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Impact of Credits on cost, return, profitability and marginal value productivity of sugarcane cultivation in Bahraich District of Uttar Pradesh

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Abstract
The study was conducted in Bahraich District of Uttar Pradesh to comprehend the relationship between cost and return, impact of input costs on sugarcane yield, returns and marginal value productivity. The study is entirely based on primary data gathered from 200 farmers (borrower and non-borrower) and for objectives of the study using the statistical methods such as CACP cost concept and Cobb-Douglas production function. The result reveled that the overall average cost of sugarcane cultivation on borrower sample farms was higher than the non-borrower sample farms. It is showed that the finance helped the borrower farmers to apply the scientific input factor and technologies which ultimately raised the cost of cultivation, increase gross income, net income and B:C ratio were proportionately higher on borrower farms than non-borrower sample farms. And functional analysis shows that the value of sum of elasticity, R^2 and marginal value productivity were higher on borrower sample farms than non-borrowers. It was concluded that financial support from institutional financing agencies to the farmers are always supportive to improve the socio-economic condition of the farmers.

Highlights
1. The finance helped the borrower farmers to apply the scientific input factor and technologies.
2. The B:C ratio was observed to be highest on borrower and lowest on non-borrower sample farms.

The functional analysis, return to scale and marginal value of productivity were higher on borrower sample farms.

Keywords: B: C ratio, Credit, Cobb-Douglas function, cost, profitability, MVP, return

Introduction
Agriculture plays a vital role in Indian Economy. More than 60 percent of populations were dependent on agriculture as their main occupation (Sahu, 2018) [7]. Finance in agriculture is as important as other inputs being used in agricultural production. Technical inputs can be purchased and used by farmer only if he has money (funds). But his own money is always inadequate and he needs outside finance or credit. Agricultural finance capitalizes farmers to undertake new investments and/or adopt new technologies. The importance of agricultural credit is further reinforced by the unique role of Indian agriculture in the macroeconomic framework along with its significant role in poverty alleviation. Realizing the importance of agricultural credit in fostering agricultural growth and development, the emphasis on the institutional framework for agricultural credit is being emphasized since the beginning of planned development era in India (Mishra & Mohapatra, 2017) [5].

The procedures and amount of loans for various purposes have been standardized. Among the various purposes "Crop loan" (Short-term loan) has the major share. In addition, farmers get loans for the purchase of electric motor with pump, tractor and other machinery, digging wells or boring wells, installation of pipelines, drip irrigation, planting fruit orchards, purchase of dairy animals and feeds/fodder for them, poultry, sheep/goat keeping and for many other allied enterprises (Kalhon and Karam Singh, 1985) [4]. The modern agriculture has increased the use of inputs specially for seed, fertilizers, irrigational water, machineries and implements, which has increased demand for agricultural credit.

The adoption of modern technology, which is capital intensive, has commercialized agricultural production in India. Besides, the farmer's income is seasonal while his working expenses are spread over time. In addition, farmer's inadequate savings require the uses of more credit to meet the increasing capital requirements. Furthermore, credit is a unique resource, since it provides the opportunity to use additional inputs and capital items now and to pay for them from future earnings.

Methodology

The study was based on primary data; the primary data were collected from the randomly selected 200 farmers (borrowers and non-borrowers) sample farms of data collected through personal interview by using pre-structured schedule in Bahraich district of Uttar Pradesh related to the economic profile of the farmers. To achieved the result of objective, worked out the cost and return for sugarcane cultivation on borrowers and non-borrowers sample farms based on CACP cost concept by using various costs such as cost A_1, A_2, B_1, B_2, C_1, C_2 and C_3. In order to determine the B: C ratio and the Cobb-Douglas production function were in following form:

CACP Cost Concepts

Cost A_1: All actual expenses incurred in the banana cultivation.

Cost A_2: Cost A_1 + rent paid for leased inland.

Cost B_1: Cost A + interest on value of owned fixed capital (excluding land).

Cost B_2: Cost B_1 + rental value of owned land.

Cost C_1: Cost B_1 + imputed value of family labour.

Cost C_2: Cost B_2 + imputed value of family labour.

Cost C_3: Cost C_2 + 10 percent of cost C_2 to account for managerial cost of inputs of farmers.

Profitability concepts

Total production: Main product

Gross income = Value of main product

Farm business income = Gross income –Cost A_1

Family labour income = Gross income –Cost B_2

Net income = Gross income –Cost C_3

Benefit-cost ratio (B:C ratio)

To judge the profitability of sugarcane production B: C ratio was worked out with the help of following formula.

$$\text{B: C ratio} = \frac{\text{Total Return}}{\text{Total Cost or Cost } C_3}$$

Functional Analysis

To study the effect of various independent variables on the output, various forms of production function have been dealt. However, Cobb-Douglas function was found more suitable to the data; therefore, it was used for measuring resource use efficiency.

The mathematical form of Cobb-Douglas function is:

$$Y = aX_1^{b1}.\ X_2^{b2}.\ X_3^{b3}.\ X_4^{b4}.e^{u}$$

Where

Y= per hectare out-put (Rs.)

X_1= Total human labour (Rs. /ha)

X_2= Seed (Rs. /ha)

X_3= Manure and fertilizer (Rs. /ha)

X_4= Irrigation charge (Rs. /ha)

X_5= Plant Protection (Rs. /ha)

a = Constant (intercept)

e^{μ}= Error and b_1, b_2, b_3, b_4 and b_5 are the production elasticities of the respective input variables.

a. Cobb-Douglas Production function in log form

$$\text{Log } Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 \ldots \mu \log e$$

This formula was used for estimating the parameters of the function based on sample.

Marginal Value Productivity (MVP): The marginal value product of inputs was estimated by following Formula:

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

Where,

MVP= Marginal value of product of j^{th} input

b_j = Production elasticity with respect to X_j

$\bar{Y}$ = Geometric mean of the dependent variable Y

$\bar{X}_j$ = Geometric mean of the independent variable X

Result and Discussion

The economics of sugarcane cultivation was studied and presented in table-1and table-2 for borrower and non-borrower sample farmers respectively.

1. Economics of sugarcane cultivation on sample farms

Per hectare costs of sugarcane grown at the borrower and non-borrower sample farms are presented in Table-1.

In case of borrower sample farms, it is revealed from the table that the total per hectare cost of cultivation on overall farm came to Rs. 93837.11, which was maximum on medium size of farms i.e., Rs. 95970.11 followed by small and marginal size of sample farms i.e., Rs. 94139.76 and Rs. 91850.30 respectively. The main input items which cause comparatively higher costs on medium farm were seed, manure fertilizer and irrigation. As far as per cent share of different input items in total costs are concerned, it was found that expenditure on rental value of land was highest i.e., 25.57 per cent followed by human labour, costs of seed, tractor charges, irrigation charge and plant protection which accounted for 16.40, 15.98, 13.60, 8.83, 6.94 and 0.66 per cent respectively.

Whereas in case of non-borrower, the economics of sugarcane cultivation on non-borrower sample farm is presented in Table-1. The total cost of cultivation on the overall farm was found to Rs. 82064.69, which was the highest on medium farms i.e. Rs. 84874.44 followed by small and marginal size of farms Rs. 83142.62 and Rs. 80603.43 respectively.

Table 1: Per hectare costs of different inputs used in Sugarcane production (Rs.) sample farms

Sl. No.	Particulars	Borrower				Non-Borrower			
		Size group of farms			Overall average	Size group of farms			Overall average
		Marginal	Small	Medium		Marginal	Small	Medium	
A.	**Variable cost**								
1.	Seed	14689.19 (15.99)	15012.33 (15.95)	15341.91 (15.97)	14995.26 (15.98)	11980.82 (14.86)	12879.21 (15.49)	13002.82 (15.32)	12429.35 (15.14)
2.	Tractor Charges	8023.64 (8.37)	8215.94 (8.37)	8647.10 (9.01)	8290.39 (8.83)	7439.26 (9.23)	7548.54 (9.08)	8021.88 (9.45)	7557.98 (9.21)
3.	Total Human Labour	14841.80 (16.16)	15426.21 (16.38)	16024.32 (16.70)	15396.08 (16.40)	12882.33 (15.98)	13470.23 (16.20)	13794.65 (16.25)	13209.94 (16.10)
a.	Family Labour	9146.25 (9.96)	7061.65 (7.50)	7080.64 (7.38)	7944.02 (8.46)	7621.26 (9.45)	7028.13 (8.45)	6382.67 (7.52)	7246.19 (8.83)
b.	Hired Labour	5695.55 (6.20)	8364.56 (8.88)	8943.68 (9.32)	7452.06 (7.94)	5261.07 (6.53)	6442.10 (7.74)	7411.98 (8.73)	5963.75 (7.27)
4.	Manure and fertilizer	12452.36 (13.65)	12946.25 (13.75)	13002.22 (13.55)	12758.97 (13.60)	8865.37 (11.00)	9161.32 (11.01)	9466.88 (11.15)	9050.20 (11.03)
5.	Irrigation	6324.20 (6.88)	6583.90 (6.99)	6690.67 (6.97)	6513.26 (6.94)	5466.23 (6.78)	5678.43 (6.83)	5894.67 (6.954)	5598.36 (6.83)
6.	Plant Protection	592.55 (0.64)	605.73 (0.64)	652.94 (0.68)	617.19 (0.66)	423.51 (0.52)	478.52 (0.57)	789.63 (0.93)	493.47 (0.60)
7.	Total working capital	47777.49 (52.02)	51728.71 (54.95)	53278.52 (55.22)	50627.13 (53.95)	39436.26 (48.81)	42188.12 (50.74)	44587.86 (52.53)	41093.11 (50.07)
B.	**Fixed cost**								
1.	Interest on working capital	1672.21 (1.80)	1810.50 (1.92)	1864.75 (1.94)	1771.95 (1.89)	1380.27 (1.71)	1476.58 (1.77)	1560.57 (1.84)	1438.25 (1.75)
2.	Rental value of land	24000.00 (26.13)	24000.00 (25.49)	24000.00 (25.01)	24000.00 (25.57)	24000.00 (29.77)	24000.00 (28.87)	24000.00 (28.27)	24000.00 (29.24)
3.	Interest on fixed capital	904.32 (0.98)	980.74 (1.04)	1021.65 (1.06)	963.37 (1.03)	838.06 (1.04)	891.37 (1.07)	900.21 (1.06)_	864.88 (1.05)
	Subtotal (A+B)	83500.27 (90.91)	85581.60 (90.91)	87245.56 (90.91)	85306.47 (90.91)	73275.85 (90.91)	75584.20 (90.91)	77431.31 (91.90)	74642.45 (90.91)
12.	Managerial Cost@10% of sub-total	8558.16 (9.09)	8558.16 (9.09)	8724.55 (9.09)	8530.65 (9.09)	7327.58 (9.09)	7558.42 (9.09)	7743.13 (9.09)	7464.24 (9.09)
Grand total		91850.30 (100.00)	94139.76 (100.00)	95970.11 (100.00)	93837.11 (100.00)	80603.43 (100.00)	83142.62 (100.00)	84874.44 (100.00)	82064.69 (100.00)

The highest value of per hectare costs of cultivation on medium category was occurred due to comparatively more expenditure on all the variable inputs. It is also revealed from the table that the overall costs of cultivation per hectare was mainly increase due to maximum expenditure on rental value of owned land of which per cent share was maximum 29.24 followed by human labour, seed cost, manure and fertilizer, tractor charge, irrigation and plant protection corresponded to 16.10, 15.14, 11.03, 9.21, 6.83 and 0.60 per cent respectively. Major input components which raised the cost of cultivation were rental value of land, human labour and cost of seed.

2: Per hectare costs and income from the production of sugarcane crop on borrower and non-borrower sample farms: The Table-2 revealed that, in case of borrower sample farms on an average cost A1/A2, costB_1, costB_2, cost C_1, cost C_2 and cost C_3 came to Rs.52399.08, Rs.53038.45, Rs. 77038.45, Rs. 60982.47, Rs.84981.47 and Rs. 93837.11 respectively. On an average, gross income was recorded Rs. 176432.20 and net income came to Rs.82595.09. On medium farms, gross income was highest, which was recorded Rs.179955.00, followed by small farms Rs. 177115.00 and lowest on marginal farms i.e. Rs.173055.00 respectively. The net income was highest on medium farms i.e. Rs. 83984.89, followed by small farms Rs. 82975.24 and marginal farms Rs. 81204.70. On an overall average family labour income and farm business income were observed to Rs. 99393.75 and Rs. 124033.12, respectively. Family labour income and farm business income show the similar trend which was highest on medium farms followed by marginal and small farms. On an average, cost of production per quintal and yield per hectare were estimated to Rs. 192.96 per quintal and 541.74 quintal respective.

On the basis of Costs C_3, Benefit cost ratio on an overall basis was observed having no clear difference on various sizes of farms. It may be concluded the costs of cultivation of sugarcane on different size group of farm increases with an increase in farm size and also net return per hectare was found of definite trend with different group of farm size but benefit cost ratio was found indefinite trend.

Whereas on non-borrower sample farms, per hectare cost of cultivation and income and income measures are presented in Table-2. It is revealed from the table that on overall average per hectare cost A1/A2, B1, B2, C1, C2 and C3 came to Rs.42531.37, Rs.43396.26, Rs. 67396.26, Rs. 50642.45, Rs.74642.45 and Rs. 82064.70 respectively.

Table 2: Per hectare costs and income measures from various costs concept (Rs)

Sl. No.	Particulars	Borrower				Non-Borrower			
		Size group of farms			Overall average	Size group of farms			Overall average
		Marginal	Small	Medium		Marginal	Small	Medium	
1.	Cost A1/A2	49449.70	53539.21	55143.27	52399.08	40816.53	43664.70	46148.43	42531.37
2.	Cost B1	50354.02	54519.95	55264.92	53038.45	41654.59	44556.07	47048.64	43396.26
3.	Cost B2	74354.02	78519.95	79264.92	77038.45	65654.59	68556.07	71048.64	67396.26
4.	Cost C1	59500.27	61581.60	62345.56	60982.47	49275.85	51584.20	53431.31	50642.45
5.	Cost C2	83500.27	85581.60	86343.56	84981.75	73275.85	75584.20	77431.31	74642.45
6.	Cost C3	91850.30	94139.76	95970.11	93837.11	80603.43	83142.62	84874.44	82064.70
7.	**Yield (qtl/ha.)**								
a.	Main Product	533.00	540.00	553.00	541.74	465.00	481.00	485.00	473.24
b.	By-product	129.00	136.00	144.00	135.90	90.00	95.00	98.00	92.82
8.	Grass Income	173055.00	177115.00	179955.00	176432.20	148275.00	153415.00	155365.00	151015.20
a.	Main Product	167895.00	171675.00	174195.00	170994.60	146475.00	157515.00	153405.00	151198.80
b.	By-product	5160.00	5440.00	5760.00	5437.60	1800.00	1900.00	1960.00	1856.40
9.	Net return over cost C3	81204.70	82975.24	83984.89	82595.09	67671.57	70272.38	70490.56	68950.50
10.	Family Income	98700.98	98595.05	100690.08	99393.75	82260.41	84858.93	84316.36	83431.74
11.	Farm Business income	123605.30	123575.79	124811.73	124033.12	107458.47	109750.30	109216.57	108483.83
12.	Cost of production (Rs./qtl.)	191.03	193.11	195.13	192.96	182.11	188.31	183.72	184.48
13.	B:C Ratio	1:0.88	1:0.89	1:0.87	1:0.88	1:0.83	1:0.84	1:0.82	1:0.82

Different income measures received from per hectare of sugarcane cultivation on non-borrower sample farms are also presented in Table-2. It is depicted that a maximum of Rs. 151015.20 was received as gross income and net return over cost C3 was Rs. 68950.50 on overall farm. The benefit cost ratio was highest on small farm i.e. 1:0.84 followed by marginal and medium farms received 1:0.83 each. On overall farm it was received 1:0.82. Gross income and net income per hectare were found positively correlated with size of non-borrower farms.

3: Comparative economics of sugarcane cultivation on borrower and non-borrower sample farms:

To compare the economics of sugarcane cultivation on borrower and non-borrower sample farm, mainly total cost, gross income, net income per hectare and benefit ratio were considered and the data is presented in Table-3.

Sample farmers mainly spent their crop loan on purchase of variable inputs like, seed, manure & fertilizer, wages of labour, plant protection chemical and payment of irrigation and tractor charges. It is depicted from the table that the borrower farmers could receive 96.80 per cent higher B:C ratio, 95.60 per cent cost of production, 85.59 per cent gross income and 83.48per cent of net incomes were also higher on borrower farms which was resulted due to more expenditure on variable inputs supported with financial assistance.

Table 3: Comparative economics of Sugarcane cultivation on borrower and non-borrower sample farms.

Sl. No.	Particulars	Value of overall average (Rs.)		
		Borrowers	Non-borrowers	Per cent increase
1	Total Cost	93837.11	82064.70	87.45
2	Gross income	176432.20	151015.20	85.59
3	Net income	82595.09	68950.50	83.48
4	Costs of production Rs./qt.	192.96	184.48	95.60
5	B:C ratio	1:0.88	1:0.82	96.80

4. Resource use efficiency and marginal value productivity in sugarcane on borrower and non-borrower sample farms: Cobb-Douglas production function was found to be best fit to study the resource use efficiency of various inputs used in production process, it is well known fact that after certain stage law of diminishing return applied in agricultural production. The elasticity of production, return to scale and marginal value productivity of different resources on different size group of sample farms were worked out.

Resource use efficiency, elasticity of production, return to scale and other qualities of interest in sugarcane crop at different size group of sample borrower farms are displayed in Table-4. High value of R^2 of the fitted function indicates that sufficient and maximum proportion of the total variation in the dependent variable was explained by the included factors in production process. The five variables *viz*., human labour, seed cost, manure & fertilizers, irrigation and plant protection explained 90.01, 92.73 and 95.19 per cent variation in the dependent variable on marginal, small, and medium sized group of farms respectively.

It is indicated in Table-4 that in case of marginal size group of sample farms X_1 (human labour) and X_2 (seed cost) were found having significant effect at 5 per cent level of probability. As far as small size group sample farms are concerned X_1, X_3 and X_5 (human labour, manure & fertilizer and plant protection) were found having statistically significant association with dependent variable at 1 per cent and 5 per cent level of probability and in case of medium size group of sample farms resource like seed (X_2) and irrigation (X_4) were also significantly associated with dependent variable at 1 per cent and 5 per cent level of probability. Rest of all other factors did not have any significant impact on sugarcane production in the study area. Returns to scale on marginal, small, and medium sized group of farms were found 0.8830, 0.9248 and 0.9347 respectively, which were less than unity. It is therefore, concluded that cultivation of sugarcane crop is characterized by decreasing returns to scale on all size group of farms of the study area.

In case of all the three categories of sample farms and for all variable, the ratio of MVP to factor cost was found more than unity, which indicates that there is chance to spent more on additional inputs to receive further additional income. It may be concluded that investment on these variable resources may help to attain optimum combination of factors of production in the process of sugarcane production, which fulfils the aim of profit maximization.

The magnitude of elasticity of production, standard error, coefficient of multiple determination and returns to scale for sugarcane production on different size group of non-borrower

farms are presented in Table-5. It is evident from the Table that the coefficient of multiple determination (R^2) on marginal, small and medium farmers have defined 89.01, 92.25 and 92.20 per cent variation in the dependent variable, respectively which indicates that all the variables *viz*. human labour, seed, manure &fertilizer, irrigation and plant protection jointly explained the maximum variation in dependent variable.

Table 4: Resource use efficiency and MVP of sugarcane (borrower)

Size-group of sample farms	Production elasticity					Sum of elasticities	R^2	Marginal value productivity				
	X_1	X_2	X_3	X_4	X_5			X_1	X_2	X_3	X_4	X_5
Marginal	0.2959** (0.0961)	0.3804* (0.0648)	0.0171 (0.0531)	0.0302 (0.0221)	0.1594 (0.1027)	0.8830	0.9001	6.4002	3.7150	1.3470	1.6971	1.0081
Small	0.3944* (0.0958)	0.0676 (0.9064)	0.2106** (0.2216)	0.0154 (0.0280)	0.2368** (0.1901)	0.9248	0.9273	3.5811	11.5481	2.3421	1.0596	1.8910
Medium	0.1285 (0.0512)	0.3675* (0.0594)	0.1417 (0.1239)	0.2839** (0.1733)	0.0131 (0.0228)	0.9347	0.9519	3.1649	4.9064	1.0779	2.2741	1.0378

Table 5: Resource use efficiency and MVP of sugarcane (non-borrower)

Size-group of sample farms	Production elasticity					Return to scale	R^2	Marginal value productivity				
	X_1	X_2	X_3	X_4	X_5			X_1	X_2	X_3	X_4	X_5
Marginal	0.2388** (0.0778)	0.3720** (0.0474)	0.0434 (0.1170)	0.1125 (0.0184)	0.1039 (0.0516)	0.8606	0.8901	10.379	12.9750	0.1606	1.5181	1.3496
Small	0.1394 (0.0501)	0.0539 (0.1253)	0.1025 (0.1247)	0.3344* (0.0456)	0.2740** (0.1834)	0.9042	0.9225	5.062	12.3455	0.2881	4.3009	1.0849
Medium	0.3743* (0.0979)	0.1361 (0.0906)	0.2310** (0.4682)	0.0249 (0.0412)	0.1501 (0.4363)	0.9164	0.9420	5.650	15.0380	3.4748	0.6458	0.8951

* Significant at 1% probability level

**Significant at 5% probability level

X_1, X_2, X_3 and X_4 stands for human labour, seed cost, manure and fertilizers, irrigation and plant protection.

In case of marginal farms, the elasticity of production with respect to human labour and seed cost (X_1, and X_2) were statistically significant at 5 per cent and 1 per cent level of probability. In case of small farms, the elasticity of production with respect to irrigation and plant protection were statistically significant at 1 per cent and 5 per cent probability level, while in case of medium size group of farms, human labour and manure & fertilizer were statistically and significantly associated with dependent variable at 1 per cent and 5 per cent level of probability.

Return to scale in case of medium was size group of farms found higher (0.9164) compared to small (0.9042) and marginal (0.8606), respectively. Sum of the production elasticities were found less than one in case of marginal, small and medium farms revealed that production process is of diminishing returns to scale. It indicates that simultaneous increase of 1% in factors of production yields increases by less than 1 per cent.

It is evident from the table-5 that MVP of all included factors were more than one in case of marginal, small and medium farms, it indicates that further scope of investment on all of these included factors to obtain optimum return, but manure & fertilizer in marginal and small size of farm, irrigation and plant protection on medium size group of farms offered the MVP less than one. It is concluded from the above fact that there except (X_3) manure & fertilizer on marginal and small farms and irrigation and plant protection (X_4 and X_5) on medium size group of farms, all other on all three size of sample farms have the scope for further expenditure to receive additional inputs.

Conclusion

It is concluded that in Borrower case, per hectare cost of cultivation of sugarcane crop indicates that it is an input responsive crop. On an overall average, cost of cultivation per hectare of sugarcane crop came to Rs.93837.11. The gross income, net incomes were found to Rs.176432.20 and Rs. 82595.09 from sugarcane crop. The cost of production per quintal and B:C ratio were observed to Rs. 192.96 and 1:0.88 respectively. Whereas in case of non-borrower sample farms, the overall average per hectare cost of cultivation were found Rs. 82064.70, and gross income (Rs. 151015.20), net income (Rs.68950.50), cost of production per quintal (Rs.184.48) and B:C ratio (1:0.82) respectively. The comparative economics of borrower and non-borrower sample farms were found the borrower farmers were than the non-borrower in all economic aspects. Which support the need of credit requirement for better farming. Functional analysis of the data collected from borrower and non-borrower sample farms also the effect of finance on crop production. Sum of elasticity (return to scale) shows the trend of diminishing return accounting the elasticity of production less than 1 for sugarcane cultivation on borrower and non-borrower farms. But as far as R^2 (multiple coefficients of determination) are concern it was found higher on borrower farms in comparison to non-borrower. And marginal value productivity (MVP) was also found more than one on borrower farms but it was less than one in few cases on non-borrower farms. It shows further scope of investment on those variables.

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