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Resource use efficiency and profitability of poultry and dairy enterprise *vis-à-vis* crop cultivation- A case study of Mandya district

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ABSTRACT

Farming systems approach leads to the sustainable development of agriculture without much hazardous to the environment. The whole farming, rather than the individual crops/enterprises need to be considered in the decision making under the Farming Systems approach. The study was conducted in Mandya district of southern Karnataka with an overall objective of identifying and analyzing the optimality and sustainability of different paddy based farming systems. Major farming systems identified in the study area were Farming System-I (crop production and poultry enterprises), Farming System -II (crop production and dairy enterprises). The net return in Farming System-I was. Rs.171933.81, which was found to be most profitable one and net returns in farming system-II, was Rs. 83657.88. The analysis revealed that farmers were operating closer to optimality under existing resource levels as indicated by marginal increases in net farm returns. However, with the reallocation of resources net returns were increased by 0.33% over existing plan under Farming System-I, but in case of Farming System-II there is sizeable increase in net farm returns (17.31%) over existing plan and in optimum plan- II (by relaxation of labour and capital), the net farm returns increased by 9.06 and 23.65 per cent over existing plan Farming System-I and Farming System-II respectively.

Key Words: Farming system, MVP, MFC and production function

Agricultural progress is normally regarded as a prerequisite of economic development. It is true that economic development in modern times has to be associated with industrialization, nevertheless, it is generally accepted that industrialization can follow only on the sound heels of agriculture or, to turn the metaphor, agriculture is the foundation on which the entire superstructure of the growth of industrial sector and other sectors of the economy has to stand. Indian agriculture is characterised by mixed farming involving a system of combining crop production with one or more of the livestock enterprises like rearing of cattle, sheep, goat, pigs and poultry as well as fishery, bee-keeping, sericulture, *etc*. Although in India farming is not commercialized to a large extent, it remains that farmer has to make decisions regarding his business of farming, with a view to attaining maximum welfare.

Today, farming systems research with a farmer's perspective occupies pride of place in India's agricultural research agenda. farming systems concept, after tracing the evolution of general systems theory as a system referring to crop combination or enterprise mix in which the products and/or the by-products of one enterprise serve as inputs for the production of other enterprises (Maji, 1991). The whole farming, rather than the individual crops/enterprises need to be considered in the decision making under the farming systems approach. Mandya is one of the major paddy-growing districts in Karnataka and paddy cultivation occupies nearly 45 per cent of the net cultivated area in Mandya district. Hence, in the study area paddy based farming systems forms an important means to generate employment and income. In this district, with the cultivation of paddy, other field crops and livestock enterprises like dairy, poultry and sericulture are also being practiced. Few studies have been made in isolation but no systematic study has been made to know the impact of paddy based farming systems on income and employment generation.

Keeping this in view, an attempt was made *i.e* to evaluate cost and returns and resource use efficiency in paddy based farming systems ii, to determine optimum paddy based farming system models

METERIALS AND METHODS

Mandya is one of the major paddy-growing districts in Karnataka. Paddy is grown as a major field crop by majority of the farmers. In the present study, multistage random sampling technique was adopted for the selection of study area and sample respondents for collection of information required for the study. The study was based on primary data and primary data were collected through personal interview method using well structured, pre-tested schedules designed for the purpose. The information so collected for the study pertained to the agricultural year 2004-05.

To study resource productivity and allocative efficiency in both farming systems, a modified Cobb-Douglas type of function was fitted. This was done with a view to determine the extent to which the important resources that have been quantified, explain the variability in the gross returns of the farming systems and to determine whether the resources were optimally used in these farming systems. The general form of the function is $y = ax_i^{bi}$ where, 'x_i' is the variable resource measure, 'y' is the output, 'a' is a constant and 'bi' estimates the extent of relationship

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between xi and y and when xi is at different magnitudes. The 'b' coefficient also represents the elasticity of production in Cobb-Douglas production function analysis.

The ratio of the MVP to MFC of individual resources were used to judge the allocative efficiencies. The computed Marginal Value Product (MVP) was compared with the Marginal Factor Cost (MFC) or opportunity cost of the resource to draw inferences. A resource is said to be optimally allocated when its MVP = MFC.

$$\text{MVP of } x_i^{th} \text{ resource} = b_i \frac{Y}{\bar{x}_i}$$

Where,

Y = geometric mean of gross returns.

x_i = geometric mean of i^{th} independent variable

b_i = regression coefficient or elasticity of production i^{th} independent variable

This analysis was carried out in order to identify the possibilities of increasing gross returns under a given farm situation.

The deterministic linear programming technique was employed to workout the maximum attainable returns by the optimum allocation of various available resources. In linear programming analysis, linear functions of a number of variables to be maximised subject to a number of constraints in the form of linear equalities and inequalities. Land, labour and capital are the most limited resources on the farms and these were treated as constraints in the production of different activities. In mathematical form, linear programming model can be expressed in the following way.

$$\text{Maximize } Z = \sum_{j=1}^{n} C_j X_j \text{ …….....(objective function)}$$

Subject to

1) $\sum_{j=1}^{n} C_{ij} X_{ij} \geq b_i \; (i=1 \ldots . k)$

2) $\sum_{j=1}^{n} a_{ij} X_{ij} \leq b_i \; (i=k+1 \ldots . m)$

3) $\sum_{j=1}^{n} a_{ij} X_{ij} = b_i \; (i=m+n \ldots . n)$

4) $\sum_{j=1}^{n} X_j \geq 0$

where,

Z = net returns from all crops activities included in the model

C_j = Net returns from j^{th} activity, measured in rupees per unit of j^{th} activity

X_j = Level of j^{th} activity

a_{ij} = The quantity/amount of i^{th} resource/input required per unit of j^{th} activity

b_i = Total availability of i^{th} resource on the farm

Optimum Plans: To accomplish the objectives of the study, a few variations in the basic models were incorporated. The following alternative plans were developed.

Existing Model: These models comprised of the existing crop alternatives with existing cultivation practices and the available resources to the farmers.

Optimum Plan I: These models were similar to the Existing Model with the reallocation of existing resources by using programming technique.

Optimum Plan II: These models were similar to optimum Plan-I with relaxation of labour and capital. These models would help to examine the effect of increased capital and reallocation of land and consequential effect on net farm incomes.

RESULTS AND DISCUSSION

Different paddy based farming systems were identified in the study area, among those identified farming systems Farming System-I (Crop production and poultry enterprises) and Farming System-II (Crop production and dairy enterprises) are most profitable one, here the by product of one enterprise acts as a input for other enterprise.

A. Economics of different enterprises

A. 1. Costs and returns structure in farming system I

The costs and returns of different enterprises under Farming System-I in the study area and the share of cost and returns of each enterprise in the whole farming system was presented in Table 1. In the whole Farming System's total costs, the share of poultry enterprise was the highest (88.14%) which revealed that in Farming System-I, poultry was a major enterprise and the maximum capital available with farmers were used for rearing poultry. As that of the share of total costs to share of net returns (83.90%) were also high in poultry enterprise, as it is a highly remunerative enterprise. But the return per rupee of expenditure was observed to be low in poultry (1.22). In this Farming System, farmers maintained the poultry enterprises as a subsidiary enterprise and supplemented sustained higher income.

Table 1. Costs and returns structure of different enterprises under farming system-I

(Rs. / Farm)

Sl. No.	Particulars	Paddy		*R*agi		Poultry	Farming system as a whole
		Kharif	***Rabi***	***Kharif***	***Rabi***		
I	**Costs**						
	Total variable cost	29294.09 (3.99)	28166.11 (3.83)	6921.68 (0.94)	5555.95 (0.76)	664880.23 (90.48)	729262.10 (100.00)
	Total fixed cost	9333.38 (27.35)	9333.38 (27.35)	1401.60 (4.11)	1154.80 (3.38)	12904.77 (37.81)	32973.13 (100.00)
	Total cost	38627.47 (5.02)	37499.49 (4.88)	8323.28 (1.08)	6710.75 (0.87)	677785.00 (88.14)	768945.99 (100.00)
II	**Returns**						
	Gross return	50358.17 (5.35)	49804.67 (5.29)	10085.58 (1.07)	8589.58 (0.91)	822041.80 (88.37)	932290.2 (100.00)
	Net return	11730.70 (6.82)	12305.18 (7.16)	1762.30 (1.02)	1878.83 (1.09)	144256.80 (83.90)	171933.81 (100.00)
	B: C ratio	1.31	1.32	1.20	1.27	1.22	1.28

*Figures in parentheses indicate percentage to respective totals.

Under this farming system, the *kharif* paddy cultivation had 5.02 per cent share in total cost, where as its contribution to total returns was 5.35 per cent. Similar results were observed by Chahal and Chahal (1989). Per cent share of total costs of *rabi* paddy was found to be 4.88 per cent and its contribution to total returns was 5.29 per cent. Even though the share of *kharif* ragi and *rabi* ragi in total cost as well as in total returns was less, ragi was cultivated by the farmers, as it is a staple food crop and also provides fodder for maintenance of livestock (drought animals).

2. Costs and returns structure in farming system-II

The per farm costs and returns and their shares in the whole Farming System is presented in the Table 2. It was observed that in the total cost of the whole Farming System, dairy had comparatively a higher share (44.20%) with respect to total cost and as well as net returns (49.49%). Similar results were observed by Alagumani and Ajugam (2000). The share of *rabi* paddy was 20.55 per cent, followed by *kharif* paddy 17.11 per cent, sugarcane 14.04 per cent and *kharif* ragi in the total cost.

Sugarcane crop accredited maximum profit in the system as a whole and found to be the most remunerative crop as indicated by high returns per rupee of expenditure with comparatively lower cost of cultivation. It was observed that dairy enterprise yielded high returns per rupee of expenditure compared to *kharif* paddy, *rabi* paddy and *kharif* ragi. The byproducts of crop enterprises were used as input in dairy enterprise and milk production was comparatively high.

Table 2. Cost and returns structure of different enterprises under farming system-II

(Rs. / Farm)

Sl. No.	Particulars	*Kharif* paddy	*Kharif* ragi	*Rabi* paddy	Sugarcane	Dairy	Farming system as a whole
I.	**Costs**						
	Total variable cost	22461.58 (14.70)	5873.16 (3.84)	26398.89 (17.28)	21246.31 (13.91)	76791.33 (50.27)	152771.27 (100.00)
	Total fixed cost	7434.79 (33.96)	1259.24 (5.57)	9497.62 (43.38)	3290.50 (15.03)	413.43 (1.89)	21895.58 (100.00)
	Total cost	29895.79 (17.12)	7132.40 (4.08)	35896.51 (20.55)	24536.81 (14.05)	77204.76 (44.20)	174666.85 (100.00)
II.	**Returns**						
	Gross return	37907.83 (14.67)	8993.42 (3.48)	48983.29 (18.96)	43826.67 (16.97)	118613.46 (45.92)	258324.73 (100.00)
	Net return	8012.04 (9.58)	1861.02 (2.22)	13086.78 (15.64)	19289.86 (23.06)	41408.70 (49.50)	83657.88 (100.00)
	B: C ratio	1.27	1.28	1.37	1.76	1.53	1.44

*Figures in parentheses indicate percentage to respective totals.

B. Resource use efficiency and allocative efficiency of resources

In order to maximize the profits from an enterprise, the optimum use of resources is imperative. The technique of Cobb-Douglas production function was used to measure the resource use efficiency and allocative efficiency of resources.

B.1. Farming system-I

The production function analysis of Farming System-I for different resources (Table 3) indicated that the elasticity coefficient of feed was statistically significant, while those of other coefficients were non significant. Gross income was significantly and positively affected by feeds, which indicated that, one per cent increase of feed would increase gross income to an extent of 0.57 per cent. The coefficient of multiple determination indicated that 99.50 per cent of the variation in gross income was explained by the independent variables included in the production function. The return to scale was found to be less than unity, which indicated decreasing returns to scale.

Table 3. Cobb-Douglas production function estimates and MVP to MFC ratios for farming system-I

Sl. No.	Particulars	Parameter	Estimated values		Mean	MVP : MFC ratios
1.	Intercept	a	1.2733			
2.	Land (ha)	b_1	0.0004	(0.0590)	2.20	0.016
3.	Bird (Nos.)	b_2	0.2193	(0.1868)	11,583.33	1.484
4.	Fertilizer + FYM cost (Rs.)	b_3	-0.0507	(0.0369)	15,640.58	-3.051
5.	Human labour cost (Rs.)	b_4	0.0703	(0.0570)	25,810.63	2.561
6.	Bullock labour cost (Rs.)	b_5	-0.0143	(0.0333)	8,771.44	-1.531
7.	Other paid out cost (Rs.)	b_6	0.0589	(0.1991)	24,787.91	2.234
8.	Feed cost (Rs.)	b_7	0.5742	(0.0951)**	4,29,475.00	1.258
9.	Seed cost (Rs.)	b_8	0.0806	(0.0439)	2,919.04	25.993
		R^2	0.995			
		Returns to scale	0.967			
		Gross returns	**9,40,879.80**			

Note : Figures in parentheses indicate the respective standard errors. ** Significant at 5% level

For Farming System-I, all MVP:MFC ratios were greater than unity except for land, which showed under-utilization of these resources. There is scope for increasing the use of inputs to increase the gross income. In the case of fertilizer+FYM and bullock labour, MVP:MFC ratios were negative, which indicated over-utilisation of these resources. The gross income could be increased by withdrawing certain units of these over-utilized resources.

B. 2. Farming system-II

In the case of Farming System-II, bullock labour and number of cows had negative coefficients, indicating the decrease in gross income for the increased use of any of these resources. Feed, seeds and fertilizer+FYM had positive and significant influence on gross returns at 5 per cent level, which could be attributed the crops grown under this system are fertilizer intensive. Every per cent increase in fertilizer+FYM increased the gross returns to the tune of 0.24 per cent, and a per cent increase in feed and seed increased the gross income to the tune of 0.63 and 0.14 per cent, respectively. The resources viz. land, human labour and other paidout cost also had positive effect indicating that gross returns could be increased by using increased quantities of these resources. The coefficient of determination (R^2) value showed that 98.45 per cent of the variation in gross income was explained by the variables considered in the production function. The sum of elasticities of coefficient was 1.02, which showed increasing returns to scale.

The Table 4 shows that the MPV:MFC ratios for land, fertilizer+FYM, feeds and seeds were more than unity, which showed the under-utilization of these resources. There is scope for increasing the returns by increasing these resources to some extent. The MVP:MFC ratios for the resources like number of cows and bullock labour were negative and for human labour and other paidout costs were less than unity which shows uneconomic use of these resources. The ratios suggested for curtailment of number of cows, human labour, bullock labour and other paidout cost to some extent, to increase income.

C. Optimum farm plans for different paddy based farming systems

C.1. Farming system-I

The area under *kharif* paddy increased in both the plans i.e., Plan-I and Plan-II. In the case of *kharif* ragi, the area decreased in Plan-I, whereas it increased in Plan-II. The area under *rabi* paddy increased in both the Plans, but for *rabi* ragi, the area substantially decreased in Plan-I but increased in Plan-II (Table 5). The number of birds decreased in Plan-I and in Plan-II, the number of birds increased. The per farm net returns increased in both the plans over the Existing Model. From this, one can say that instead of spending resource on crop enterprises, if the number of poultry birds were increased to optimum level of 12,577 per farm, one can optimize the net income of the farm.

Table 4: Cobb-Douglas production function estimates and MVP to MFC ratios for farming system-II

Sl. No.	Particulars	Parameter	Estimated Values		Mean	MVP : MFC Ratios
1.	Intercept	a	0.6399			
2.	Land (ha)	b_1	0.1418	(0.0678)	2.00	1.516
3.	Cows (Nos.)	b_2	-0.1309	(0.0414)	4.57	-0.252
4.	Fertilizer + FYM cost(Rs.)	b_3	0.2445	(0.0656)**	16,555.09	3.815
5.	Human labour cost (Rs.)	b_4	0.0089	(0.0587)	22,814.99	0.101
6.	Bullock labour cost (Rs.)	b_5	-0.0314	(0.0439)	9,720.75	-0.835
7.	Other paid out cost (Rs.)	b_6	0.0160	(0.0166)	21,300.33	0.195
8.	Feed cost (Rs.)	b_7	0.6342	(0.0473)**	1,18,613.52	1.381
9.	Seed cost (Rs.)	b_8	0.1399	(0.0266)**	10,897.61	3.317
		R^2	0.985			
		Return to scale	1.023			
			Gross returns		**2,58,324.73**	

** Significant at 5% level , Figures in parentheses indicate the respective standard errors

Table 5: Optimum paddy based farming system-I in different plans (Area in ha)

Sl. No.	Crop or Livestock activity	Existing plan	Plan-I	Plan-II
1.	*Kharif* paddy (X_1)	1.41	1.53	1.53
2.	*Kharif* ragi (X_2)	0.57	0.35	0.58
3.	*Rabi* paddy (X_3)	1.41	1.53	1.53
4.	*Rabi* ragi (X_4)	0.43	0.25	0.65
5.	Poultry (Nos.) (X_6)	11583.33	11565.54	12576.59
I	**Net returns per farm**	**171933.81**	**172498.90**	**187555.00**
II	**Per cent change in net returns**			
	a) Over Existing Plan		0.33	9.06
	b) Over Plan-I			8.73

C.2. Farming system-II

The area under *kharif* paddy and *rabi* paddy decreased substantially in both the Plans, whereas the area under sugarcane increased substantially in both the plans, since the sugarcane is a high earning crop. The area under *kharif* ragi decreased which is still observed in the Plans, as it required lower level of inputs. The number of animals decreased in Plan-I and increased substantially in Plan-II (Table 6). Hence, it could be concluded that sugarcane and dairy were the best enterprises in the system by which one can maximize the net returns.

Table 6. Optimum paddy based farming system-II in different plans (Area in ha)

Sl. No.	Crop or livestock activity	Existing plan	Plan-I	Plan-II
1.	*Kharif* paddy (X_1)	1.136	0.39	0.39
2.	*Kharif* ragi (X_2)	0.46	0.27	0.03
3.	*Rabi* paddy (X_3)	1.44	0.39	0.39
4.	Sugarcane (X_5)	0.41	1.15	1.15
5.	Dairy (Nos.) (X_8)	4.57	4.00	5.06
I	**Net returns per farm**	**83658.40**	**98140.73**	**106867.10**
II	**Per cent change in net returns**			
	a) Over Existing Plan		17.31	23.65
	b) Over Plan-I			6.34

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