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Research Article

Resource use efficiency in paddy and cotton cultivation in Uttara Kannada district of Karnataka

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SUMMARY : The study was under taken in Uttara Kannada district of Karnataka state. The two major Taluks *viz.,* Mundagod and Haliyal where paddy has been largely replaced by cotton were selected. From each Taluk, 30 farmers growing paddy and 30 farmers growing cotton were selected randomly for the study. In paddy cultivation farmers used 46.90 man days of human labour, 13.76 pair days of bullock labour and 4.28 hours of machine labour, 3.92 tonnes of FYM. 138.8 kg of nitrogenous, 69.7 kg of phosphorus and 59.61 kg of potassium fertilizers kg per hectare. The seed rate used was 78.8 kgs per hectare. In cultivation of cotton the sample farmers used 59.41 man days of human labour, 20.67 pair days of bullock labour and 1.19 hours of machine labour per hectare, 5.32 tonnes of FYM. 140.9 kg of nitrogenous and 71.2 kg of phosphorus and 68.3 kg of potassium fertilizer per hectare. The seed rate used was 2.87 kg per hectare. In cultivation of paddy FYM, chemical fertilizers and bullock labour were underutilized whereas seeds and FYM were underutilized where was chemical fertilizers, human labour and bullock labour were over utilized.

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BACKGROUND AND OBJECTIVES

Karnataka is one of the major rice growing states in India. The area under rice production is increasing over the years. Rice is grown under varied conditions and bulk of the area is under assured rainfall and irrigated conditions under canals and tanks. Karnataka ranks fourth in productivity and ninth in production among major rice growing states of the country. The important rice growing districts of the state are, Haveri, Uttar Kannada, Dharwad, Koppal, Raichur, Mysore, Hassan, and Chitradurga. In Uttara Kannada district, the major paddy growing region in the state of late the paddy crop is being replaced by cotton crop in upland of the district.

RESOURCES AND METHODS

The study was undertaken in Uttara Kannada district of Karnataka State. Uttara Kannada district is situated roughly in the mid-north-western part of the state. Uttara Kannada district is the major paddy growing area in the state of Karnataka. Of late the paddy crop is being replaced by cotton in uplands of the district and hence the district was purposively selected for the study. The two major taluks *viz.,* Mundagod and Haliyal where paddy has been largely replaced by cotton, were purposively selected for the study. From each Taluk, 30 farmers growing paddy and 30 farmers growing cotton were selected randomly for the study. Thus, the total sample size selected for the study was 120 consisting of 60 paddy growers and 60 cotton growers. The primary data with respect to labour and input use pattern were collected from the sample farmers by personal interview method with the help of pre-structured schedule.

The tabular presentation method was followed to study the labour and input use pattern. The averages and percentages were worked out. To analyse the resource use efficiency Cobb-Douglas production function was employed and MVP to MFC ratios were calculated for each of

each of the resource used in cultivation.

The form of Cobb-Douglas production function used in the present study is as follows:

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}e^u \quad (1)$$

where,

Y = Gross returns (Rs./acre)
a = Intercept
X_1 = Chemical fertilizers cost (Rs./acre)
X_2 = Seed cost (Rs./acre)
X_3 = FYM cost (Rs./acre)
X_4 = Human labour cost (Rs./acre)
X_5 = Bullock labour cost (Rs./acre)
e^u = Random error term
bi's = Output elasticities of respective factor inputs, i = 1, 2...5

The Cobb-Douglas production function was converted into log linear form and parameters (coefficients) were estimated by employing Ordinary Least Square Technique (OLS) as given below:

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + u \log e \quad (2)$$

The returns to scale were estimated directly by getting the sum of 'bi' coefficients. The returns will be increasing, constant or diminishing based on whether value of summation of 'bi' is greater, equal or less than unity, respectively.

The ratios 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 the inferences. A resource is said to be optimally allocated when its MVP = MFC. The marginal value products (MVP's) were calculated using the geometric mean levels of the variables using the formula.

$$\text{MVP } i^{th} \text{ resource} = b_i \frac{\bar{Y}}{\bar{X}i}$$

where,

$\bar{Y}$ = geometric mean of gross returns.
$\bar{X}_i$ = geometric mean of i^{th} independent variable
b_i = regression coefficient or elasticity of production of i^{th} independent variable

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

OBSERVATIONS AND ANALYSIS

The quantity of labour used in the different operations of paddy cultivation per hectare area is presented in the Table 1. It can be observed from the table that the paddy farmers used more quantity of human labour in case of harvesting *i.e.* 39.66 per cent, because harvesting is a more labour intensive operation compared to other operations being practiced by the farmers.

The other operations where human labour was used were ploughing (5.23 per cent), harrowing (7.72 per cent), transportation of FYM (2.98 per cent), spreading of FYM (8.10 per cent), sowing which also includes seed bed preparation (10.02 per cent), fertilizer application (5.54 per cent), weeding (9.38 per cent), intercultivation (5.12 per cent), application of plant protection chemicals (3.05 per cent) and irrigation (3.20 per cent). The bullock labour was used mainly in sowing (28.13 per cent), harrowing (26.30 per cent), ploughing (17.82 per cent) operations, transportation of FYM (10.17 per cent) and intercultivation (17.58 per cent). Farmers preferred to carryout these operations with the bullock labour may be because they had bullock pairs and they thought using machine labour is

Table 1: Labour utilization pattern in paddy cultivation **(Per hectare)**

Operations	Human labour		Bullock labour		Machine labour	
	(Mandays)	Percentage	(Pair days)	Percentage	(Machine hours)	Percentage
Ploughing	2.45	5.23	2.45	17.82	2.81	65.63
Harrowing	3.62	7.72	3.62	26.30		
Transportation of FYM	1.40	2.98	1.40	10.17	1.47	34.37
Spreading of FYM	3.80	8.10				
Sowing	4.70	10.02	3.87	28.13		
Fertilizer application	2.60	5.54				
Weeding	4.40	9.38				
Intercultivation	2.42	5.12	2.42	17.58		
Plant protection chemicals	1.43	3.05				
Irrigation	1.50	3.20				
Harvesting	18.60	39.66				
Total	46.90	100	13.76	100	4.28	100

Table 2: Labour utilization pattern in cotton cultivation **(Per hectare)**

Operations	Human labour		Bullock labour		Machine labour	
	(Mandays)	Percentage	(Pair days)	Percentage	(Machine hours)	Percentage
Ploughing	3.69	6.20	3.69	17.84	1.00	84.04
Harrowing	4.95	8.33	4.91	23.75		
Transportaion of fym	4.56	7.67	4.56	22.05	0.19	15.96
Spreading of Fym	3.80	6.40		0.00		
Sowing	4.70	7.91	3.77	18.22		
Ferrtilizer application	3.41	5.74				
Weeding	5.03	8.47				
Intercultivation	3.52	5.92	3.75	18.14		
Plant protection chemicals	1.32	2.22				
Irrigation	-	-				
Harvesting	24.44	41.13				
Total	59.42	100	20.68	100	1.19	100

costly affair. Among the operations being practiced by the paddy farmers machine labour was used for ploughing of the land (65.63 per cent) and transportation of FYM (34.37 per cent). It is only the big farmers who used machine labour as they had machines and they wanted to carryout these operations on larger area in a shorter period of time.

In the study area, farmers used the different types of inputs in the cultivation of paddy. About seven types of inputs were used in the cultivation of paddy (Table 2). They were seeds, farm yard manure, human labour, bullock labour, tractor labour, bio fertilizers, chemical fertilizers and plant protection chemicals. The seeds were used at the rate of 78.8 kg per hectare of land. The recommended seed rate is 75 – 80 kg per hectare. The total human labour used was 46.90 mandays. Human labour was mainly required in harvesting, ploughing and harrowing operations. Bullock labour was also a component in paddy production; it was mainly used in ploughing and harrowing operations. Tractor labour was also a component in paddy production, it was mainly used in transportation of FYM. Farmers used large quantity of FYM (3.92 tonnes per hectare). Biofertilizer was also used in paddy production (20.21 kg per hectare). Biofertilizers were mainly used in submerged type paddy cultivation. Farmers used chemical fertilizers also with the intention of increasing their yield levels. Mainly used chemical fertilizers were NPK, of which urea of 138.8 kg and phosphorus fertilizer of 69.7 kg and Potassium fertilizers of 59.61 kg for one hectare of land. In order to control the pests and diseases of paddy, farmers used plant protection measures. They used 974.73 ml of plant protection chemicals for the purpose (Table 3).

The quantity of labour used in different operations in cultivation of cotton on an hectare area is presented in the Table 2. It can be observed from the table that the cotton farmers used more quantity of human labour in case of harvesting *i.e.* 41.13 per cent, because harvesting was more

Table 3: Input use pattern in paddy and cotton cultivation **(Per hectare)**

Sr. No.	Particulars	Units	Paddy	Cotton
1.	Seeds	Kg	78.8	2.87
2.	Human labour	Mandays	46.90	59.41
3.	Bullock labour	Pair days	13.76	20.67
4.	Tractor labour	Hours	4.2	1.19
5.	Farm yard manure	Tonnes	3.92	5.32
6	Biofertilizer	Kg	20.21	
7.	Chemical fertilizer			
	Nitrogenous	Kg	138.8	140.9
	Phosphorus	Kg	69.7	71.2
	Potassic	Kg	59.61	68.3
8.	Plant protection chemical	Ml	974.73	899.92

labour intensive operation compared to other operations being practiced by the farmers because they had three pickings in one season. The other operations where human labour was used were ploughing (6.20 per cent), harrowing (8.33 per cent), transportation of FYM (7.67 per cent), spreading of FYM (6.40 per cent), sowing (it also includes human labour involved in gap filling and dibbling) (7.91 per cent), fertilizer application (5.74 per cent), weeding (8.47 per cent), intercultivation (5.92 per cent) and application of plant protection chemicals (2.22 per cent).

The bullock labour was used mainly for ploughing (17.84 per cent), harrowing (22.05 per cent), transportation of FYM (23.75 per cent), sowing (18.22 per cent) and intercultivation operations (18.14 per cent). The farmers preferred to use bullock labour for all these operations as they had their own bullocks and they were of the opinion that using machine labour is a costly affair. Among the operations being practiced by the cotton farmers, machine labour was used in case of ploughing

Table 4: Production function estimates in paddy and cotton production

Sr. No.	Particulars	Parameter	Paddy	Cotton
1.	No of observations	n	60	60
2.	Intercept	ln A	7.226** (0.336)	7.091** (0.196)
3.	Chemical fertilizers (Rs.)	X_1	0.231** (0.033)	0.014 (0.031)
4.	Seed (Rs.)	X_2	0.004 (0.004)	0.037* (0.038)
5.	FYM (Rs.)	X_3	0.048** (0.012)	0.276** (0.029)
6.	Human labour (Rs.)	X_4	0.030 (0.015)	0.009 (0.024)
7.	Bullock labour (Rs.)	X_5	0.153* (0.061)	0.080** (0.019)
8.	Coefficient of multiple determination	R^2	0.955	0.958
9.	F Value	F	156.189	119.591

** and * indicate significance of values at P=0.01 and P=0.05, respectively

(84.04 per cent) and transportation of FYM (15.96 per cent). It is mainly large farmers who used machine labour for these operations in order to complete these operations in a shorter period of time and also these operations can be done efficiently with machine labour compared to bullock labour.

In the study area farmers cultivated Bt. cotton. The inputs used per hectare of Bt. cotton (Table 3) revealed that the seed rate used by the sample farmers was 2.87 kg per hectare as against the recommended seed rate of 1.13 kg/ha because they used two seeds per spot. As the seeds were costly, farmers took all the care to use them properly without wasting a single seed. The farmers used 59.41 man days of human labour in Bt. cotton cultivation because most of the operations such as harvesting/picking, weeding were labour intensive. Most of the farmers used bullock labour (20.67 pair days) as against use of tractor labour (1.19 hours) by only few because use of bullock labour worked out to be cheaper than tractor labour use, but some large farmers used tractor for ploughing and other operations. Farmers in the study area used large quantity of farmyard manures (5.32 tonnes) mainly to maintain the health of the soil and to increase its fertility. They also used urea of 140.9 kg and phosphorus fertilizer of 71.2 kg and potassium fertilizers of 68.3 kg for one hectare of land. As the type of cotton cultivated by the farmers was Bt. cotton the incidence of boll worm was very less. Hence the use of plant protection chemicals for protecting the crop from pests and diseases was less. They used 899.92 ml of plant protection chemicals.

The estimated coefficients of the Cobb-Douglas production function fitted to the data from paddy farmers are presented in Table 4. The output elasticities of chemical fertilizers (0.231) and FYM (0.048) were significant at one per cent. The output elasticity of bullock labour (0.153) was significant at five per cent level. The output elasticities of seeds (0.004) and human labour (0.030) were positive, but found to be non-significant. The coefficient of multiple determination (R^2) for paddy production was 0.955. This indicated that the variables included in the function explained 95.5 per cent of the variation in the production of paddy.

The Marginal Value Product (MVP) to marginal factor cost (MFC) ratios of resources in the production of paddy are presented in Table 5. The MVP to MFC ratio was greater than unity for chemical fertilizers (20.46), FYM (1.54) and bullock labour (2.42) indicating the greater scope for using additional units of these resources to increase the gross income from paddy cultivation. The MVP to MFC ratio was positive but less than unity for seeds (0.13) and human labour (0.27) indicating excessive use of these inputs. Thus, chemical fertilizers, FYM and bullock labour were underutilized while seeds and human labour inputs were over-utilized in paddy cultivation.

The Marginal Value Product (MVP) to marginal factor cost (MFC) ratios of resources in the production of cotton are also presented in Table 5. The MVP to MFC ratio was greater than unity for seed (1.64) and FYM (2.36) indicating the greater scope for using additional units of these resources to increase gross income from cotton cultivation. The MVP to MFC ratio was positive but less than unity for chemical fertilizers (0.42), bullock labour (0.93) and human labour (0.12) indicating

Table 5: MVP to MFC ratios of resources in paddy and cotton production

Particulars	MVP	MFC	MVP/MFC
Paddy			
Chemical fertilizers	20.46	1	20.46
Seed	0.13	1	0.13
FYM	1.54	1	1.54
Human labour	0.27	1	0.27
Bullock labour	2.42	1	2.42
Cotton			
Chemical fertilizers	0.42	1	0.42
Seed	1.64	1	1.64
FYM	2.36	1	2.36
Human labour	0.12	1	0.12
Bullock labour	0.93	1	0.93

excessive use of these inputs. Thus, seed and FYM were underutilized while chemical fertilizers, human labour and bullock labour inputs were over-utilized in cotton cultivation. While the ratios for chemical fertilizer, bullock labour and human labour were lesser than unity revealing that these resources are over utilized. Use of these resources need to be reduced if not they will reduce the level of output. These result are in conformity with results of Dodamani (2009) with respect to usage of resources in cultivation of naturally coloured cotton in Dharwad district. Narasimhan *et al.,* (2003) estimated the cost and returns of paddy, Ramasundaram *et al.* (2005) the cost of cultivation of cotton and Sita Devi and Ponnarasi (2009) worked on the rice production technology and its adoption behaviour.

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