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Economics of Banana Production in Solapur District of Maharashtra, India

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Authors' contributions

This work was carried out in collaboration between both authors. both authors read and approved the final manuscript.

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ABSTRACT

The study analyses the resource-use efficiency of banana cultivation in relation with per ha return and cost based on the information of 90 sample farmers of Solapur district, Maharashtra in 2018-19. Findings show that production level was 563.11q/ha on an aggregate level. The estimated cost of cultivation was Rs.324671.04/ha. The per hectare inputs utilized for banana at overall level were 118.58 human days, 22.67 tonnes manures, 399.60 kg N, 126.11 kg P, 720.29 kg K. Average gross income was Rs.627708.57. The gross income received in size group small, medium and large was Rs. 609142.70, Rs. 614926.70 and Rs.659056.30, respectively. The benefit-cost ratio was 1.93 at the overall level indicating highly prosperous crop. This ratio is the highest (2.06) for large size farms. Thus, the crop was found to be economically viable. The results of Cobb-Douglas production function howed that seed, manures, potassium fertilizer and irrigation had positive and significant influence on the yield of banana. The magnitude of coefficient of multiple determination (R^2) was 0.92. Value of the ratio of MVP/Px was found greater than unity in case of seed, manures and irrigation indicated the underutilization of these resources. Quantity of per hectare produce marketed was maximum (99.09 per cent) for large size group and minimum in (98.88 per cent) for small size group i.e. there is no significant differences as marketing system was similar.

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1. INTRODUCTION

Banana (*Musa paradisiaca* L.) belong to the family Musaceae. Though originated in South East Asia, it is widely grown in India, China, Philippines, Brazil, Indonesia etc. Banana is an elongated, edible fruit – botanically a berry. The fruit is variable in size, colour and firmness, but it is elongated and curved, with soft flesh rich in starch covered with a rind, which may be green, yellow, red, purple, or brown when ripe. The global ed production of banana is around 115.74 million tonnes of which India contributes 29.19 %. Besides India other major banana producing countries are China, Philippines, Ecuador, Brazil and Indonesia. (Source: Horticultural Statistics at a Glance 2018). Total area under banana in India was 8.84 lakh hectare. India was the largest producer with an annual production of banana was 308.08 lakh MT with productivity of 34.86 T/ha, in the year 2017-2018. The major production of banana crop was confined to Andhra Pradesh (50.03 lakh MT), Gujarat (44.72 lakh MT), Maharashtra (42.09 lakh MT) which account about 44.50 per cent of total production in India. Total estimated export of banana 1.01 lakh MT in quantity with value of Rs.34877.39 lakh in 2017-18 year. In Maharashtra during 2017-2018, total production of Banana was 42.09 lakh MT having 0.80 lakh hectares area with the productivity of 52.05 T/ha. Basrai, Robusta, Shreemanti, Grand naine, Dwarf Cavendish are the varieties cultivated in Maharashtra, India. (Source: Horticultural Statistics at a Glance 2018). The specific objective of the study is to estimate the resource use efficiency and to work out the costs and returns of banana production in the study area.

2. METHODOLOGY

In the present investigation two stage purposive sampling with sample Tahsil as a primary unit of sampling and village as a secondary unit of sampling were adopted. As Solapur is one of the leading banana growing district in Maharashtra. Solapur district was selected purposively for the present study. In two stage purposive sampling, two tahsil viz. Malshiras (65 ha) and Madha (50 ha) were selected purposively. The three villages from each tahsil were selected on basis of highest area under banana. The list of banana growers were prepared from five villages viz. Mahalung, Nevare, Umbare, Alegaon (Khurd), Alegaon (Budruk) and Tembhurni. Then growers from list were categorized into three size groups on the basis of area under banana for viz. Small (below 0.40 ha), Medium (0.41 to 0.80 ha) and Large (0.81ha and above). Fifteen banana growers were selected randomly from each village. Thus, total sample of 90 banana growers comprising of 30 small, 30 medium and 30 large growers were selected for present study.

2.1 The Cost Concepts Used as Follows

2.1.1 Cost 'A'

Includes the costs on account of hired human labour, bullock labour, machinery charges, value of manures, value of fertilizers, value of seedling, irrigation charges, plant protection charges, land revenue, depreciation and repairs, interest on working capital etc.

2.1.2 Cost 'B'

Rental value of land and interest on fixed capital represent imputed cost which is added to the Cost 'A'.

Cost 'B' = Cost 'A' + rental value of land + interest on fixed capital.

2.1.3 Cost 'C'

It is the total cost of production, which included all the costs items, actual as well as imputed. The value of owned labours is imputed and added to cost 'B' to work out cost 'C'.

Cost 'C' = Cost 'B' + imputed value of family labour.

2.2 Functional Analysis

The empirical evidence from previous studies suggest that amongst the many mathematical functions, Cobb-Douglas production function is the appropriate one for the study of resources productivities because it gives specific diminishing, increasing or constant returns. The data were therefore, subjected to functional analysis by using the following Cobb-Douglas type of production function,

$$Y = a X1b1 X2b2 X3b3 X4b4 X5b5 X6b6 X7b7 X8b8X9b9. eu$$

When expressed in logarithmic terms this function transfer into linear function of the following types,

Log Y = Log a + b1 Log X1+b2 Log X2+ ..... + bn Log Xn + u Log e

Where,

Y= Dependent variable (Output) in Quintals

a = Intercept

X1 = Seed (Seedlings) (plants per hectare)

X2= Male Labour (man days)

X3= Female Labour (man days)

X4= Manures (quintals)

X5= Nitrogen (kg)

X6= Phosphorus (kg)

X7= Potash (kg)

X8= Irrigation charges (Rs.)

X9= Plant protection charges (Rs.)

bi's = Elasticity of production of respective factors

e = Error term

3. RESULTS AND DISCUSSION

The results obtained from the present investigation have been summarized in the Tables 1 to 4.

3.1 Input Use Pattern in Banana Cultivation

The information on per hectare utilization of different inputs for Banana are presented in Table 1. At the overall level, the use of total human labour was 118.58 labour days per hectare, comprising 36.01 male labour and female 82.57 labour days. The use of human labour was found more in large size group of holding. It was 127.45 labour days followed by 122.55 labour days in small size and 105.74 labour days in medium size group. Per hectare use of machine labour was 13.61 hours. The per hectare machine labour utilization was observed slightly more in case of large size group of holding (14.31 hours) than medium and small size group of holdings. The machine power i.e. use of tractors was mostly for the operation of carrying of FYM, ploughing and harrowing etc.The use of manure per hectare at overall level was 22.67 tonnes/ha. The use of manure was found more on large size of group (23.16 tonnes.) holding than small (22.81 tonnes.) and medium size (22.06 tonnes.) of group holdings. In manure, banana farmers applied farm yard manure, compost and banana press mud. Similar results were found by Dave et al. [1] in the study comparative economics of banana cultivation in Anand district of Gujarat.

The per hectare use of chemical fertilizers i.e. Nitrogen, Phosphorous, Potash were 399.60, 126.11 and 720.29 kg/ha. Use of fertilizer was found more in small size group than medium and large size group of holding. On an average, utilization of seedlings was 4427.88 plants per hectare which was lesser than the recommendation (i.e. 4444 Plants per hectare). Farmers belonging to large size group use more seedlings than medium and small size group. Cost of plant protection charges were Rs. 7385.06 and small size group was found to use more of it. In the same way Stephy et al. [2] estimated the cost of cultivation of banana in the Thiruvananthapuram district of Kerala and Guledgudda et al. [3] in Haveri district of Karnataka.

The overall level per hectare cost of cultivation for banana was worked out to Rs.324671.04. The contribution of Cost 'A' (Rs.192743.39) accounted for 59.37 per cent to total cost. The contribution of Cost 'B' to total cost was 93.11 per cent. Out of total per hectare cost of cultivation of banana, the maximum 32.16 per cent cost was incurred on rental value of land followed by seedling (17.82 per cent) and fertilizer cost (12.78 per cent). Cost 'B' for small size group (Rs.306704.60) is significantly high than medium group (Rs.296580.26) and large group (Rs.303609.72). There was significant difference of Cost 'A' between small group (Rs.198837.50) and medium group (Rs.189533.58), also there was no significant difference of Cost 'A' between medium and large group. It was further noticed that among the different size groups per hectare cost of cultivation was maximum (Rs.333214.76) in small size group followed by medium (Rs.321554.50) and large (Rs.319243.87) size group. In small size group Cost 'A' was

Rs.198837.54 which accounted for 59.67 per cent to the total cost and Cost 'B' Rs.306704.60 accounted for 92.04 per cent to the total cost. It can also be seen that in medium size group the contribution of Cost 'A' was 58.94 per cent to the total cost and contribution of Cost 'B' in the total cost of cultivation was 92.23 per cent to the total cost. In large size group Cost 'A' accounted for 59.47 per cent to total cost and Cost 'B' 95.10 per cent to the total cost. There was no significant difference between Cost 'A' and Cost 'B' of large size group, medium size group and small size group. Per quintal cost of banana was calculated on net Cost 'C' by dividing it value of main produce, at overall level per qtl. cost of banana was Rs.576.58. It was Rs.580.15, Rs.569.06, and Rs.580.54 for small, medium and large group, respectively.

3.2 Costs, Returns and Profitability of Banana Farm

At the overall level, the per hectare gross return was found to be Rs.627708.57. The per hectare gross returns of banana in small, medium and large size group was Rs.609142.70, Rs. 614926.70 and Rs.659056.30, respectively as depicted in Table 3. The net returns obtained at overall level were Rs.303037.52. Net returns obtained from small, medium and large size groups were Rs.275927.94, Rs.293372.40 and Rs.339812.43, respectively. The benefit-cost ratio indicates the return from each rupee investment in banana cultivation. The results revealed that the B: C ratio is highest in large size group and it was 2.06. Similarly, B: C ratio was 1.83 and 1.91 for small and medium size groups, respectively. At overall level, B: C ratio was 1.93. It clearly indicated that, banana is a profitable cash crop. In resemblance to this study Maurya et al. [4] evaluated the profitability of banana plantation in Bihar and Mali et al. [5] and Khedakar et al. [6] in Maharashtra.

3.3 Resource Use Structure in Banana Cultivation

The Cobb- Douglas type of production function was found to be "best fit" to present data. The regression coefficients for identified resources for Banana are presented in Table 4. It was observed that at overall level the magnitude of coefficient of multiple determination (R^2) was 0.92, indicated that 92 per cent variation in Banana production was explained by variables included in the function. It is also revealed from the data presented in Table 1. that the elasticity coefficients for seed (X1), manure (X4), K (X7) and irrigation cost (X8) were positive and statistically significant at 5 per cent level of significance, male labour (X_2) was negative and found statistically non-significant, female labour (X_3) and plant protection cost (X9) were negative and found statistically significant at 1 per cent level of significance. N (X5) and P (X6) were found negative and statistically significant at 5 per cent level of significance. This may be because of their excess use than recommended level. The R^2 was 0.92 indicating 92 per cent variation in the yield of Banana caused by the input factors. Similar study were convoyed by Kumar et al. [7] on tissue culture and sucker propagated banana and Mishra et al. [8] in Gorakhpur district of Uttar Pradesh.

Table 1. Per hectare resource use for Banana

Sr. No.	Particulars	Size Groups			Overall
		Small	Medium	Large	
1	Human labour (Days)	122.55	105.74	127.45	118.58
	Male	38.39	33.86	35.79	36.01
	Female	84.16	71.88	91.66	82.57
2	Machine labour (hours)	13.06	13.45	14.31	13.61
3	Manures (Tonnes)	22.81	22.06	23.16	22.67
4	Fertilizers (kg)				
	N	409.67	397.08	392.04	399.60
	P	136.47	122.08	119.77	126.11
	K	725.82	720.53	714.53	720.29
5	Seedlings Nos./ha	4420.66	4427.26	4435.74	4427.88
6	Plant protection (Rs.)	8082.24	7240.40	6832.55	7385.06

Table 2. Cost of cultivation of Banana (Rs./ha)

Sr. No.	Particulars	Small	Medium	Large	Overall
A.	**Cost of Cultivation**				
i)	Hired Labour				
	Male	11517.74	10158.48	10739.51	10805.23
		(3.46)	(3.16)	(3.37)	(3.33)
	Female	16831.98	14376.87	18332.25	16513.70
		(5.05)	(4.47)	(5.74)	(5.09)
	Total labour	28349.72	24535.35	29071.76	27318.94
		(8.51)	(7.63)	(9.11)	(8.42)
ii)	Suckers or Rhizomes	57468.62	58439.80	57664.60	57857.67
		(17.25)	(18.17)	(18.06)	(17.82)
iii)	Machinary	7836.67	8067.21	8588.95	8164.28
		(2.35)	(2.51)	(2.69)	(2.52)
iv)	Manure	22816.98	22067.91	23165.19	22683.36
		(6.85)	(6.86)	(7.26)	(6.99)
v)	Fertilizer	45415.09	41719.28	37380.74	41505.03
		(13.63)	(12.97)	(11.71)	(12.78)
vi)	Irrigation	11284.33	12014.44	12066.95	11788.57
		(3.39)	(3.74)	(3.78)	(3.63)
vii)	PPC	8082.24	7240.40	6832.56	7385.07
		(2.43)	(2.25)	(2.14)	(2.27)
viii)	Repairs	1077.82	1191.14	1195.03	1154.66
		(0.32)	(0.37)	(0.37)	(0.36)
ix)	Incidental charges	1564.12	1563.82	1590.95	1572.97
		(0.47)	(0.49)	(0.50)	(0.48)
	Working Capital	183895.60	176839.36	177556.74	179430.57
		(55.19)	(55.00)	(55.62)	(55.27)
x)	Interest on working capital @6%	11033.74	10610.36	10653.40	10765.83
		(3.31)	(3.30)	(3.34)	(3.32)
xi)	Depreciation	3708.21	1883.82	1448.95	2346.99
		(1.11)	(0.59)	(0.45)	(0.72)
xii)	Land revenue	200	200	200	200
		(0.06)	(0.06)	(0.06)	(0.06)
	Cost A	**198837.54**	**189533.58**	**189859.10**	**192743.39**
		(59.67)	**(58.94)**	**(59.47)**	**(59.37)**
xiii)	Rental value of land	101323.78	102287.78	109642.72	104418.09
		(30.41)	(31.81)	(34.34)	(32.16)
xiv)	Interest on F.C.	6543.27	4758.94	4107.91	5136.70
		(1.96)	(1.48)	(1.29)	(1.58)
	Cost B	**306704.60**	**296580.26**	**303609.72**	**302298.19**
		(92.04)	**(92.23)**	**(95.10)**	**(93.11)**
xv)	Family labour				
i)	Male	11576.19	10494.22	5945.66	9338.69
		(3.48)	(3.27)	(1.86)	(2.88)
ii)	Female	14933.97	14480.01	9688.49	13034.16
		(4.48)	(4.50)	(3.04)	(4.01)
	Total	26510.16	24974.23	15634.15	21716.26
		(7.96)	(7.77)	(4.90)	(6.89)
	Cost C	**333214.76**	**321554.50**	**319243.87**	**324671.04**
		(100.00)	**(100.00)**	**(100.00)**	**(100.00)**
B.	**Output**				
	Main produce (q.)	574.36	565.06	549.91	563.11
	By produce (q.)	0.00	0.00	0.00	0.00
	Gross value	609142.70	614926.70	659056.30	627708.57
C.	**Cost of Production/q**	580.15	569.06	580.54	576.58
D.	**R: C ratio**	1.83	1.91	2.06	1.93

Table 3. Profitability analysis of Banana (Rs/ha)

Sr. No.	Particulars	Size Group			
		Small	Medium	Large	Overall
1	Gross returns	609142.70	614926.70	659056.30	627708.57
2	Costs (Rs.)				
	i) Cost A	198837.54	189533.54	189859.09	192743.39
	ii) Cost B	306704.60	296580.26	303609.72	302298.19
	iii) Cost C	333214.76	321554.50	319243.87	324671.04
3	Profit (Rs.)				
	i) Cost A	410305.16	425393.16	469197.21	434965.18
	ii) Cost B	302438.10	318346.44	355446.58	325410.37
	iii) Cost C	275927.94	293372.40	339812.43	303037.52
4	Production	574.36	565.06	549.91	563.11
5	Per Qtl cost of production	580.15	569.06	580.54	576.58
6	Output-Input ratio				
	i) Cost A	3.06	3.24	3.47	3.26
	ii) Cost B	1.99	2.07	2.17	2.08
	iii) Cost C	1.83	1.90	2.06	1.93

Table 4. Results of estimates Cobb-Douglas production function

Sr. No.	Variables	Regression coefficients
1	Constant (Intercept)	0.1624
		(1.2596)
2	Seed (X_1)	0.6898**
		(0.3091)
3	Male (X_2)	-0.0530^{NS}
		(0.0351)
4	Female (X_3)	-0.0633***
		(0.0172)
5	Manure (X_4)	0.1816**
		(0.0700)
6	N (X_5)	-0.2350**
		(0.1131)
7	P (X_6)	-0.0496**
		(0.0237)
8	K (X_7)	0.0105**
		(0.0051)
9	Irrigation Cost	0.3573**
	(X_8)	(0.0775)
10	Plant Protection Cost	-0.2401***
	(X_9)	(0.0633)
	R^2	**0.92**

(Figures in parentheses indicates standard error)
**** - Significance at 1 % level, * - Significance at 10% level*
*** - Significance at 5 % level, NS - Non significant*

3.4 Resource Use Efficiency in Banana Production

The resource use efficiency was studied and the marginal value of product (MVP) of each explanatory variables were computed with factor cost (FC) to know the resource use efficiency of farmer and the results are presented in Table 5. The data revealed that, the ratio of MVP/Px was found greater than unity in case of seed, manures and irrigation indicated the underutilization of these resources. The ratio of MVP/Px is less than unity in case of human labour, nitrogen, phosphorous, potassium and plant protection charges etc. which showed excess utilization of these resources. Use of these resources should be curtailed down for maximization of profit.

Table 5. Resource use efficiency in banana cultivation per ha

Sr. No.	Resources	M.V.P.	F.C.(Px)	MVP/FC	Remarks
1	Seed (X1)	100.17	13	7.71	Underutilization
2	Male (X2)	-964.14	300	-3.21	Excess
3	Female (X3)	-524.50	200	-2.62	Excess
4	Manure (X4)	547.63	100	5.48	Underutilization
5	N (X5)	-376.93	5.34	-70.59	Excess
6	P (X6)	-253.03	126	-2.00	Excess
7	K (X7)	10.72	19	0.56	Excess
8	Irrigation Charges	19.43	1	19.43	Underutilization
9	Plant Protection Charges	-20.88	1	-20.88	Excess

4. CONCLUSION

It was observed that the per hectare physical inputs used for banana at overall level was human labour, machine labour, manures, fertilizers, seedlings and plant protection. Use of manures was more in large size than small and medium group, use of machine labour was more in large group than medium and small group. In case of rest of inputs, their use were more in small group than medium and large size. Related to the per hectare cost of cultivation of banana was Rs.324671.07 at overall level. The per hectare total cost of small size was significantly higher than medium and large size group. At overall level, per hectare yield of banana was 563.11 qtl and per hectare gross returns were Rs.627708.57. Gross returns obtained to large size group was significantly higher than small and medium size group. The benefit cost ratio at overall level was 1.93, indicating that banana production is profitable. The R2 was 0.92 indicating 92 per cent variation in the yield of banana caused by the input factors. The regression coefficients for seed (X1), manure(X4), K(X7) and irrigation (X8) were positive and statistically significant. The ratio of MVP/Px is less than unity in case of male labour, female labour, nitrogen phosphorous and plant protection charges etc. which showed excess utilization of these resources. Use of these resources should be curtailed down for maximization of profit. The resource use efficiency analysis indicated the excess use of chemical fertilizers and plant protection measures in the study area suggest that farmers should use appropriate quantity of fertilizers and plant protection chemicals to reduce cost of production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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