister during the budget speech for the year 1998-99. NABARD formulated a Kisan Credit Card scheme for uniform adoption by the banks so that the farmers may use the card to readily purchase agriculture inputs such as seeds, fertilizers, pesticides etc. and draw cash for their production needs. The model scheme was circulated to Commercial Banks, Co-operative Banks and Regional Rural Banks in August 1998. Now, about ten years are over since the introduction of this innovative scheme. It gives the adequate and timely credit for purchasing the all resources needed for the cultivation. The proper use of resources results in the better production of crop which can be studied by resource use efficiency (Anjanikumar *et al.*, 2007). So present study is conducted on the objective of resource use efficiency in production of Sugarcane in study area.

[1] P.G. Student, [2] Assistant Research Scientist (Agril. Economics), AICRP on OFR, Jagudan.

MATERIALS AND METHODS

The Kolhapur district of Maharashtra was purposively selected as the number of KCCs issued in this district was high. The primary data on all costs incurred on labour, seeds, fertilizer, irrigation, bullock, machinery and insecticide. For selection of sample farmers, two branches in Kolhapur district which has made a good progress in implementing Kisan Credit Card scheme was selected. From each branch 10 small farmers (less than 2 ha), 10 medium farmers (2.01 ha to 4 ha) and 10 large farmers (above 4 ha) were randomly selected. The corresponding numbers of farmer borrowers in each of these categories who are not KCC holders were also selected for comparison purpose. Thus, study was based on the information obtained from 60 KCC and 60 non-KCC borrowers spread across one district in Maharashtra. Primary data relating to cost incurred on labour, seeds (cane sets), fertilizer, irrigation, bullock, machinery and insecticide is taken into account for calculating resource use efficiency. Similar type of methodologies was used by Sajane (2011).

Production function analysis

The Cobb-Douglas (CD) production function was used

to study the influence of inputs on yield in the study area. The production function of the following type was specified in the present study.

$$Y = A X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} e^u$$

Where,

Y : Gross income (₹/ha)
X_1 : Expenditure on Seeds (₹/ ha)
X_2 : Expenditure on Fertilizers and Manures (₹/ha)
X_3 : Expenditure on Irrigation (₹/ha)
X_4 : Expenditure on Labour (₹/ha)
A : Constant
b_i : Production elasicities
u : Random error.

The above function was converted into the linear form through logarithmic transformation of all variables and is written as

$$\log Y = \log A + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + \log u.$$

The marginal value products for each input was calculated at the geometric mean levels of the respective resources by using formula,

Marginal value product of $X_i = b_i \frac{\overline{Y}}{\overline{X}_i}$

Where,

$\overline{Y}$ = geometric mean of gross income
$\overline{X}_i$ = geometric mean of i^{th} resource
b_i = production elasticity of i^{th} resource

The marginal value product was compared with the respective marginal factor cost to arrive at resource use efficiency.

RESULTS AND DISCUSSION

It is difficult to estimate efficiency of farms without knowledge of the condition under which the production is performed. Comparison of output in relation to level of input used will reveal the true picture of efficiency. The studies on efficiency have shown that it is possible to raise the productivity of crop without actually raising the input application. The corrective steps undertaken to mitigate the reasons for low efficiency of the farmers will help in long run to achieve higher productivity. As such the production function approach was used to find out the productivity of resources used for Sugarcane production. For this purpose, the cob-Douglas form of production was estimated taking gross income as dependent variable. Whereas, labour, bullock labour, machinery, cost of fertilizers, manures, seed (cane sets) , irrigation, and insecticide/pesticides as independent variables. The productivity of resources used for Sugarcane production obtained by the production (intercept, co-efficient of multiple determination and returns to scale) for sample farms are depicted in Table 1 and Table 2

It is seen from the Table 1 that in case of KCC holder the elasticity of the production was positive as well as negative. It is inferred that among the explanatory variables labour and seed was positive and significant at 5% level of significance. while in case of irrigation, and machinery charges elasticity were negative with 5% level of significance and bullock charges was highly significant at 1% level of significance with negative elasticity. This negative elasticity at 5% level of significance shows negative impact on gross income of Sugarcane. The value of elasticity ranges from -0.10909 (Bullock labour) to 9.1322 (fertilizer and manure). The cost of labour, seed, fertilizer and manure and insecticide were 0.06042, 0.04820, 9.1322 and 1.9852 adding to the level of gross income by 2.01248 per cent ,respectively. The cost of irrigation (X_4) (-8.4702), bullock (X_5)(-0.10909) and machinery (X_6) (-1.70482) shows negative elasticity. It was statistically non significant. The elasticity of irrigation, bullock and machinery did not contribute to gross income as they are statistically non significant, indicating that at the current level they were applied at optimum level. The value of coefficient of determination (R^2) was 0.9051 indicating that 90 per cent of total variations in the gross income from Sugarcane cultivation was explained by independent variables in the function. The sum of regression coefficient (Σbi's) was 0.9419 indicating increasing return to scale. Similar observation was also made by Rangrajan (1994). Looking to the elasticity, coefficient of multiple determination and return to scale it can be concluded that gross income from Sugarcane crop increased proportionality with an increase in variables factors. Similar findings were reoported by Bista (2012).

In case of non KCC it can be seen from the Table 2 that elasticity of production was positive as well as negative. It is inferred that among the explanatory variables, labour, fertilizer and manure were positive elasticity of production and highly significant at 1 % level of significance while, in case of labour charges was positive and 5 % level of significance while showing positive impact on gross income of Sugarcane. The cost of bullock, insecticide shows negative impact on gross income. The value of

Table 1 Cobb-Douglas production function estimates for Sugarcane for with KCC farmers

Variables	With KCC		
	Production Elasticity	P value	Standard Error
X_1 Cost of Labour (₹)	0.060426*	0.0483	0.21941
X_2 Cost of Seeds(₹)	0.048201*	0.0359	0.15777
X_3 Cost of Fertilizer and manure (₹)	9.1322	0.139954	6.092742
X_4 Cost of Irrigation (₹)	-8.47023*	0.0410	12.17399
X_5 Cost of Bullock (₹)	-0.10909**	0.00894	0.166058
X_6 Cost of Machinery (₹)	-1.70482	0.460771	2.29922
X_7 Cost of Insecticide (₹)	1.985246	0.836365	9.663588
Intercept	2.012481	0.721852	5.622702
R^2 Coeff. of multiple determination	0.905121		
Multiple R 0.951378			
Adjusted R	0.892348		
Σbi Return to scale	0.941953		

*denotes significance at 5% , ** denotes significance at1%

elasticity ranges from -0.00501(bullock) to 3.5127 9(irrigation). The cost of labour, seeds, fertilizer, irrigation, bullock, machinery and insecticide are 0.0123, 0.003785, 0.1042,3.5175, -0.00501,0.8145 and -3.5037, respectively. The cost of bullock (X_4) (-0.00501) and cost of insecticide(X_7)(-3.50378) shows negative elasticity. It was statistically non significant indicating that at the current level they were applied at optimum level. The value of coefficient of determination (R^2) was 0.9586 indicating that 95 per cent of total variations in the gross income from sugarcane cultivation were explained by the independent variable included in the function. The sum of regression coefficient (Σ bi's) was 0.9388 indicating

Table 2 Cobb-Douglas production function estimates for Sugarcane for without KCC farmers

Variables	Without KCC		
	Production Elasticity	P value	Standard Error
X_1 Cost of Labour (₹)	0.012312*	0.04644	0.639268
X_2 Cost of Seeds (₹)	0.003785	0.951875	0.062408
X_3 Cost of Fertilizer and manure (₹)	0.104218**	0.00434	0.332407
X_4 Cost of Irrigation (₹)	3.512753	0.610121	6.847409
X_5 Cost of Bullock (₹)	-0.00501	0.695332	0.012732
X_6 Cost of Machinery (₹)	0.814561**	0.00531	6.15076
X_7 Cost of Insecticide (₹)	-3.50378	0.401459	4.141847
Intercept	0.26598	0.950969	4.304712
R^2 Coeff. of multiple determination	0.958616		
Multiple R	0.979089		
Adjusted R	0.953045		
Σbi Return to scale	0.938838		

*denotes significance at 5%, ** denotes significance at1%

Table 3 Marginal value product, factor cost and their ratio of KCC holder

Variables	Marginal value Product(MVP)	Factor cost	Ratio of MVP to Factor Cost
X_1 Cost of Labour (₹)	0.007793	1	1: 0.007793
X_2 Cost of Seeds (₹)	0.03599	1	1: 0.03599
X_3 Cost of Fertilizer/Manure (₹)	9.55598	1	1: 9.55598
X_4 Cost of Irrigation (₹)	8.1931	1	1: 8.1931
X_5 Cost of Bullock Labour (₹)	-0.23442	1	1: -0.23442
X_6 Cost of Machinery (₹)	2.49183	1	1: 2.49183
X_7 Cost of Insecticide/ pesticide (₹)	3.968	1	1: 3.968

increasing return to scale. Similar observation was also made by Rangrajan (1994). It can be concluded that gross income from Sugarcane crop increased proportionately with an increase in the variable factor. The result of the study of is in colloboration with the earlier findings of Sajane (2011).

Marginal value product for KCC

The marginal value product (MVP) of particular resource represents the expected addition of one unit of resource, while other inputs are held constant. For evaluating the efficiency of resources use, the ratio of marginal value products for different factors to their respective factors costs was estimated for Sugarcane. Allocative efficiency (MVP/FC ratio) more than 1 (one) indicates under utilization of particular resource and scope to increase its application till the ratio reaches to one. The estimated marginal value products (MVP), factor costs and their ratio for Sugarcane in case of KCC holder were computed and the results are given in the Table 3.

The data furnished in Table 3 reveal that the MVP/FC ratio was more than one and it was highest in case of fertilizer and manure (9.55598), irrigation (8.1931) and insecticide and pesticide (3.968).This indicates that an addition of one rupee in fertilizer and manure would yield return of ₹ 9.55598 through the elasticity of fertilizer was very low and non significant; the MVP - factor Cost Ratio was high. This was due to the lack of knowledge and importance about application of these inputs among Sugarcane cultivators. The cost of irrigation has an MVP-factor cost ratio of 8.1931indicates that farmers would get net gain of ₹ 8.193 if they apply additional unit of irrigation worth ₹.1. The production function analysis gave statistically non-significant and negative value to the cost of bullock labour. But the MVP- factor Cost ratio indicated that additional expenditure of one rupee on bullock labour would reduce revenue from Sugarcane by ₹ 0.234. Hence, to be economically efficient farmers have to reduce the expenditure on bullock labour.

The data furnished in Table 4 reveal that the MVP/FC ratio was more than one and it was highest in case of fertilizer and manure (3.0049), irrigation (9.7523) and machinery (3.304).This indicates that an addition of one rupee in fertilizer and manure would yield return of ₹ 3.0049 through the elasticity of fertilizer and manure was very low and non significant; the MVP

Table 4 Marginal value product, factor cost and their ratio of non KCC holder

Variables	Marginal value Product(MVP)	Factor cost	Ratio of MVP to Factor Cost
X_1 Cost of Labour (₹)	0.02217	1	1: 02217
X_2 Cost of Seeds (₹)	0.02418	1	1:0.02418
X_3 Cost of Fertilizer/Manure (₹)	3.0049	1	1:3.0049
X_4 Cost of Irrigation (₹)	9.7523	1	1:9.7523
X_5 Cost of Bullock Labour (₹)	-0.000823	1	1:-0.000823
X_6 Cost of Machinery (₹)	3.304	1	1:3.304
X_7 Cost of Insecticide/ pesticide (₹)	-6.21867	1	1:-6.21867

- factor Cost Ratio was high. This was due to the knowledge and importance about application of these inputs among Sugarcane cultivators. The cost of irrigation has an MVP- factor cost ratio of 9.7523indicates that farmers would get net gain of ₹ 9.7523 if they apply additional unit of irrigation worth ₹ 1. The production function analysis gave statistically non- significant and negative value to the cost of bullock labour and insecticide. But the MVP- factor Cost ratio indicated that additional expenditure of one rupee on bullock labour and insecticide and pesticide would reduce revenue from Sugarcane by -0.000823 and-6.21867.Hence, to be economically efficient farmers have to reduce the expenditure on bullock labour and insecticide and pesticide.

The negative ratio of bullock labour (X_5) and insecticide and pesticide(X_7) indicates excessive use of this resource. Sugarcane growers can increase gross returns by reducing bullock labour cost. The ratio of inputs such as irrigation and machinery explained utilization of inputs. As such gross returns from Sugarcane cultivation can be increased using more of these inputs.

CONCLUSION

In case of KCC insecticide, fertilizers and manures were having positive elasticity co-efficient in the sugarcane but in case of bullock labour the co-efficient were negative. In non KCC category, elasticity co-efficient of irrigation, Machinery, fertilizers and manures were positive but for insecticide it was negative. From Table 1 & 2 it can be observed that the return to scale is maximum for KCC holder farmers than non KCC farmers. Means the resources were efficiently used by KCC holder farmer than Non KCC farmers The results were more accorded to the resum of work done by Patel (1999).

Marginal value product to marginal factor cost

In case of KCC the labour and seeds were used below optimum level and bullock labour used above optimum level. In case of non KCC the seeds and labour used below optimum level and bullock labour used at above optimum level.

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