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Resource Use Efficiency in Cultivation of Banana in Nagaon District of Assam

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ABSTRACT

The study was conducted in Nagaon district of Assam to examine the resource productivity and resource use efficiency in banana production. Results of the ordinary least square (OLS) estimates of the parameters for the sampled banana farms showed that net income of banana was positively related to expenditure on seedlings, fertilizer, labour and plant protection chemical, but was negatively related to expenditure on manure in small farms and miscellaneous expenditure in medium farms. The net income increased with increased expenditure on seedlings, fertilizer, labour and plant protection chemical, but de-creased with increased expenditure on manure in small farms and miscellaneous expenditure in medium farms. For banana cultivation in marginal, small and medium farms returns to scale was found 0.75, 0.69 and 0.40 which means that the production function exhibited decreasing returns to scale in all the farm sizes. But it was not found significant in all the farm sizes.

Key words: Banana cultivation, Resource use efficiency, Resource productivity, Return to scale

Introduction

Banana is one of the oldest cultivated tropical fruit crops of India. Being a rich source of vitamin C and minerals, it makes healthy and salt free diet. Owing to its multifaceted uses from underground stem upto the male flower- it is referred as Kalpataru (a plant of virtues). Soil and climatic condition of Assam is suitable for

growing majority of the fruit crops. Among these, banana and citrus fruits specially mandarin orange are grown at commercial scale and have a great socio-economic importance for the people of Assam. The total area under horticultural crops is 5.65 lakh hectares (15% of Gross Cropped Area) which produce 16.45 lakh MT of fruits, 44.70 lakh MT of vegetables and 2.47 lakh MT of Spices annually besides flowers, nut crops, etc (Source: Directorate of Economics and Statistics, Assam, 2010-11). It is a matter of concern that the production of banana in the state is being carried out mostly without any organised backup for packaging, storage, transport and marketing. However, fruit producers are having limited resources. So, utilization of their limited resources in a most efficient way is very much important for maximization of profit. Keeping in view the above aspects, the present study was under taken with the specific objective to analyse the resource utilisation pattern and resource use efficiency in cultivation of orange across different farmer's size groups in Assam , particularly in Tinsukia district where orange is grown commercially .

Research Method

The study was carried out in Nagon district of Assam (India) and the district was selected purposively for being the highest producer among various banana producing districts of Assam.

A sample of 150 banana growers was selected following a multistage random sampling technique..Among three civil sub divisions of Nagaon district viz., Nagaon, Kaliabor and Hojai; one block from each sub division was selected for the present study considering the area under banana plantation. At the next stage, five villages from each block were selected randomly. A list of banana growers was prepared for each selected village and from that list,10 banana growers were selected randomly from each village for final data collection on banana.

The selected sample fruit growers were categorised into 3 categories according to their area under orange cultivation *viz*., Marginal (<1ha), small (1.01 to 2 ha) and medium (2.01 to 3 ha) and sample fruit growers from each village were drawn in the ratio of 5:3:2. A total of 50 growers from each village were drawn in the ratio of 5:3:2. A total of 50 growers from each block and 150 growers from each district are taken as final sample. Data were collected from the sample farmers with the help of a set of pre-tested schedule by personal interview method.

To compensate the objective of the study, both simple tabular analysis and functional analysis were done for interpretation of results.

a)Simple tabular analysis

The data collected were tabulated and analysed according to need of objective of the study. Simple statistical tools like percentage and averages were calculated where ever necessary

b) Functional analysis

The Cobb Douglas production function was used for examining the resource use efficiency in orange cultivation and the form of the production function fitted is as follows:

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

Where, Y= Net Income (Rs./ ha)

X_1= Cost of FYM (Rs/ha)

X_2= Fertilizer cost (Rs/ha)

X_3=Labour cost (Rs/ha)

X_4= cost of plant protection chemical (Rs/ha)

X_5= Misc. expenditure (Rs/ha)

$MVPx_i = (dy/dx_i). = b_i (\bar{Y}/ \bar{X}_i)$

Where, b_i is the elasticity co-efficient of Xi, $\bar{X}_i$ and $\bar{Y}$ are the geometric means of inputs and output respectively.

The regression co-efficient (b_i) in Cobb- Douglas production function directly indicates the elasticity of production which measures the percentage change in output for unit percentage change in the input (Bhowmick, 1975). The Cobb-Douglas (CD) type of production function was used in the agricultural research for its convenience for the comparison of the partial elasticity co-efficient (Prajneshu, 2008).

Conducting a 't' test for Non-Constant Returns to Scale

To perform a specific test for either increasing or decreasing returns to scale, here one-sided *t* test is used. In the case of increasing returns, we test the following hypothesis and alternative**:**

$$H_0 : \sum_{i=1}^{n} bi = 1$$

$$H_1 : \sum_{i=1}^{n} bi > 1$$

In case of decreasing returns following hypothesis and alternatives were tested:

$$H_0 : \sum_{i=1}^{n} bi = 1$$

$$H_1 : \sum_{i=1}^{n} bi < 1$$

The *t* statistic is constructed using the results such that

$$t\sum_{i=1}^{n} = \frac{\sum_{i=1}^{n} b_i - hypothesized\ value}{se(\sum_{i=1}^{n} b_i)}$$

Where, the standard error (se) of the parameter estimates, b1+b2 is computed as

$$se\ (b1+b2+\ldots) = \sqrt{\text{var}(b1) + \text{var}(b_2) + \ldots + 2\,\text{cov}(b_1, b_2) + 2.\text{cov}(b_1, b_2)\ldots}$$

The marginal value products (MVP) of all the inputs for each size group were computed to evaluate how efficiently the farmers of the sample population were using their resources. MVP was compared with the respective factor cost between different size categories of farms to see which categories of farms were utilising different resources most efficiently. The ratio of the MVP to MFC was used to determine the resources use efficiency as shown in the following equation (Rahman and Lawal, 2003).

$$r = MVP/MFC$$

Where, r = Efficiency ratio (ratio of the MVP of an input and unit price of the input)

MVP = Marginal value product of a variable input.

MFC = Marginal factor cost(price per unit of input)

The marginal value product of a particular resource represents the expected addition to the gross return caused by an addition of one unit of that resource, while other inputs are held constant. The marginal value product of the factors were computed by multiplying the regression co-efficient of the given resource with the ratio of geometric mean of gross return to the geometric mean of the given resource which is then multiplied by unit price of the product. Here, all the variables of the regression model were measured in monetary value, therefore, the slope coefficient of those explanatory variables in the function represented the MVPs, calculated by multiplying the production coefficient of given resources with the ratio of geometric mean (GM) of net return to the GM of the given resources, that is,

$$\ln Y = \ln a + bi \ln Xi$$

Therefore, $dY/dXi = bi [\bar{Y}/\bar{X}i]$ or, $MVP (Xi) = bi [\bar{Y}/\bar{X}i]$

Where, $\bar{Y}$ = Geometric mean value of gross return in Rupees.

Xi = Geometric mean value of the ith variable input in Rupees.

As the MFC is price of input per unit, the MFCs of all the inputs will vary while calculating the ratio of MVP to MFC. However, the denominator will always be one, and therefore, the ratio will be equal to their respective MVP (Majumder *et al.*, 2009).

According to the conventional neo-classical test of economic efficiency, a production input is being used efficiently if the ratio of the MVP of an input and the unit price of the input equals unity. Thus,

a) If, r <1, it means the resource in question was over utilized hence decreasing the quantity used of that resource increases profit.

b) If, r > 1, it shows that the resource was being under utilized and increasing the quantity of use will raise profit level.

c) If, r = 1 it means resource was being efficiently utilized. MFC = Marginal factor cost (price per unit input)

Results and Analysis

In Nagaon district banana is grown commercially in almost all the subdivisions. The major commercial variety of banana grown in the district is *Amritsagar*. However, another important banana variety, namely 'Malbhog' is also grown at a very small scale by a few banana growers of the district.

1. Resource utilisation Pattern in banana cultivation

The utilisation pattern of various resources in banana cultivation by the sample farmers of Nagaon district **(Table 1)** shows that majority of the sample banana growers used bullock power for land preparation for banana plantation before planting of banana suckers or digging of pits. Average per hectare bullock pair days (BPD) used by the sample farms was found to be 10.95 BPD. A very few number of

banana cultivators utilised tractor power for land preparation before planting in the study area. The average per hectare tractor power days (TPD) utilised by the sample farmers varied from 5.83 TPD in small farms to 7.64 TPD in medium farms with the overall average of 6.87 TPD. The average per hectare human labour

Table 1 :Resource utilisation pattern in banana cultivation (per hectare) in Nagaon district of Assam

Particulars of resources	Size group of farms			
	Marginal	Small	Medium	Pooled
1.Bullock Labour(BPD)	11.38	10	11.62	10.95
2.Tractor Power(TPD)	7.30	5.83	7.64	6.87
3.Human Labour(MD)				
a)Family Labour	114.07 (60.63)	100.07 (56.02)	83.60 (47.11)	103.78 (56.66)
b) Hired Labour	74.08 (39.37)	78.56 (43.98)	93.86 (52.89)	79.38 (43.34)
c)Total human labour	188.15 (100)	178.63 (100)	177.46 (100)	183.16 (100)
4.FYM/Manure(q)	169.40	153.00	142.00	150.94
5.Fertilizer (Kg)				
a)DAP	206.60	228.30	221.60	221.67
b)MOP	163.51	160.64	153.96	158.19
c)Borax	6.01	8.72	7.16	7.57
6.Plant protection chemical (Rs.)	2866.65	3995.07	3906.77	3764.76

N.B. :Figures within parentheses indicate percentage to total human labour

was found to be 183.16 man days (MD) out of which 56.66 per cent were family labour and the rest 43.34 per cent were hired labour. It was found that smaller size groups of

farms used more labour including family labour and hired labour per hectare; and it decreases with the increase in farm size group. A similar finding was reported by Lavanin *et. al.* (1974) in his study on "Pattern of labour employment on Varanashi farm". One major reason for this could be that the number of plants per hectare was higher in smaller farms compared to the bigger farms. Similarly the percentage share of family labour in total human labour utilisation decreased with the increase in size of farms which varied from 60.63 per cent in marginal farms to 47.11 per cent in medium farms. It is also seen that the smaller size groups of farms used more family labour than the larger size groups. Similar finding was reported by Kohlon and Migiani (1974) and Mishra *et. al.* (1976). It was also observed that larger size groups used more hired labour compared to that of smaller size groups. Similar finding was reported by Motilal (1973) and Patgiri (1974). The reason for this might be due to the fact that with the increase in size group of farms, total area of operation also increases, but the family labour did not increase in the same proportion leading to lower availability of family labour per unit area in larger size groups. So, the larger size group of farms had to depend more on hired labour for carrying out different farm operations compared to that of smaller size group of farms.

Regarding the use of manures and fertilizers it was observed that the average utilisation of farm yard manure by the sample banana cultivators was 150.94 quintals per hectares and showed a decreasing trend with the increase in farm size. The sample banana cultivators also applied chemical fertilizer in plantation to the extent of 221.67 kg of DAP, 158.19 kg of MOP and 7.57 kg of borax per hectare. The average per hectare expenditure incurred on plant protection chemicals by the sample banana cultivators was found to be Rs.3,764.76 which was as high as Rs.3,995.07 in small farms and as low as Rs. 2,866.65 in marginal farms.

2. Resource Productivity in Banana Plantation

Results of the ordinary least square (OLS) estimates of the parameters for the sample farms showed that net income of banana was positively related to expenditure on seedlings, fertilizer, labour and plant protection chemical, but was negatively related to expenditure on manure in small farms and miscellaneous expenditure in medium farms. This

Table 2: Regression Coefficients of Factors Influencing Banana Cultivation Across Various Size Groups of Sample Banana Cultivators of Nagaon District

Sl. No.	Variables	Marginal n=75	Small n=45	Medium n=30	Pooled n=150
1	**Seedling cost (Rs/ha)**	0.2956* (0.0327)	0.3031* (0.1017)	0.0398* (0.1178)	0.2935* (0.0325)
2	**FYM cost (Rs/ha)**	-0.0204 (0.0464)	-0.1271 (0.0734)	0.0866* (0.0693)	-0.0194 (0.0327)
3	**Fertilizer cost (Rs/ha)**	0.2773* (0.0421)	0.0526 (0.0656)	0.1400* (0.0451)	0.1401* (0.0274)
4	**Labour cost (Rs/ha)**	0.0712* (0.0134)	0.0046 (0.0131)	0.1544 (0.2245)	0.0512* (0.0126)
5	**Chemical cost(Rs/ha)**	0.1204* (0.0316)	0.0854* (0.0226)	0.0959* (0.0222)	0.0814* (0.0153)
6	**Misc. expenditure (Rs/ha)**	0.0108 (0.0395)	0.3719 (0.0457)	-0.1165 (0.1396)	0.1820* (0.0144)
7	R^2	0.9842	0.9882	0.9700	0.9712
8	**Returns to scale**	0.7548	0.6905	0.4002	0.7288
9	**t-value (testing significance of returns to scale)**	-0.2380	-0.2964	-0.6583	-0.2557

**Significant at 1 per cent probability level, Figures within parentheses indicate standard error*

implies that net income increased with increased expenditure on seedlings, fertilizer, labour and plant protection chemical, but decreased with increased expenditure on manure in small farms and miscellaneous expenditure in medium farms. The value of multiple determinations (R^2) ranged from 97.00 per cent in medium farms to 98.82 per cent in small farms indicating satisfactory fit to the data.

3. Returns to scale in Banana Cultivation

Returns to scale was found 0.75, 0.69 and 0.40 in marginal, small and medium farms, respectively which means that the production function exhibits decreasing returns to scale in all the farm sizes. However, it was not found significant in all the farm sizes. The 't' values calculated **(Table 2)** for testing the significance of returns to scale were less than the table values in all the size groups. Hence, it can be concluded that returns to scale were not significantly decreasing.

4. Resource Use Efficiency in Banana Cultivation

Table 3 reveals the resource use efficiency of various inputs in banana cultivation across various size groups of sample banana growers of Nagaon District. It is observed from the table that in marginal farms MVP of seedling, fertilizer, human labour, plant protection chemical and miscellaneous expenditure were found 0.4830, 0.8240, 0.0687, 0.9639 and 0.0602,respectively which indicated that one unit increase in expenditure on these input factors would have increased net return by Rs.048, Rs. 0.82, Rs. 0.07, Rs.0.96 and Rs.0.06. Whereas the MVP of manure (-0.0511) indicated that one unit increase in expenditure on manure would have decreased net return by Rs.0.05. The ratio of MVP to factor cost of majority of the resources viz. seedling, fertilizer, human labour, plant protection chemical and miscellaneous expenditure are less than 1 which indicated that the resources are over-utilized. Hence decreasing the quantity used of these resources would have increase profit. The ratio of MVP of manure to its marginal factor cost was found negative indicating grossly in-efficient and over-utilisation of the resource.

Table 3: Resource Use Efficiency of Various Inputs in Banana Cultivation across Various Size Groups of Sample Banana Growers in Nagaon District

Sl. No.	Input factor	Geometric Mean of Xi	MVP in Rs.	Factor cost	Ratio of MVP to factor cost
Marginal					
1	Seedling (Rs/ha)	13162.46	0.4830	1	0.4830
2	FYM (Rs/ha)	8596.08	-0.0511	1	-0.0511
3	Fertilizer(Rs/ha)	7237.89	0.8240	1	0.8240
4	labour(Rs/ha)	22298.23	0.0687	1	0.0687
5	chemical(Rs/ha)	2686.97	0.9639	1	0.9639
6	Misc(Rs/ha)	3862.35	0.0602	1	0.0602
Small					
1	Seedling (Rs/ha)	12698.37	0.4833	1	0.4833
2	FYM (Rs/ha)	7917.169	-0.3250	1	-0.3250
3	Fertilizer(Rs/ha)	7745.514	0.1374	1	0.1374
4	labour(MD/ha)	19303.22	0.0048	1	0.0048
5	chemical(Rs/ha)	3529.916	0.4897	1	0.4897
6	Misc(Rs/ha)	2573.94	2.9258	1	2.9258
Medium					
1	Seedling (Rs/ha)	11605.16	0.0645	1	0.0645
2	FYM (Rs/ha)	7413.17	0.2199	1	0.2199
3	Fertilizer(Rs/ha)	7381.67	0.3572	1	0.3572
4	Labour(MD/ha)	18748.18	0.1551	1	0.1551
5	Chemical(Rs/ha)	3532.95	0.5113	1	0.5113
6	Misc(Rs/ha)	1980.98	-1.1075	1	-1.1075
All Farm					
1	Seedling (Rs/ha)	12697.65	0.4754	1	0.4754
2	FYM (Rs/ha)	8141.83	-0.0490	1	-0.0490
3	Fertilizer(Rs/ha)	7415.7	0.3886	1	0.3886
4	Labour(MD/ha)	20626.05	0.0511	1	0.0511
5	Chemical(Rs/ha)	3080.27	0.5433	1	0.5433
6	Misc(Rs/ha)	2992.14	1.2513	1	1.2513

Conclusion

It is clear from the above analysis that seedlings, fertilizer, labour and plant protection chemical contribute significantly to the net return from banana cultivation. From the resource use efficiency, it is seen that decrease in the expenditure of seedling, fertilizer, human labour, plant protection chemical, manure and miscellaneous expenditure will make the banana cultivation profitable in the study area since there was an excess use of these resources. So, it is necessary for farmers to use resources properly in order to achieve potential output and thereby to earn more profit.

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