Madras Agric. J., 97 (4-6): 175-179, June 2010
https://doi.org/10.29321/MAJ.10.100375

Resource Use Efficiency of Tribal Farming in *Sittilingi* Valley of Tamil Nadu

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The economy of tribal population primarily depends on agriculture. Heavy deterioration of natural resources in the forest area and reduction in the flora and fauna made their shifting cultivation unfeasible. Since access to agricultural technology and inputs from the state or private sector machinery is much weaker their net returns from agriculture are also much lower. A study undertaken in the Sittilingi Valley of Dharmapuri district among 50 tribal and 50 non-tribal farmers selected randomly to compare tribal farming with non-tribal farming is more essential to document the economic condition of tribal farming. The resource use efficiency among tribal and non tribal farms revealed that the production functions fitted were found to be on the increasing returns to scale underlying the scope to increase the inputs for increasing the productivity. Since access to institutional credit facilities was found to be much weaker, a Farmers Interest Group (FIG) is suggested to be established among them, which may help the tribal farmers to invest more on farm inputs so that the productivity of crops can be increased considerably.

Key words: Tribals, Cobb-Douglas production function, resource use efficiency

Tribal Population in India is estimated about 84 million in 2001, which constitutes 8.4 per cent of the total population. Tamil Nadu is also one of the important state in South India with 0.65 million tribals which is accounted for one per cent of the state population (Census 2001). The economy of tribals in the state can be treated as an agrarian since majority of tribals primarily depend on agriculture. Tribals had been following shifting cultivation (*Jhum* cultivation) from time immemorial. Rich organic matter in the soil, availability of forest land to practice shifting cultivation, less tribal population and rich flora and fauna had helped them to sustain their agriculture. In recent years, due to reduction in the forest area, increasing tribal population and reduction in the flora and fauna made the shifting cultivation unfeasible. Further, tribals have much weaker access to agricultural technology and inputs from the state or private sector machinery. Hence, tribal farmers derive less income from their lands than their non-tribal counterparts even in the tribal dominated blocks or tribal districts and their net returns from agriculture are also much lower (Phansalkar and Verma, 2004).

Adverse terrain conditions, inaccessibility of the areas, absence of roads, lack of infrastructure facilities, exploitation, unstable price of agricultural commodities and ignorance added to the backwardness of the tribal population (Nandakumar, 2004). However, tribals have to depend upon agriculture to meet their food grains demand and other expenditures. Hence, any improvement in agriculture has direct impact on employment and household income. In this context, it is necessary to study the tribal farming and constaints in tribal farming. The comparation of tribal farming with non-tribal farming is also essential to highlight the condition of tribal farming. Hence, the resource efficiency and constraints in tribal farming have been taken as the major objective of the study.

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Materials and Methods

Sittilingi Valley of Dharmapuri district of Tamil Nadu was purposively selected since large number of tribals is practicing agriculture in the forest land. In this valley, two villages *viz., Sittilingi* and *Naikuthi,* which have large number of tribal population were purposively selected for this study. A.K. Thanda and Kottapatti were are selected from this region to study the non-tribal farming From each selected tribal and non- tribal villages, 25 farmers were selected randomly to examine the cropping pattern, average area and the productivity of crops and factors affecting farming. Primary data related to the above information were collected with the help of pre-tested interview schedule. Secondary data about soil type, rainfall, cropping pattern and infrastructure facilities available in the selected villages were also collected for analysis. The study was conducted from November 2005 to February 2006. Data used in this study pertains to the year 2004-05.

Production Function Analysis

Production function analysis was used to study the resource use efficiency of the tribal and non tribal

farms. In this study Cobb-Douglas Production function was used to estimate the elasticity of the variables.

The Cobb-Douglas Production Function for Paddy and Turmeric Farms

The production function for paddy and turmeric farms was defined as follows

$$Y=boX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}D_1^{b7}D_2^{b8}e^{ui} \ldots\ldots\ldots (1)$$

The above equation (1) was transformed in to an estimable form by taking log on both sides and the same is presented in the following form

$$\log Y = \log b_0+b_1\log X_1+b_2\log X_2+b_3\log X_3+b_4\log X_4 + b_5\log X_5+b_6\log X_6+b_7\log D_1+b_8 \log D_2+U_i \ldots(2)$$

Where,

Y= Paddy output (kgs/ha)

X_1 =Quantity of seeds (kgs/ha)

X_2=Cost of inorganic fertilizer (Rs/ha)

X_3=Cost of organic manure (Rs/ha)

X_4= Machine power (Hrs/ha)

X_5=Cost of plant protection chemicals (Rs/ha)

X_6= Human labour (man days/ha)

D_1=1; if the head of the family is literate;

D_1= 0, Otherwise

D_2 =1; If extension agency contact,

D_2 = 0, Otherwise

b_0, b_1 b_2, b_3, b_4, b_5, b_6, b_7 and b_8 = regression coefficients

U_i =Error term

The Cobb-Douglas Production Function for Sugarcane Farms

The production function for sugarcane farms was defined as follows

$$Y=boX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}D_1^{b6}D_2^{b7}e^{ui} \ldots\ldots\ldots (3)$$

The above equation (3) was transformed in to an estimable form by taking log on both sides and the same is presented in the following form

$$\log Y = \log b_0+b_1\log X_1+b_2\log X_2+b_3\log X_3+b_4\log X_4+ b_5\log X_5+b_6 \log D1+b_7 \log D_2+U_i \ldots\ldots\ldots (4)$$

Where,

Y = Sugarcane output (tonnes/ha)

X_1 = Quantity of setts (tonnes/ha)

X_2 = Cost of inorganic Fertilizers (Rs/ha)

X_3 = Cost of organic manures (Rs/ha)

X_4 = Machine power (Hrs/ha)

X_5 = Human labour (man days/ha)

D_1 = 1; if the head of the family is literate;

D_1 = 0, Otherwise D_2 =1; If extension agency contact, D_2 = 0, Otherwise b_0, b_1 b_2, b_3, b_4, b_5 b_6 and b_7 = regression coefficients

U_i =Error term

Table 1. Average Inputs usage and average yields in tribal and non tribal farms of Sittilingi valley

Sl. No	Particulars	Paddy		Turmeric		Sugarcane	
		Tribal	Non Tribal	Tribal	Non Tribal	Tribal	Non Tribal
1.	Productivity (Kg/ha)	3971	4285	2374	2699	85590	119410
2.	Seed (Kg/ha)	13.5	126	299	329	749	902
3.	Organic Manure (Rs/ha)	3117	4319	4276	6040	2922	3451
4.	Inorganic fertilizer (Rs/ha)	2035	1876	5966	6824	4237	6503
5.	Human Labour (Rs/ha)	4233	4764	11393	15341	10525	11222
6.	Machine power (Rs/ha)	1822	1176	2320	2468	831	909
7.	Plant protection chemicals (Rs/ha)	185	170	1094	1896	-	-
8.	Literacy (years)	4.2	8.2	4	9.1	3.5	8.2
9.	Extension Agency contact (Nos)	0.1	0.15	0.05	0.07	0.01	0.09

Garette's Ranking Technique

To study the factors which are affecting the tribal farming among sample farmers Garette's ranking technique was used (Garrett, 1981). The order of merit assigned by the respondents was converted into ranks by using the following formula.

$$\text{Per cent position} = \frac{(R_{ij} - 0.5)\ 100}{N_j}$$

Where,

R_{ij} = Rank given for i^{th} factor by j^{th} individual

N_j = Number of factors ranked by j^{th} individuals

By using Garette's score table the per cent position of each rank were converted into scores. Then, for each factor, the score of individual respondent were added together and divided by the total number of respondents for whom scores were added. The mean scores of all the factors were arranged in descending order and ranks were given. The factor having the highest mean value was considered to be the most important and influencing variable.

Results and Discussion

Paddy

From the results of production function, seed rate, usage of organic manure and plant protection chemicals, usage of human labour and literacy level were explaining 85 per cent of the variation in paddy productivity of paddy farms of tribal farmers. Similarly,

Table 2. Production function analysis of paddy farms in Sittilingi valley

Sl. No	Particulars	Tribal		Non Tribal	
		Regression coefficients	't' value	Regression coefficients	't' value
1.	Intercept	2.617*	1.950	3.216**	2.179
2.	Seed	0.513***	2.466	0.718***	2.570
3.	Inorganic fertilser	0.044	0.408	0.165**	2.026
4.	Organic manure	0.139*	1.907	0.059**	2.280
5	Machine labour	0.124	0.994	0.007	0.095
6.	Plant protection chemicals	- 0.123***	- 2.700	- 0.006	- 0.266
7.	Human labour	0.406***	4.372	0.223*	1.275
8.	Literacy	0.186***	2.868	0.029	0.765
9.	Extension Agency contact	0.172	2.636	0.016	0.502
10.	R^2		0.848		0.718
11.	Adjusted R^2		0.809		0.657
12.	Number of observation	40		46	

seed rate, usage of organic manure and inorganic fertilizers and human labour were explaining 72 per cent of the variation in paddy productivity of non-tribal farmers (Table 2). Further, one per cent increase in seed rate from the mean level (Table 1) would increase the productivity of rice by 0.51 per cent in tribal farms and 0.72 per cent in non- tribal farms. The farmers were using the adequate seed rate and the reason could be due to the low germination per cent of seeds. If they used quality seeds, the germination per cent would be higher when comparatively low seed rate required. However, inorganic fertilizer usage was significantly influencing the productivity only in the non-tribal farms. One per cent increase in the expenditure of inorganic manure from the mean level would increase the productivity by 0.17 per cent. This shows that there is a scope for increasing the productivity by increasing inorganic fertilizer among the non-tribal farms.

The expenditure of organic manure was significantly influencing the paddy productivity in both types of farms. One per cent increase in expenditure of organic manure from the mean level would increase the productivity by 0.14 per cent and 0.06 per cent in tribal and non-tribal farms respectively. The impact was higher in tribal farms than the non-tribal farms. Though farmers were using significant levels of organic manure the nutrient level could be lower because of the poor collection method. Further, tribals also were not adding adequate organic matters due to lack of animals. In contrast to the above factors, the expenditure on plant protection chemicals was negatively influencing the productivity in both tribal and non-tribal farms and it was significant only in tribal farms. One per cent increase in expenditure on plant protection chemicals from the mean level would decrease the productivity by 0.12 per cent. This could be due to the wrong chemical usage and incorrect management practices of the farmers in this region.Human labour was positively and significantly influencing the paddy productivity in both farms. One per cent increase in human labour would decrease the paddy productivity by 0.41 per cent in tribal farms and 0.22 per cent in non-tribal farms. Paddy needs more efforts in land preparation and the time of sowing and transplantation and also during weeding and harvesting. However, tribal and non-tribal farmers in this region were not having enough owned or borrowed capital for investment. Hence, they were engaging less human labour in farm operations. This could be the reason for the positive influence of this variable. Further, literacy level of the farmers had also significantly influencing the productivity of tribal farms. One per cent increase in literacy from the mean level would increase the productivity by 0.19 per cent. Education could be useful to the tribal farmers in understanding and adopting the new technology in rice cultivation. In the paddy farms, the sum of coefficients of all the variables included in the study was arrive at 1.461 and 1.210 in respect of tribal and non-tribal farms revealing the existence of scope of getting additional return on appropriate usage of inputs.

Turmeric

From the result of turmeric production, seed rate, usage of inorganic fertilizer, machine labour and extension agency contact were significantly influencing the turmeric yield of tribal farms. The results from Table 3 revealed that 85 per cent of the variation on the dependant variable was explained by the independent variables included in the function for tribal farms, whereas, only 66 per cent of the variation was explained by independent variables in respect of non-tribal farms. In the non-tribal farms, seed rate, plant protection chemicals and human labour were significantly influencing the productivity (Table 3). The seal rate was significantly influencing the turmeric productivity in both tribal and non-tribal farms. One percent increase in the seed rate from the mean level would increase the productivity by 0.56 per cent and 0.44 per cent in tribal and non-tribal farms respectively. This could be due to low seed rhizome rate usage by the farmers. Usage of adequate quantity of planting materials may improve the situation.

Table 3. Production function analysis of turmeric farms in Sittilingi valley

Sl. No	Particulars	Tribal		Non Tribal	
		Regression coefficients	't' value	Regression coefficients	't' value
1.	Intercept	0.384	0.232	0.236	0.164
2.	Seed	0.560***	2.859	0.435***	2.485
3.	Inorganic fertilzer	0.255***	3.420	0.277	1.534
4.	Organic manure	0.050	0.921	0.033	0.489
5.	Machine power	0.229***	2.215	0.050	0.437
6.	Plant protection chemicals	0.0062	0.139	- 0.142**	- 2.156
7.	Human labour	0.328	1.773	0.647***	3.177
8.	Literacy	0.0021	0.1035	0.028	0.500
9.	Extension Agency contact	0.111**	2.039	0.091	1.599
10.	R^2	0.852		0.657	
11.	Adjusted R^2	0.801		0.574	
12.	Number of observation	32		42	

However the expenditure on inorganic fertilizer was significant only in tribal farms. One per cent increase in the expenditure of inorganic fertilizers from the mean level would increase the yield by 0.26 per cent in these farms. This showed that there is scope for increasing productivity by 0.26 per cent in tribal farms.

The expenditure on plant protection chemicals was significantly influencing the productivity of non tribal farms but it was not significant in tribal farms. One per cent increase in the expenditure on plant protection would decrease the productivity by 0.14 per cent. This could be due to the wrong selection and wrong time of application of the pesticide by the non tribal farmers. Further expenditure on human labour was significantly influencing the productivity of turmeric in the non tribal farms. The coefficient of the variable showed strong and positive association with the turmeric productivity. One per cent increase in expenditure on human labour would increase the productivity by 0.65 per cent in non tribal farms. In contrast, the extension agency contact was positively influencing the productivity of the tribal farms and it was also positive among non tribal farms but it was not significant.

The sum of coefficient of all the variables included in the study was arrived at 1.51 and 1.14 in respect of tribal and non tribal farms respectively revealing that the production function fitted was showing an increasing return to scale implying the scope of getting additional return.

Sugarcane

From the results of production function of sugarcane, sett rate and literacy level of the tribal farmers were explaining 77 per cent of the variation in the productivity and sett rate, human labour and extension agency contact were explaining 81 per cent of the variation in the productivity in non tribal farms. One per cent increase in the sett rate from the mean level would increase the productivity by 0.64 and 0.20 per cent in tribal and non tribal farms respectively. The impact of productivity was significantly higher in tribal farms than the non tribal farms. This could be due to the low germination percentage of setts resulted in higher sett requirement in tribal farming. Further, the literacy level of the tribal farmer was significantly influencing the productivity of sugarcane and it is positive but not significant among non tribal farmers. One per cent increase in the literacy level of tribal farmers from the mean level would increase the productivity of sugarcane by 0.35 per cent. The literacy of the tribal farmer may help to understand and adopt the sugarcane technology. Human labour was found to

Table 4. Production function analysis of sugarcane farms in Sittilingi valley

Sl. No	Particulars	Tribal		Non Tribal	
		Regression coefficients	't' value	Regression coefficients	't' value
1.	Intercept	4.551***	2.470	2.574***	6.721
2.	Setts	0.641**	2.106	0.195***	2.816
3.	Inorganic fertilizer	- 0.222	- 1.029	0.045	1.010
4.	Organic manure	- 0.054	- 0.360	0.037	1.549
5.	Machine labour	0.220	1.005	0.306	0.518
6.	Human labour	0.063	0.337	0.171***	2.877
7.	Literacy	0.349***	2.908	0.017	0.503
8.	Extension Agency contact	0.084	0.5612	0.0158***	4.39
9.	R^2	0.769		0.810	
10.	Adjusted R^2	0.702		0.762	
11.	Number of observation	32		36	

Note: *, ** and *** indicate significance at 10, 5 and 1 per cent level

be significantly influencing the productivity of sugarcane in non tribal farms but it was not significant among the tribal farms. One per cent increase in the expenditure of human labour usage from the mean level would increase the productivity of non tribal farms by 0.17 per cent. This could be due to the less intercultural operations by the farmers due to lack of capital and human labour availability in time. Similarly, one per cent increase in extension agency contact from the mean level would increase the productivity by 0.02 per cent. The extension agency contact could be useful to the farmers to choose right plant protection technique, adoption of new technology and right time of harvest.

Constraints in Crop Production

The tribal and not tribal farmers are facing lot of constraints in farming. From the results of Garrett's Ranking Technique, the major constraint for tribes was found to be unawareness to latest technology which obtained 73.60 mean score and it was ranked first followed by inaccessible production site and lack of transportation with the mean score of 67.60. Lack of marketing infrastructures with a mean score of 62.02 was ranked third. Lack of soil nutrients, pest incidence and excess weed growth had got subsequent ranks.In respect of non tribes, the majority of constraints were almost similar to that of tribes. Inaccessible production site and lack of transportation had got the first important constraint with a mean score of 70.80 followed by lack of marketing infrastructure ranked second with a mean score of 66.20. The third important constraint was high pest incidence in the field which obtained a mean score of 56.16. Disease out break in the field, lack of soil nutrients and unawareness to new technology were ranked next in the order.

Table 5. Constraints in crop production among tribal and non tribal farmers of Sittilingi valley

Sl. No	Constraints	Tribal farmers		Non tribal farmers	
		Garrett's score	Rank	Garrett's score	Rank
1.	Lack of marketing infrastructure	62.02	III	66.20	II
2.	Inaccessible production site and lack of transportation	67.60	II	70.80	I
3.	Unawareness to latest technology	73.60	I	45.04	VI
4.	Pest incidence in the field	46.00	V	56.16	III
5.	Disease outbreak in the field	32.92	VII	46.60	IV
6.	Excess weed growth in the field	38.44	VI	32.76	VIII
7.	Lack of soil nutrients	50.16	IV	45.72	V
8.	Scarcity of labour for agricultural operations during seasons	29.84	VIII	36.72	VII

Conclusions and Policy Implications

From the study, it is concluded that the seed rate, usage of organic manure and plant protection chemical, usage of human labour and literacy level were significantly influencing the paddy productivity in the tribal farms. In turmeric production, seed rate, usage of inorganic fertilizer, machine power and extension agency contact are significantly influencing the yield in the tribal farms. Sett rate and literacy level of the tribal farmers were significantly influencing the sugarcane production. Except expenditure on machine power and literacy of the farmers, all other variables were common to both tribal and non tribal farmers in their significance in crop productivity. To sum up, the resource use efficiency among tribal and non tribal farms revealed that the production functions fitted were found to be on the increasing returns to scale underlying the scope to increase the inputs for increasing the productivity. The major constraints for tribes were unawareness to latest technology followed by inaccessible production site, lack of transportation and lack of marketing infrastructure.

Technology awareness was found to be very poor among the tribal households. The Agricultural Extension System of the Department of Agriculture should provide periodic training to the tribal farmers on techniques of obtaining higher productivity. If not, the Sittilingi village can establish a Farmers' Interest Group (FIG) among them and can employ farm graduate on contractual basis both for production technologies and for marketing strategies.

Productive farming through FIG can also be promoted with need based forward and backward linkages among farmers and collective bargaining could easily be made to ensure credit access, marketing tie up, value addition etc. Hence need for institution building emerges very important among farmers. Access to institutional credit facilities may help the tribal farmers to invest more on farm inputs so that the productivity of crops can be increased considerably.

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Received: September, 2009; Accepted: April 20, 2010