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ALLOCATIVE EFFICIENCY IN A TRADITIONAL ORISSAN AGRICULTURE A LINEAR PROGRAMMING APPROACH

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Abstract

The present paper is a humble attempt to test the allocative efficiency of the farmers in a traditional Orissan agriculture system in terms of resource-use and crop selection. While examining their allocative efficiency it is noted that the rational farmers are not necessarily efficient farmers. The farmers in the sample area are found to be rational in taking production decisions and efficient in the selection of crops and allocation of land in obtaining maximum possible outputs with the given resource constraints. However, they have been misutilizing their surplus non-hired labour and operating at the low level of efficiency due to some hurdles such as inadequate working capital, irrigation water and lack of embankments on the rivers. If these hurdles are removed, they would be able to perform at their highest level of efficiency.

INTRODUCTION

Standard economic theory treats an economic agent as rational person who maximizes his return using the available resources at his disposal while undertaking any economic activity. Basing upon this assumption various theories have been developed in the economic literature and these theories have been encouragements to the researchers in the field time and again to examine the optimizing behaviour of economic agents in various economic activities including agricultural activities. A number of studies have been undertaken in this regard both in the support of and against the hypothesis that the farmers are optimizers; they are efficient in the allocation of resources and in the selection of crops. The researchers who supported the hypotheses are Schultz (1964), Mundlak (1964), Raj Krishna (1964), Hopper (1965), Welsch (1965), Chennareddy (1967), Falcon and Gotsch (1967), Sahota (1968), Yotopolous (1968) etc and those who opposed the hypothesis are Desai (1963), Randhwa and Heady (1964), Rao (1965), Nayak (1990), Rudra (1992) and many others.

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In the last decade, the work of Amartya Sen (1990) has challenged the popular view that the rational human beings are optimizers. Se has been critical of both the definitions of rationality, i.e., rationality in terms of internal consistency of choice and maximization of self-interest. According to him, although rational behaviour may demand some consistency yet internal consistency of choice cannot be an adequate condition of rationality. The second approach to rationality as self-interest maximization is implicit in its approach of the rejection of the role of ethics in actual decision making (Bhattacharjee, 2000). Sen finds no reason why it will be uniquely rational to pursue one's own self-interest to the exclusion of everything else. In his view, although maximization of self-interest is not necessarily irrational, it is absurd that any thing other than maximizing self-interest must be irrational. Thus equating self-interest maximization with rationality and then identifying actual behaviour with rational behaviour is counter productive while defending the hypothesis of self-interest maximization.

Sen points out that the self-interest maximization hypothesis has no backing from empirical findings and the argument that the self-interested action would lead to efficient outcomes does not stand the test of motivational evidences in industrially successful countries like Japan and where factor like duty, loyalty and goodwill have played substantial role (Bhattacharjee 200). Sen's work on Indian agriculture also does not lend support to the hypothesis of self-interest maximization (Sen, 1966). He is stimulated by the farm management studies which state that if family inputs are evaluated at imputed prices then small farms are loss-makers. Sen has explained the continued existence of such deficit farms by the fact that their objectives are different. They are driven by a different rationality from that of the capitalist farms (Das, 1997-98). The view of Sen has been fully shared by Rudra (1992) in a study carried out in two clusters of 39 villages near Shantiniketan in West Bengal during the agricultural year 1980-81. According to Rudra, a close look at the decisions taken by the farmers in India suggests that they are guided by considerations other than maximization of short run profit. His study revealed that among the crops grown by the farmers' potato and sugarcane involved not only the highest amounts of working capital but also yielded the highest volume of profit per acre. In spite of these facts the large farms allocated largest portion of their land to wheat crop and not to potato and sugarcane. The farmers were found to be guided not by the profit

motive in the selection of crops but by the cost of cultivation of each individual crop. His study established an inverse relation between land allocated and cost of cultivation. Besides this, he identified few other reasons behind allocation of lands to different crops; about 65 percent of the farmers in his sample area opined that they got satisfaction in consuming home grown food. All the farmers irrespective of their size of land holdings believed in self-sufficiency in all the crops that they produced. Some of the farmers also opined that if they grew crops on the basis of profitability then had to face the problem of uncertainty with regard to the availability of some crops and their prices. As regards production of a single most profitable crop, 12 percent of the farmers felt it unwise to depend on a single crop whose excess supply during harvesting might fetch un-remunerative price in the absence of better marketing network. These are some of the observations made by the author on the behaviour of farmers which are quite rational but opposed to the hypothesis of self-interest maximization in terms of return.

Basing upon the trend of thinking about the concept of rationality and its distinctiveness from the behaviour of optimality it was felt necessary to conduct a sample study in the traditional agriculture of Orissa. The study was undertaken with the objective to test the allocative efficiency of the farmers in terms of resource-use and crop selection with the assumption that they are rational in their decision making process.

DATA AND METHODOLGY

Data were collected in the year 200 from 250 agricultural farms spread over five villages, viz. Baramania, Govindpur, Hadua, Juania and Madhuban in the Aul Development Block of Kendrapara District in Orissa. The farmers were divided into six different categories according to their size of land holdings and from each category 25 percent of farmers were randomly selected for collecting data on various agricultural inputs and outputs. The data were analyzed using the linear programming technique. In total, four models were constructed and tested. In Model I, it was desired to know if the total output could be maximized without increasing the resources. Model II was constructed to minimize the labour input (man days) without affecting the existing level of output and other inputs. In Model III, the possibility of maximizing output was explored by increasing all the resources excepting land and irrigation water. Lastly in

Model IV, all the resources were allowed to increase including the land for double cropping in order to maximize the level of output.

RESULTS AND DISCUSSIONS

The sample villages are located on the bank of the river 'Kharasrota' and surrounded by another river call 'Kani'. Infrastructure wise the area is not lagging behind much. Villages are well connected by spacious but *Kutcha* roads and are having other facilities including electricity, telephone, public tube wells, schools and college. Farmers are acquainted with the use of tractor, improved varieties of seeds (HYVs) and chemical fertilizers. In spite of all these they have been facing uncertainty in agricultural production, particularly in Kharif season. Kharif rice is totally dependent on natural rainfall and gets affected by flood almost every year due to absence of embankments on both the rivers. Farmers grow in total six different crops in the sample villages which include kharif rice, summer rice, wheat, black gram, green gram and groundnut. However, all the crops are not grown by all the farmers. Some of the important inputs by them that are taken as resource constraints in our models of the present study include human labour, bullock labour, seeds, organic and inorganic fertilizers, pesticides, irrigation water and land.

The study reveals that out of a total of 1820.30 acres of land cultivated by the farmers in the sample villages more 60 percent of the cultivated lands were devoted to production of rice in kharif season in spite of the fact that the crop was most unreliable and least yielding (Table 1). Black gram got the second in priority followed by summer rice, groundnut, wheat and green gram so far as allocation of land was concerned. On an average, an acre of land yielded an output worth Rs.3740. However, the productivity of land varied from one crop to another. It was estimated to be highest in wheat (Rs.17, 865) followed by summer rice (Rs.11, 040), groundnut (Rs.7005), black gram (Rs.3001), kharif rice (Rs1815) and green gram (Rs.1030). Analysis of cost of production of various crops revealed that it was lowest in kharif rice mainly because of two reasons: Firstly, as the crop is grown in kharif season and is dependent on natural rainfall. There was no expense involved on account of irrigation water. Secondly, the farmers did not apply chemical fertilizers to the crop apprehending flood. Thus, per acre working capital

investment was quite low in kharif rice in comparison to all other crops. That was the main reason why the farmers in the sample villages had been giving more weight to kharif rice in the allocation of land in spite of low productivity.

It further revealed that 90 percent of the farmers grew all the six crops and they did not bother whether any particular crop was high yielding or not. They believed that as far as satisfaction was concerned home grown crops were better than the crops sold in the market. More than 80 percent of the farmers opined their willingness to be self-sufficient in various crops produced by them for their home consumption. They did not believe in commercialized farming. Had they believed so, they would have preferred to produce only those crops which were high yielding and more profitable. Thus, observing the allocation pattern of land to different crops it is concluded that the production decisions are not influenced by the productivity of crops but by their production cost and such other considerations like self-sufficiency in food for home consumption, uncertainty in the prices of the produced crops etc.

In Table 2, data on output, labour and the land input allocated to different crops are presented. Data shown against the column 'existing case' represent the actual data on outputs and inputs whereas the data against other columns refer to estimated data under efficient resource allocation under certain conditions. In Model I, the objective was set to maximize the total output without increasing any of its inputs. Unfortunately Model I could not provide a solution to this effect implying the fact that the farmers were quite efficient in achieving highest level of outputs with the given resources at their disposal. But we know that there is surplus labour in agriculture and the farmers in the absence of alternative/additional occupations are forced to engage their labour in the agricultural work. In order to know to what extent they have been misutilizing their labour, Model II was constructed with the objective to minimize the labour resource for achieving the existing level of output without increasing any of its resources. The model provided us with a solution suggesting production of only three crops such as kharif rice, black gram and wheat instead of the existing six crops. This type of strategy in production and land allocation would have enabled the farmers to save labour to the extent of 44,590 man days. In other words, 28 percent of the labour engaged could be withdrawn and used as leisure time if not used in any other profitable venture.

In Model III, an attempt was made to have a test on the possibility of increasing output beyond its existing level by increasing all the inputs excepting land and irrigation water. The result revealed that the output measured in rupees could be increased from the existing level of 67, 49,000 to 82, 92,335. In other words, if the farmers could opt to cultivate only four crops such as kharif rice, summer rice, wheat and groundnut they would have been able to increase output by more than 32 percent and simultaneously been able to generate additional employment of 28,880 man days of work.

In Model IV, it was explored to achieve highest level of output where the farmers did not have to face any problem regarding resource. It was thought of an ideal situation where the farmers were provided with all the required inputs including required irrigation water and land for double cropping. The result revealed that there was a great scope for achieving the desired objective of output maximization. The solution suggested production of three crops in total: two crops in summer such as wheat and summer rice and one crop in kharif season. However, this necessitated the provision for large-scale irrigation. It recommended the increase in area under irrigation from existing 241.71 acres to 1083.77 acres. This would enable the farmers not only to increase the output by three-folds but also to generate additional employment by 10,110 man days of work. Besides, the farmers did not have to take botheration of producing six different crops.

CONCLUSION

The review of literature and the facts and figures collected from the traditional agriculture of Orissa revealed that the entire controversy regarding the concept of rationality and self-interest maximization was unwarranted and uncalled for. The study revealed that an economic agent who is rational is not necessarily a self-interest maximizer. The farmers are found to be by and large efficient and rational in utilizing their resources for achieving maximum level of output excepting in the case of labour resource which is in plenty. However, certain inadequacies in the form of the working capital and irrigation facilities and in the absence of embankments on the rivers, the farmers have been operating at their low level of efficiency. These inadequacies, if removed, would go a long way in helping the farmers in the sample villages in solving their food problem and in leading a decent life.

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THE MODELS:

The following four Models were formulated to test allocative efficiency of the farmers in the sample villages:

Model - I

Maximize Aggregate Output (Q), $Q = \sum_{j=1}^{6} b_j X_j$

Subject to the constraints, $\sum_{i=1}^{7} a_{ij} X_j \le C_i \quad j = 1,2,...,6$

$$X_1 = L_1$$

$$\sum X_j = L_1 + L_2 \quad j = 2,3,...,6$$

and $X_j \ge 0$ where, X_j - acres of land to be cultivated to produce jth crop.

b_j - per acre output of jth crop.

a_{ij} - amount of ith input required to produce jth crop per acre of land.

C_i - amount of ith input available to farmers.

L_1 - acres of land available/cultivated for production of kharif rice.

L_2 - acres of land cultivated to produce all the crops excepting kharif rice.

Model – II

Minimize Aggregate Human Labour (HL), $HL = \sum_{j=1}^{6} a_j X_j$

Subject to the constraints, $\sum_{i=1}^{7} a_{ij} X_j \le C_i \quad j = 1,2,...,6$

$$\sum_{j=1}^{6} b_j X_j = Q$$

$$X_1 = L_1$$

$$\sum X_j = L_1 + L_2 \quad j = 2,3,...,6$$

and $X_j \ge 0$ where X_j, b_j, a_{ij}, C_i, L_1 and L_2 are same as defined in Model - I.

Model – III

Maximize Aggregate Output (Q), $Q = \sum_{j=1}^{6} b_j X_j$

Subject to the constraints, $\sum_{i=1}^{6} a_{ij} X_j \geq C_i \quad j = 1,2,...,6$

$$\sum a_{7j} X_j \leq C_7 \quad j = 1,2,...,6$$

$$X_1 = L_1$$

$$\sum X_j = L_1 + L_2 \quad j = 2,3,...,6$$

and $X_j \geq 0$ where X_j, b_j, a_{ij}, C_i, L_1 and L_2 are same as defined in Model - I.

Model – IV

Maximize Aggregate Output (Q), $Q = \sum_{j=1}^{6} b_j X_j$

Subject to the constraints, $\sum_{i=1}^{7} a_{ij} X_j \geq C_i \quad j = 1,2,...,6$

$$X_1 = L_1$$

$$\sum X_j = 2L_1 \quad j = 2,3,...,6$$

and $X_j \geq 0$ where X_j, b_j, a_{ij}, C_i and L_1 are same as defined in Model - I.

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Table 1

OUTPUTS AND INPUTS OF AGRICULTURAL FARMS

Item	Per Acre Output and Input of the Crops						Aggregate Output/ Input
	Kharif Rice	Summer Rice	Wheat	Black Gram	Green Gram	Groundnut	
Output ('000 Rs.)	1.6180	11.0434	17.8691	3.1012	1.0326	7.0087	6749
Labour (man days)	82	198	52	26	28	110	157870
Bullock Labour (days)	9	14	11	3	6	21	17140
Tractor Service ('000 Rs.)	0.2	0.25	0.25	0.25	0.25	0.25	12350
Seeds ('000 Rs.)	0.2901	0.7907	0.5136	0.3739	0.2738	0.9683	750650
Fertiliser ('000 Rs.)	0.0	3.0167	0.8556	0.0	0.0	0.1561	754615
Pesticide ('000 Rs.)	0.0	0.5361	0.0431	0.0	0.0	0.0017	119175
Water ('000 Rs.)	0.0	0.5844	0.0924	0.0	0.0	0.0	128995
Land (acres)	1095.2	218.0	24.0	330.0	20.0	133.1	1820.3

Table 2

EXISTING VERSUS EFFICIENT RESOURCE ALLOCATION

(Solution of LP Models)

Item		Existing Case	Optimum Cases in			
			Model – I*	Model – II	Model – III	Model – IV
Output (in '000 rupees.)		6749	-	6749	8292.34	20356.98
Labour(in '000 man days)		157.87	-	113.28	168.75	167.98
Land (no. of acres allocated to the crops)	Kharif Rice	1095.2	-	1095.20	1095.20	1095.20
	Summer Rice	218.0	-	0.0	215.00	145.00
	Wheat	24.0	-	180.45	40.00	952.40
	Black Gram	330.0	-	544.65	0.00	0.00
	Green Gram	20.0	-	0.00	0.00	0.00
	Groundnut	133.1	-	0.00	470.10	0.00

* No feasible solution obtained.

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