Mysore J. Agric. Sci., 52 (3) : 479-485 (2018)

Economics and Resource use Efficiency of Little Millet Cultivation in Central Dry Zone of Karnataka

T. Amrutha and M. G. Chandrakanth
Department of Agricultural Economics, College of Agriculture, UAS, GKVK, Bengaluru - 560 065
E-mail: amruthakbh@gmail.com

Abstract

The study was conducted in Tumkur and Chitradurga districts in central dry zone of Karnataka. Cultivation of little millet found to be profitable with a positive net returns of ₹ 5619.50 and for every one rupees spended in little millet cultivation farmer realized returns of ₹ 1.72. Little millet cultivation is highly profitable compared to ragi cultivation in the rainfed area (net returns from ragi cultivation was negative of ₹ 830). Little millet cultivation in the rainfed area is more profitable compared to ragi. Cultivation of millets in rainfed area is one of the potential climate smart practices to fight climate uncertainties, malnutrition and poverty as millets are rich source of nutrients. The average technical, allocative and cost/economic efficiencies were found to be 0.758, 0.654 and 0.500, respectively. About 86.66 per cent farm households were having below 0.70 economic/cost efficiency score. Improvement in economic efficiency through intensive efforts on part of the farm management and extension agencies is the felt need for improving productivity of little millet and income levels at the farm level.

Keywords: Little millet, Cost and returns, Resource use efficiency, Farm efficiency

Millets are ancient grains and rich source of nutrition. India is one of the world's largest producer as well as consumer of millets. Ninety-seven per cent of millets production is in Asian and African countries only. During 2014, India had 5.89 lakh ha area under small millets with a production of 3.85 lakh tons and productivity of around 630 kg per ha. The area under small millets has decreased at the rate of 3.27 per cent per annum and production has decreased at the rate of 2.83 per cent per annum from 1950 to 2014 (Vilas, 2017). Millets (Great millets - Sorghum, Pearl millet - Bajra, Finger millet - Ragi and Small millets - Foxtail millet, Little millet, Proso millet, Barnyard millet, Kodo millet and Browntop millet) provide nutrition, resilience to climate change as they have low carbon and water foot print and yields sustainable income to farmers in developing countries, whereas in developed countries millets can help to tackle health issues such as obesity, diabetes and lifestyle problems as they are free from gluten and have a low glycemic index. Millets are rich in dietary fiber and antioxidants as well. In spite of all these superiorities, there has been a drastic decline in area and production of millets over the years. The main reason could be the prioritization of cereals such as rice and wheat during green revolution for intensive farming to fight hunger and millets treated as bird food, poor man's food and inferiorto other cereals. Karnataka has second largest dryland area after Rajasthan and has the highest proportion of drought prone area. The Government of Karnataka is supporting small millets cultivation massively by conducting millet melas and rising area under millets through sahaja samrudhi scheme and savayava bhumi programme. Hence, there is a wide scope for producing millets in Karnataka. In 2014, the area under small millets was 23000 hectares, production 13000 tons and productivity 573 kg/ha, out of which little millet had the largest share both in terms of area and production. Little millet is a rich source of iron, calcium and other nutrients. Given the importance of little millet cultivation, the present study made an attempt to estimate the cost and returns from little millet cultivation and resource use efficiency in the production of little millet.

Methodology

The study was conducted in Tumkur and Chitradurga districts of central dry zone of Karnataka during

2017-18. The study area was selected based on secondary data. Chitradurga district has largest area under small millets of about 6589 ha and production of around 2194 qtl/ha (Anon., 2014). Tumkur is one of the major districts in central dry zone of Karnataka where promotion of small millets under different schemes is intensively done. The primary data was collected from a random sample of 30 farmers who are cultivating little millet and were interviewed through pre-tested schedule. Random sampling technique was employed in the sample selection.

Analytical Tools / Techniques

I. Costs and returns analysis

The costs were classified into variable and fixed costs. Variable costs include cost of inputs, labour cost, and interest on working capital etc. Fixed costs were defined to include rental value of land, land revenue and taxes. The measurement and definitions of various cost components were as follows :

Variable cost

Those costs which vary with the level of production were included in this category. The items included under this section are given below.

Labour cost

The cost of human labour was calculated by multiplying the mandays with prevailing wage rate. Women days were converted into man days by multiplying it with the ratio of women labour wages to that of men labour (0.61). The imputed cost on family labour was computed by multiplying man days with the prevailing wage rate. The bullock labour was taken as number of days and the cost towards it was estimated by multiplying days with bullock labour wage rate. Machine labour was measured in hours and valued at prevailing hourly rates in the area.

Cost of Inputs

Cost of various inputs like fertilizers, Farm Yard Manure (FYM) and others were included in this category. Non-farm inputs were valued at prevailing prices while owned farm inputs were imputed at current prices.

Interest on working capital

The prevailing bank rate of seven per cent (commercial bank lending rate in study area) was taken to estimate the interest on working capital for the duration of the crop.

Marketing cost

This item includes the cost incurred for marketing of the produce.

Fixed cost

This consists of those cost items which don't vary with the level of production.

The items included under this section are;

Rental value of land

The prevailing rental value of the land for the crop depending on the duration wasconsidered.

Land revenue and taxes

Land revenue and taxes were charged at the rates levied by the government.

Cost of cultivation: It was the sum of variable costs and fixed costs, which was expressed on per acre basis.

Returns

Gross returns: Gross returns were obtained by multiplying the total product with its unit price.

Net returns: Net returns were obtained by deducting the total costs from the gross returns.

II. Resource-use efficiency in little millet production

Resource use efficiency in little millet production was studied by fitting the Cobb-Douglas type production functions to the farm level data.

The specification of the equation was as follows,

$$Y = a\ X_1^{bl}\ X_2^{b2}\ X_3^{b3}\ X_4^{b4} e^{u} \text{.....(1)}$$

Where,

Y = Gross returns (Rs.)

X_1 = Labour cost (Rs.)

X_2 = Seeds (Kgs)

X_3 = Fertilizer cost (Rs.)

X_4 = Land (Acre)

a = Constant

u = Random variable

b_1, b_2, b_3 and b_4 are the elasticity coefficients.

The equation (1) was converted into the logarithmic form; it is assumed a log linear equation as under.

$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + u \log e$

Specification of variables

Dependent variables

a. Gross returns (₹) Y obtained from little millet cultivation per farm was taken as a dependent variable

Independent variables

a. *Total labour cost* (₹): Cost incurred on human labour, bullock and machine labour per farm was taken.

b. *Seeds (Kg.)*: Seeds used per farm in production of little millet.

c. *Fertilizer* (₹): Cost incurred on fertilizers used per farm in millet production.

d. *Land area (Acres)*: The input was measured in terms of area under little millet in acres.

Marginal Value Product (MVP): The estimated coefficients from regression were used to compute the MVP. By studying the marginal value product of factors of production, their relative importance we can assessed. Marginal Value Product of Xi, the i^{th} input was estimated using the following formula,

$$MVP = bi * \frac{G.M.\ (Y)}{G.M.\ (Xi)}$$

G.M. (Y) and G.M. (Xi) represent the geometric means of output and input respectively and bi is the regression co- efficient of i^{th} input.

The model was estimated as follows,

r = MVP/MFC

Where, r = efficiency ratio

MVP = Marginal value product of variable input

MFC = Marginal factor cost (price per unit input)

Based on economic theory, a firm maximizes profits with regards to resource use when the ratio of the marginal return to the opportunity cost is one. The values are interpreted thus,

If r is <1; resource is excessively used or over utilized (there is no scope to increase the use) hence, decreasing the quantity of resource used increases profits.

If r > 1; resource is under used or being underutilized (there is a scope to increase the use) hence, increasing its rate of use will increase profit level.

If r = 1; it shows that the resource is efficiently used, or optimum utilization of resource has been achieved and hence it is the point of profit maximization.

III. Data envelopment analysis

Data envelopment analysis was used to work out the technical, allocative and economic efficiencies of farms. Technical efficiency (TE) is the ability of farm to produce maximum feasible output from given resources or the minimum feasible resources used to produce a given level of output. Allocative efficiency (AE) refers to the ability of a technically efficient farm to use resources in an appropriate proportion to minimize the production costs considering input prices. Product of TE and AE gives Economic efficiency (EE). Thus, if a farm is both technically and allocatively efficient then that farm is said to be economically efficient. The popular method of estimating the maximum possible output has been the *data envelopment analysis* (DEA) advocated by Charnes *et al.* (1978).

The DEA method is a frontier method which does not require specification of any functional form or a distributional form, and can accommodate scale issues also. DEA was applied by using both classic models CRS (constant returns to scale) and VRS (variable returns to scale) with input orientation, in which one looks for input minimization to obtain a particular product level. Under assumption of constant returns to scale, the linear programming models for measuring the efficiency of farms are (Coelli and Battese, 1998).

The model was solved for each little millet growing farmer in the sample. Gross yield (Q/ha) was used as output (Y) in the present case and total labour (man days), bullock labour (bullock pair days), machine labour (hrs.), seeds (kg) and FYM (tractor load) as inputs (X). The models are solved using the DEAP version 2.1 taking an input orientation to obtain the efficiency levels at a farm.

Results and Discussion

The average age of the respondent in the study area is 46.5 years, about 50 per cent of the farmers are in the age group of above 50 years. Around 70 per cent of sampled famers are literate out of which among 43.33 per cent of farmers' have undergone primary education. Major proportion of the sample respondents are small farmers (70 %), whose land holding is less than two hectares and the average area devoted for little millet cultivation is 0.54 ha. This clearly indicated that little millet is cultivated in marginal lands (Table 1).

The cost of cultivation of little millet per acre was ₹ 7727.64. In the total cost of cultivation, variable cost accounted a major share of about 83.74 per cent followed by fixed cost 16.26 per cent. In the total variable cost, human labour (23.16 %) forms the highest proportion followed by FYM (16.99 %), fertilizer (13.38 %) and machine labour 12.15 per cent (Table 2).

The yield of main product from little millet cultivation is 3.4 qtl/acre and by product is 1.1 tractor loads. The gross returns realized are ₹ 13347.50 and farmers obtained a positive net returns of about ₹ 5619.85. The return per rupee of expenditure is ₹ 1.72, which indicated that for every rupee invested in little millet cultivation, the farmer realized ₹ 1.72 as a return (Table 3). The results are in accordance with the study conducted by Naik in 2013. The variable costs accounted a major portion in the total cost of cultivation, whereas fixed cost forms meager proportion as little millet is cultivated in dry land and these do not require larger investment.

To assess the extent of profitability of little millet cultivation over other crop, the study considered economics of rainfed ragi cultivation, which was estimated by Hamsa in 2016 in central dry zone of Karnataka. The study opined that the negative net returns was realized from the rainfed ragi cultivation to the extent of ₹ 830 per acre and returns per rupee of expenditure in ragi cultivation was ₹ 0.94 indicating that cultivation of ragi is not a profitable crop in rainfed

Table 1

Socio-economic characteristics of little millet farmers in central dry zone of Karnataka, 2016-17

Particulars	No.	Per cent
I. *Age Group*		
a. Below 35 years	6	20.00
b. 35-50 years	9	30.00
c. *Above 50 years*	15	50.00
Average age (years)	46.5	
II. *Education Level*		
a. Primary	13	43.33
b. High School	6	20.00
c. College	3	10.00
d. Illiterate	8	26.67
III. *Average family size*	5	
IV. *Size group*		
a. Small farmers (< 2 ha)	21	70.00
b. Medium and Large farmers (> 2.01 ha)	9	30.00
Average land holding (ha)	1.8	
Average area under little millet cultivation (ha)	0.54	

TABLE 2

Details of cost of cultivation of little millet in central dry zone of Karnataka, 2016-17

(Rs./Acre)

Sl. No.	Particulars	Cost (Rs.)	Percentage
I	*Variable cost*		
	Human labour	1789.38	23.16
	Bullock labour	829.26	10.73
	Machine labour	938.78	12.15
	Seed	92.12	1.19
	FYM (Farm Yard Manure)	1313.10	16.99
	Fertilizer cost	1034.06	13.38
	Marketing cost	363.63	4.70
	Interest on working capital @ 7 per cent	111.31	1.44
	Total variable cost	6471.64	83.74
II	*Fixed cost*		
	Land revenue	6.00	0.08
	Rental value of land	1250.00	16.18
	Total fixed cost	1256.00	16.26
III	Total cost of cultivation	7727.64	100.00

TABLE 3

Details of returns from little millet cultivationin central dry zone of Karnataka, 2016-17

(Rs./Acre)

	Returns	Quantity	Price/Unit (Rs.)	Total (Rs.)
I	Main product (Quintals)	3.4	2850	9690.00
	By product (tractor load)	1.1	3325	3657.50
	Gross returns (Rs.)			13347.50
	Net returns (Rs.)			5619.85
	Cost of production (Rs./quintal)			2272.94
II	Returns per rupee of expenditure (Rs.)			1.72

area, whereas the little millet cultivating farmer realized a net returns of about ₹ 5619.50 per acre and returns per rupee of expenditure is ₹ 1.72. In rainfed area cultivation of little millet is relatively more profitable compared to ragi hence more area should be devoted to little millet cultivation since demand for millets is also gaining importance in metropolitan cities because of health consciousness among consumers (Table 4)

TABLE 4

Comparative economics of little millet and rainfed ragi cultivation in central dry zone of Karnataka

(Rs./Acre)

Sl. No.	Particulars	Little millet	Rainfed ragi
1.	Cost of cultivation	7728	15209
2.	Returns		
	Main product (Qtl)	3.4	7.2
	Price per quintal (Rs.)	2850	1629
	Main product value (Rs.)	9690.00	11729
	By product value (Rs.)	3657.50	2650
	Gross returns (Rs.)	13347.50	14379
	Net returns (Rs.)	5619.50	-830
3.	Cost of production (Rs./qtl)	2272.94	2112.36
4.	Returns per rupee of expenditure (Rs.)	1.72	0.94

Resource use efficiency of little millet cultivation is estimated by using Cobb-Douglas type of production function and the regression coefficients represent respective resource elasticity of production. The results revealed that labour and seeds are significantly contributing to the production of little millet. One per cent increase in labour and seed from its geometric mean level will lead to 0.5608 and 0.3789 per cent increase in gross return (₹) from its geometric mean level respectively. Interestingly fertilizer is not statistically significant. The coefficient of multiple determination (R^2) is 0.83, implies that 83 per cent

variation in the dependent variable is explained by the variables which are included in the model. Returns to scale is 1.08 that is, if all the inputs such as labour, seed, fertilizer and land are increased simultaneously by one per cent, gross returns increases by 1.08 per cent, which exhibits constant returns to scale (Table 5).

TABLE 5

Estimates of the Cobb-Douglas production function in little millet production

[Dependent variable (Y): Gross returns in Rs. per farm]

Sl. No.	Variables	Parameters	Elasticity coefficients
1	Intercept	a	19.13036 * (1.435)
2	Labour in Rs. (X_1)	b_1	0.5608 ** (2.880)
3	Seeds in kg (X_2)	b_2	0.3789 ** (2.194)
4	Fertilizer in Rs.(X_3)	b_3	0.1254 (0.6461)
5	Land in acre (X_4)	b_4	0.01500 (0.0458)
6	Co-efficient of multiple determination(R^2)		0.83
7	F value		32.55
8	Returns to scale		1.08

Note : 1. * indicates significant at 10 per cent and ** indicates significant at 5 per cent

2. Figures in parentheses represent "t" value.

The MVP-MFC ratio is more than one for labour, seeds and fertilizer, which indicated that still there is a scope to increase and reallocate expenditure on these resources in order to maximize the profits (Table 6).

Efficiency of the farm is estimated using Data Envelopment Analysis (DEA). If the efficiency score is less than 0.5 to 0.6 which indicates that farmers are inefficient and the score is nearly 0.9 to 1.0 which means farmers are more efficient in production. The average technical, allocative and cost/economic efficiency was found to be 0.758, 0.654 and 0.500 respectively. Around 40 per cent of the little millet farmers are technically efficient (0.9-1.0) and average technical score is also quite impressive. About 26.66 per cent of farmers are in the range of allocative efficient score 0.7-0.8 and only seven per cent of the farmers are economically efficient (0.9-1.0). This showed that a majority of farmers are technically efficient but not allocatively and economically efficient (Table 7.)

Little millet cultivation is relatively profitable realized positive net returns of ₹ 5619.50 as compared to rainfed ragi cultivation, which realized negative net returns of ₹ 830. Returns per rupee of expenditure is more than 1.0 in little millet cultivation against 0.94 in rainfed ragi cultivation. This suggests that farmer can devote more area for growing little millet in fertile land that yields more profit to the farmers. Since efficiency ratio is more than one for all the resources, there is a need to reallocate the expenditure on different resources such as seed and labour to maximize the profits. About 86.66 per cent of farm households are in below 0.70 economic/cost efficiency score. Thus,

TABLE 6

Resource use efficiency in little millet cultivationin central dry zone of Karnataka, 2016-17.

(Per farm)

Independent Variables usedper farm basis	Geometricmean level of use of input	Elasticity Coefficient	MVP (Rs.)	MFC (Rs.)	MVP/MFC
Labour in Rs.	4546.67	0.56073	1.86	1	1.86
Seeds in kg	16.37	0.37890	349.25	45	7.76
Fertilizer in Rs.	1167.60	0.12548	1.62	1	1.62

TABLE 7

Technical, Allocative and Cost Efficiency of little millet farms in central dry zone of Karnataka 2016-17

Efficiency scores	Technical efficiency	Allocative efficiency	Economic/Cost efficiency
<0.5-0.6	8 (26.66)	11 (36.66)	22 (73.33)
0.6-0.7	6 (20)	6 (20)	4 (13.33)
0.7-0.8	4 (13.33)	8 (26.66)	1 (3.33)
0.8-0.9	0 (0.00)	3 (10)	1 (3.33)
0.9-1.0	12 (40.00)	2 (6.66)	2 (6.66)
Total	30	30	30
Average	0.758	0.654	0.500

Note: * Figures in Parenthesis are percentages

improvement in economic efficiency through intensive efforts on part of the farm management and extension agencies is the felt need for improving the productivity of little millet and income levels at the farm level.

REFERENCES

ANONOYMOUS, 2012, Report on Revalorizing Small Millets in Rainfed Regions of South Asia. DHAN Foundation, Tamil Nadu, India.

ANONOYMOUS, 2014, Annual Report, Directorate of Economics and Statistics, Bengaluru.

CHARNES, A., COOPER, W. W. AND RHODES, E., 1978, Measuring the efficiency of DMUs, *European Journal of Operation Research*, **2** : 429 - 444.

COELLI, T., RAO, D. S. P. AND BATTESE, G. E., 1998, An introduction to efficiency and productivity analysis, Kluwer Academic, Batson.

HAMSA, K. R., 2016, Economic optimum crop planning for resource use efficiency, sustainability and maximization of farm net income in central dry zone of Karnataka, *M.Sc. (Agri.) Thesis* (Unpub), UAS, Bengaluru.

NAIK, A. D., KUNNAL, L. B., KERUR, N. M., ANAND NAIK AND ASHOKA, N., 2013, Production and value chain analysis of minor millets in northern Karnataka. *Research Journal of Agricultural Sciences*, **4** (2) : 262 - 266.

VILAS, A. AND TONAPI, 2017, Policy prospective for mainstreaming small millets, presented in: *National Policy Workshop on Mainstreaming Small Millets in Our Diets*, India Habitat Centre, New Delhi.

(*Received :* May, 2018 *Accepted :* August, 2018**)**