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RESOURCE USE EFFICIENCY AND CONSTRAINTS IN FARMING IN THE TANK COMMANDS : THE CASE OF NORTH EASTERN KARNATAKA

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ABSTRACT

The study was conducted in three districts namely Bidar, Bellary and Raichur of north-eastern Karnataka in the selected tank commands rejuvenated by JalaSamvardhaneYojanaSangha, Government of Karnataka with an objective of studying the resource use efficiency and to identify the constraints faced by farmers in farming activities. Multi-stage proportionate random sampling is adopted in selecting the respondents. Majority of the farmers in the study area were practising only animal husbandry as subsidiary enterprise, field crops were the major enterprises. Results revealed that the inputs like feeds + concentrates were over-utilised and number of cows and seeds were under-utilised in Bidar district. The resources like land, number of cows, fertiliser + FYM were over-utilised and labour, PPC + veterinary charges were under-utilised in Bellary districts. In Raichur, fertiliser + FYM and labour were under-utilised. Results indicate the scope for reorganisation of resources to optimise their use to enhance returns. In all the districts, the use of resources that are showing negative production elasticity should be decreased to achieve the optimality in the resource use and the use of resources showing more than one elasticity should be encouraged to enhance the profitability condition. There are several problems associated which are grouped under two heads namely production constraints and marketing constraints. For safeguarding the farmers' interest to enhance farm efficiency, arrangements should be made to avail timely and adequately the credit and storage, inputs and market information.

Introduction

Tank irrigation is one of the age old established practices in most of the semi-arid tropical parts of India. Tanks were used for domestic purpose from time immemorial and they also serve as an important source of groundwater recharge. Tanks are historical innovation to mitigate the monsoon irregularities and reduce the risk of uncertainties in water availability in the dry zones. The tank irrigation system has a special significance to marginal and small farmers who depend on the tank irrigation. In the face of multi-dimensional challenges only way out to achieve/increase productivity and to improve standard

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of living of the farm families in the tank commands is to diversify the economic activities in an inter-dependent and integrated manner at micro level by balanced allocation of the available resources. It is important to consider farmers' conditions specifically according to the availability of resources to sustain and satisfy many necessities of the farmer on a continuous basis in a manner that may ensure increased production with stability, ecological sustainability and equitability. North-eastern Karnataka comprises three major districts namely, Bidar, Bellary and Raichur falling under north-eastern transitional zone, northern dry zone and north-eastern dry zones of Karnataka accordingly. These districts are suitable for growing all types of field crops and also equally for growing sugarcane, paddy and horticultural crops, if irrigation is available. Other occupations like cross-bred cow rearing, poultry and fish farming are potential areas of development. All these enterprises together are incorporated in the farming explicitly using the resources to raise the overall production and income of farmers in these districts. Keeping all these aspects in view, present study has been undertaken to study the socio-economic profile of the tank command farmers and analyse the resource use efficiency and constraints faced by farmers in the tank commands of *Jala Samvardhane Yojana Sangha*-managed tanks in north-eastern Karnataka.

Methodology

Farmers served as the primary source of data for the present study and data were collected through personal interview method using pre-tested and well-structured questionnaires. The study area and sample respondents were selected using multi-stage proportionate random sampling. In the first stage based on all variabilities of agro-climatic conditions, three districts *viz.,* Bidar, Bellary and Raichur were selected from north-eastern part of Karnataka where *Jala Samvardhane Yojana Sangha** (JSYS) is managing the tanks. Based on number of JSYS tanks in each district, 3 (Bidar), 4 (Bellary) and 2 (Raichur) tanks were selected. Further, from each tank command fifteen farmer respondents were randomly considered for collecting the data. Thus, in all, 135 farmers were selected for the study.

Salient Features of the Study District

Bidar District : Bidar district falls under the north-eastern transitional zone of Karnataka. The district has total geographical area of 5,41,765 hectares, of which 3,72,202 hectares is under cultivation, accounting for 68.70 per cent of the total area of the district (District at a Glance, 2004). Of total agricultural holdings, share of marginal and small farmers' holdings together was 60.52 per cent. The average annual rainfall of this district is 847 mm, of which about 70 per cent is received in the normal monsoon season (June to September). The mean temperature of the area varies from 31°C to 21°C. The major crops grown in the district are jowar, redgram, blackgram, greengram, sunflower, safflower and sugarcane. According to the 2001 census, total population of the district was 12.55 lakhs with 6.43 lakh males and females 6.12 lakh with a literacy rate of 45.11, 58.97 and 30.53 per cent, respectively.

Bellary District : The district is located in the northern dry zones of Karnataka State. The district has a total geographical area of 8,13,196 hectares with a total cultivated area of 4,14,288 hectares accounting for 50.94 per cent to the total geographical area of the district (*ibid*). The total population of the district was 20.27 lakhs comprising male and female population of 10.29 and 9.97 lakhs, respectively. Marginal and small

* The Government of Karnataka has launched Karnataka Community Based Tank Management Project (KCBTMP) under World Bank assistance coordinated by *"Jala SamvardhaneYojanaSangha"* (JSYS). This project operates in about 2,000 selected tanks located in 9 districts of Karnataka State, of which 6 are in northern Karnataka by covering about 512 tanks with an objective of instituting the sustainable tank management system through enhancing the productivity in the tank commands to improve the standard of living of community who are directly or indirectly depending on tank commands for their livelihood.

holdings together accounted for 62.14 per cent of total agricultural holdings.The average annual normal rainfall of the district is 633.40 mm, received from both the south west and north-east monsoons. The temperature of the area varies from 15°C to 44°C. Paddy, jowar, maize, groundnut, bengalgram, cotton and sunflower are the important crops grown in the district.

Raichur District : Raichur district is situated in north-eastern dry and northern dry zones of Karnataka State. Total geographical area of the district is 8,35,843 hectares of which 5,22,093 hectares was under cultivation, accounting for about 62.46 per cent (*ibid*). Out of total agricultural holdings marginal and small holdings together form a share of 54.16 per cent.The average annual rainfall of the district is 621 mm. The mean temperature of the area varies from 29.6°C to 44°C. Paddy, jowar, bengalgram and cotton are the major crops of the district.

Analytical Tools

Data were subjected to tabular analysis involving the computation of means, percentages to present the data regarding the socio-economic profile.The regression technique was used for analysing the resource allocation in the tank commands. In order to maximise the profits from an enterprise, the optimum use of resources is imperative. Hence, considering the production activities taken up by the sample respondents, productivity of resources are analysed to measure the resource use efficiency and allocative efficiency of resources in the tank commands using Cobb-Dougla (C-D) production function technique.This technique estimates the functional relationship between the dependent variable and independent variables. Heady and Dillon (1964) indicated that the Cobb-Douglas type function has been the most popular of all possible algebraic forms in the farm firm analysis. They further indicated that C-D function has the greatest use in diagnostic analysis, reflecting the marginal productivities at mean levels of returns.

The general form of the function is $y=ax_i^{bi}$ where, 'x_i' is the variable resource measures,'y' is the output,'a' is a constant and 'b_i' estimates extent of relationship between x and y and when x is at different magnitudes. The 'b' coefficient also represents the elasticity of production; the equation is in log linear form by the method of ordinary least squares. This type of function allows for either constant or increasing or decreasing return to scale. It does not allow for total product curve embracing all the three scales simultaneously. The returns to scale can be estimated directly by getting the sum of 'bi' coefficients.The return will be increasing, constant and decreasing based on the summation of 'bi' is greater or equal or less than unity, respectively. Test was conducted to see that the sum of b coefficients were significantly different from unity.

$$Y = ax_1^{b1} . x_2^{b2}. x_3^{b3} \ldots\ldots\ldots\ldots\ldots..x_n^{bn} e^u$$

On linearisation it becomes,

$$\log y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + \ldots\ldots\ldots\ldots + b_n \log x_n + u \log e$$

Production function for the resources used as a whole,

$$\log y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 +$$

$$b_6 \log x_6 + b_7 \log x_7 + e_i$$

Where,

Y = Gross returns in rupees

a = Intercept

x_1 = Land in acres

x_2 = Number of cows

x_3 = Cost of fertiliser + cost of Farm Yard Manure (FYM)

x_4 = Bullock labour and human labour cost

x_5 = Cost of PPC + veterinary charges

x_6 = Cost of feeds and concentrates

x_7 = Cost of seeds

b_i = Elasticities of production (i=1 to 7)

e_i = Stochastic term

The marginal value product of each explanatory variable was also computed and compared with its marginal factor cost to know the resource use efficiency of farmers. This was done with a view to determining the extent to which the important resources have been quantified, to explain the variability in the gross returns of the farming systems and to determine whether the resources are optimally used in these tank commands. The marginal analysis of input utilisation using the MVP's to MFC ratio of individual resources were used to estimate the allocative efficiencies in the tank commands. The computed Marginal Value Product (MVP) was compared with the Marginal Factor Cost (MFC) or opportunity cost of the resource to draw inferences (Alimi, 2000). The ratios of the MVP's to MFC's of individual resources were used to judge the allocative efficiencies. Further, a resource is said to be optimally allocated when it's MVP = MFC. The marginal value products (MVP's) were calculated at the geometric mean levels of the variables using the formula,

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

Where,

$\bar{y}$ = Geometric mean of gross returns in tank commands

$\bar{x}_i$ = Geometric mean of i^{th} independent variable

b_i = Regression coefficient, elasticity of production i^{th} dependent variable

This analysis was carried out in order to identify the possibilities of increasing gross returns under a given farm situation. In imputing the marginal cost of the selected inputs the average per acre value of land, average per animal value of cows, were taken as its marginal cost. The marginal cost of all other inputs was considered as one, since those inputs have been measured in value terms in regression analysis.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Sample Farmers

Age, education level, family size, occupational pattern and size of landholding were the variables considered to assess the socio-economic status of the sample respondents and have been depicted in Table 1. It was observed that most of the sample farmers are of middle age group. The family composition revealed that the proportion of children per family was large group in all the districts ranging between 35-40 per cent indicating dominance of nuclear family with two or more children. This was followed by proportion of male, which accounted for 28.36 and 33.57 per cent in Bidar and Raichur district, however the proportion of male and female was observed to be almost equal (27.12 per cent) in the family composition of Bellary district. The educational level of the respondents indicated that more than 50 per cent of the farmers were literates in all the districts. Literate sample respondents possessing education ranged from primary to college level. This indicated that literacy level in the study area was higher than the State level literacy. Therefore, there may not be any problem for the extension workers to educate the farmers regarding recent developments in agriculture and other enterprises to increase their level of income and productivity in the farm. Further, the farmers' receptive capacity may ease the process and adoption of technology. The occupational pattern of the sample respondents revealed that, proportion of sample respondents who were

involved mainly on agriculture and allied activities was the highest in all the districts as expected. The size of landholding revealed that, the study area belongs to typical dry agro-climatic zone.

Table 1: Socio-economic Characteristics of the Sample Respondents

S. No.	Particulars	District		
		Bidar	Bellary	Raichur
1	**Average age (years)**	42.98	42.96	40.8
2	**Family size** (%)			
	i. Adult male	28.36	27.12	33.57
	ii. Adult female	26.86	27.12	30.95
	iii. Children	44.78	45.76	35.48
	Average size of the family (No.)	6.03	6.12	7.3
3	**Education level** (%)			46.70
	a. Illiterate	26.66	20.00	16.70
	b. Primary	2.20	16.72	6.60
	c. Secondary	6.70	13.30	20.00
	d. High school	35.54	23.38	10.00
	e. College	28.90	26.60	
4	**Occupational pattern** (%)			
	a. Agri. & allied activities	82.20	86.70	73.30
	b. Agri. & allied activities + Business	17.80	13.30	26.70
5	**Average size of landholding**(ha)	2.43	3.08	2.29
	i. Rainfed (%)	63.78	72.73	79.47
	ii. Irrigated (%)	36.22	27.27	20.53

Resource Use Efficiency in the Tank Commands

Basically, resource use efficiency was calculated to determine whether resources were under-utilised or over-utilised (Taru *et al.,* 2010). The results of efficiency in the use and allocation of resources in the tank commands of study district were presented in Table 2. The predictor variables used in the model are land, number of cows, fertiliser + FYM cost, labour cost, PPC + veterinary charges, cost of feeds and cost of seeds.

Table 2: Estimated Production Function for Resource Use Efficiency in the Tank Commands

			Bidar		Bellary		Raichur	
S.No.	Particulars	Parameters	Regression Coefficients	MVP: MFC	Regression Coefficients	MVP: MFC	Regression Coefficients	MVP: MFC
1	Intercept	a	2.780		1.650		2.713	
2	Land (in acres)	b_1	-0.0205(0.600)	-0.0323	0.228*** (0.114)	0.368	-0.254 (.168)	-0.052
3	Cows (No.)	b_2	0.422* (0.097)	2.23	0.130* (0.131)	0.355	0.334 (1.189)	2.12
4	Fertiliser + FYM cost (₹)	b_3	0.102 (0.088)	1.19	-0.285** (0.140)	-3.671	0.210* (.094)	1.62
5	Labour cost (₹)	b_4	0.05214 (0.120)	0.211	0.692* (0.175)	5.58	0.352* (.159)	1.71
6	PPC + veterinary charges (₹)	b_5	-0.0379 (0.130)	-1.77	0.414*** (0.212)	23.74	0.8063 (0.105)	3.96
7	Cost of feeds (₹)	b_6	0.177** (0.081)	0.960	0.03513 (0.105)	0.1956	-0.0480 (0.155)	-0.29
8	Cost of seeds (₹)	b_7	0.180**(0.057)	4.896	-0.0445 (0.131)	-1.52	-0.0698 (0.300)	-1.39
9	R^2		0.768		0.589		0.549	
10	Returns to Scale		0.87		1.16		0.604	
11	F- value		18.039*		11.656*		4.130***	

Note: Figures in parentheses indicate the respective Standard error. *, ** and *** denote significant level at 1, 5 and 10 per cent, respectively.

Bidar District : The production function analysis fitted for resource use in the tank commands of Bidar district (Table 2) revealed that the regression coefficients of all the resources were positive except for land (-0.0205) and PPC+ veterinary charges (-0.0379). The cost of feeds + concentrates (0.177) and cost of seeds (0.180) coefficients were found to be statistically significant at 5 per cent level. Whereas number of cows (0.422) has positive and significant at 1 per cent level and for all other resources coefficients were non-significant indicating that expenditure on these inputs were of not much influence on total gross returns. This implied that one per cent increase in number of cows would increase gross income by 0.42 per cent. Every five per cent increase in feeds + concentrates and seeds would increase gross return by 0.17 and 0.18 per cent, respectively. Similar results were obtained by Sharma and Singh (1996). The summation of regression coefficients worked out to be 0.87, which indicated decreasing returns to scale. Similar returns to scale were observed by Sani *et al* (2010) in their resource use efficiency study. The adjusted coefficient of multiple determinations (R^2) worked out to be 0.768 for the model. Thus, indicating the seven variables included in the function explained 76.8 per cent variation in the total returns which is dependent variable. The function was found to be a good fit to the data as revealed by the high value of F statistic.

The cost of feeds + concentrates (0.960) was nearing unity and the ratios of MVP to MFC were less than unity for PPC+ veterinary charges (-1.77), land (-0.0323) and labour cost (0.211). For other resources such as number of cows (2.23), cost of fertiliser + FYM (1.19) and cost of seeds (4.896) the ratios were greater than unity. It was due to use of various PPC above the recommended levels. So these inputs were to be minimised to get the optimum level of output. The labour cost ratio was positive and less than unity, indicating its under-utilisation. Whereas, the ratios of MVP to MFC for number of cows, fertiliser + FYM and cost of seeds were more than unity. This indicated that at their average levels these resources were under-utilised in the production process. There was ample scope of greater exploitation of these resources to maximise the production and to increase the gross returns. However, the ratio of MVP to MFC for feeds + concentrates was very close to the unity. This indicated that it was profitable to use additional unit of these resources.

Bellary District : In case of Bellary district tank commands (Table 2), the regression coefficients for all the resources were positive, except for fertilisers + FYM (-0.285) and cost of seeds (-0.0445). But, the regression coefficients for land (0.228), number of cows (0.130), labour cost (0.692), PPC+ veterinary charges (0.414) and cost of feeds + concentrates (0.03513) were positive. Among these variables, the coefficient for number of cows and labour cost was significant at one per cent level. While the elasticity coefficient for expenses on fertiliser + FYM exerted significant negative influence to the total gross returns at five per cent level, which means every five per cent increase in the expense on fertiliser + FYM would result in 0.285 per cent decrease in the gross returns. The amount spent on land and cost of PPC + veterinary charges put forth positive influence on total gross returns only at 10 per cent level. Similar results were observed by Muralidharan (1987). All other resources were found to be non-significant. The ratio of MVP to MFC was negative and less than one for fertiliser+FYM (-3.671) and cost of seeds (-1.52), indicating over-utilisation of resources. The MVP to MFC ratio observed to be positive and more than unity in case of labour cost (5.58) and PPC+ veterinary charges (23.74), exerting under-utilisation of these resources in the production process. The production can be enhanced by using more of these resources to enhance the profitability condition. Other resources found to be positive with less than unity like land (0.368), number of cows (0.355) and cost of feeds + concentrates (0.196) which

indicated that resources were excessively used. So these inputs were to be minimised to get the optimum level of output. It could be observed that the fitted production function was found to be a good fit to the data as revealed by 'F' value of 11.656. The R^2 was 0.58 and found significant by F value at one per cent level. The sum of regression coefficients was 1.16.

Raichur District : The estimated coefficients for the resources used in the tank commands of Raichur district (Table 2) revealed that the land (-0.254), cost of feeds + concentrates (-0.0480) and cost of seeds (-0.0698) were found to be negative. On the contrary, the regression coefficients for number of cows (0.334), cost of fertiliser + FYM (0.210), PPC+ veterinary charges (0.80) and labour cost (0.352) were positive. Among these variables the coefficient for fertilisers + FYM and labour cost were significant at five per cent and one per cent level, respectively exerting significant positive contributor to the total returns. That means additional expenditure on labour would influence on the total returns. However, the estimated coefficients for all other variables such as expenditure on land, cows, PPC+ veterinary charges, feeds + concentrates, seeds were found to be statistically non- significant with low regression coefficients, implying that variation in the levels of these inputs will not have much significant impact on the total returns generated. The R^2 was 0.54 for the selected variables. The summation of regression coefficients indicated less than unity (0.604) indicating decreasing returns to scale. The C-D function observed to be significant only at 10 per cent level with 'F' value of 4.130.The ratios of MVP to MFC were lesser than unity and showed negative values for land (-0.052), cost of feeds + concentrates (-0.29) and the cost of seeds MVP to MFC ratio is -1.39. This implies that these resources were excessively used. So use of these inputs needs to be reduced as revealed by negative regression coefficient. Whereas these ratios were greater than one with respect to number of cows (2.12), cost of fertiliser + FYM (1.62), labour cost (1.71) and PPC+ veterinary charges (3.96), indicating that resources are under-utilised and there was lot of scope for curtailment of these resources to some extent to increase the profitability in the production process.

In gist it is observed that, the inputs such as feeds + concentrates was over-utilised in production, whereas number of cows reared are less than the optimum level leaving scope for increasing the number of cows under rearing and seeds were under-utilised in Bidar district. The resources like land, number of cows, fertiliser + FYM were over-utilised and labour, PPC + veterinary charges were under-utilised in Bellary districts. Whereas in Raichur district, fertiliser + FYM, labour were under-utilised. Therefore, there is scope for reorganisation of resources to optimise the resource allocation and to enhance returns in the study area.

Constraints Associated in the Tank Commands

The problems associated in the tank commands of selected districts are grouped under two heads, namely, production constraints and marketing constraints which are presented in Table 3.

Production Constraints : In the study area, almost all the sample respondents in all the districts encountered exogenous factors like drought and irregularities of rainfall affecting the crop production, which are beyond their control. The farmers are facing problem of tiny landholdings due to fragmentation and sub-division of landholding, which is uneconomical for cultivation. Non-availability of adequate water was also experienced by majority of the farmers. However, use of tank water for other purposes other than agriculture and allied activities were observed to be meagre in all the districts. Due to drought condition, non-availability of alternative source of irrigation was highlighted by majority of the farmers. Most of the farmers' opined lack of awareness of

recommended cropping sequences. Educating farmers on the cropping patterns which are remunerative and suitable for that region was needed to increase the crop yield levels and cropping intensity. Lack of availability of quality seeds, high cost of inputs used in production together influenced negatively on the yield in the farmers' fields. Lack of credit availability and technical guidance were observed to be crucial in the study area. Low income generations created scarcity of owned fund are also main reasons claimed by majority of farmers. Low yield of local breeds indicates poor milk productivity and less income from dairy enterprise in the study area. High cost of production was observed in the study area.

Marketing Constraints : Low price for the produce was encountered by more than 50 per cent of farmers in Bellary and Raichur and 48.85 per cent in Bidar district, indicating hurdles to the process of capital formation. Lack of market information was encountered as a major problem in the study area, which resulted in low price for the produce due to glut in market during sale. Lack of transportation was not much severe. Lack of storage facility was observed to be a major constraint to store the produce after harvest till marketing that resulted in distress sale of the produce by the farmers.

Table 3: Constraints Faced by Farmers in the Tank Commands (Per cent)

S. No.	Particulars	Bidar	Bellary	Raichur
I.	**Production Constraints**			
1	Exogenous factors	100.00	100.00	100.00
2	Tiny landholding	68.88	65.00	63.33
3	Non-availability of adequate water	91.11	91.66	93.33
4	Use of the tank water other than agri. and allied activities	22.22	20.00	13.33
5	Non-availability of alternative source of irrigation	82.22	55.00	80.00
6	Lack of awareness of recommended cropping patterns	91.11	86.66	83.33
7	Non-availability of quality seeds	26.66	33.33	10.00
8	High cost of inputs	53.33	45.00	60.00
9	Lack of credit availability	40.00	48.33	43.33
10	Scarcity of owned funds	86.66	86.66	93.33
11	Lack of technical guidance	68.88	81.66	76.66
12	Low yield of local breeds and seeds	13.33	26.66	3.33
13	High cost of production	73.33	55.00	80.00
14	Scarcity of family labour	51.11	46.60	53.33
15	Poor maintenance of tanks	17.77	8.83	0.00
II.	**Marketing constraints**			
1	Lack of market information	51.11	75.00	80.00
2	High marketing cost	22.22	41.66	16.66
3	Low price for the produce	48.88	61.66	50.00
4	Lack of transportation	8.88	45.00	33.33
5	Lack of storage facility	82.22	95.00	76.66

Conclusion

The results of production function analysis revealed that there is scope for reorganisation of resources to optimise their use to enhance returns in the study area. In all the districts, the use of resources which are showing negative production elasticity's should be decreased to achieve the optimality in the resource use and the use of resources showing more than unity production elasticity's should be encouraged to enhance the profitability condition.The analysis of constraints encountered by the sample farmers in the tank commands revealed that they are grouped under two heads, namely production constraints and marketing constraints.To safeguard the interest of the farmers and to enhance farming efficiency, arrangements should be made to avail of the credit and storage facilities, inputs and market information timely and adequately.

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