Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.7836

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2019) *7*(6), 259-263

Research Article

Resource Productivity of Maize Crop under Rainfed Condition in Thoothukudi District

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Received: 1.11.2019 | Revised: 7.12.2019 | Accepted: 15.12.2019

ABSTRACT

Maize "Queen of Cereals" is the second most important cereal crop in the world. In India, Maize consumption has been increased by 2 per cent from preceding year 21 MT to 24 MT during 2015 – 2016. India had emerged as one of the largest feed industry growing at compound annual growth rate of 8 per cent mainly in Tamil Nadu growing at faster rate for cattle and poultry feed. Primary data have been collected from 120 sample farmers in Kovilpatti Block with pre-tested interview schedule. Resource use efficiency of individual farms has been estimated using Cobb-Douglas production function analysis. The R^2 was 0.73 which indicates that 73 per cent of the variations in the yield were influenced by explanatory variables.The functional analysis revealed that in maize production under rainfed condition the inputs like seeds, nitrogen, potash and machine labour were positively significant and the inputs like farmyard manure, phosphorous, plant protection chemicals and human labour were non-significant. In case of allocative efficiency all the significant inputs had a ratio of MVP to MFC greater than one indicating that inputs are under-utilized and there is a possibility of increasing the yield by increasing the input use. The technical efficiency analysis interprets that the 55.56 per cent of farmers were under medium efficiency group, 38.89 per cent under low efficiency and the minimum of 5.56 per cent were under high efficiency group. The majority of sample farmers were under medium efficiency group in technical efficiency.

Keywords: *Resource use, Cobb – Douglas production function, Rainfed conditions, Allocative efficiency*

INTRODUCTION

In India, Agriculture sector contributes about 13.9% in the country's gross domestic product besides it supports 53% of population. Cereal crop contribute more when compared to other crops. Maize "Queen of Cereals" is the second most important cereal crop in the world.

Cite this article: Vathana, S.S., Rajendran, T., Selvi, R.P., & Sundar, A. (2019). Resource Productivity of Maize Crop under Rainfed Condition in Thoothukudi District, *Ind. J. Pure App. Biosci. 7*(6), 259-263. doi: http://dx.doi.org/10.18782/2582-2845.7836

Global consumption of maize was categorized into fuel ethanol (37.8 per cent) feed and residuals (36.9 per cent), Export (12.7 per cent), corn distillers (8.5 per cent), High fructose corn syrup (3.2 per cent), sweeteners (2.6 per cent), starch (1.6 per cent), beverages (one per cent) and seed (0.2 per cent) during 2017-18 (USDA report). India had emerged as one of the largest compound feed industry growing at compound annual growth rate of 8 per cent and in Tamil Nadu there is higher growth rate for cattle and poultry feed.

Maize crop was grown in an area of about 8.69 M ha with the production of 21.81 MT and productivity of 2.5 MT / ha in India. Around 15 million farmers were involved in maize cultivation during 2015-16. Maize consumption has been increased by 2 per cent from preceding year 21 MT to 24 MT during 2015 – 2016 (India- Maize-Summit, 2018). Karnataka state has the highest area under maize with 1.13 M ha followed by Madhya Pradesh and Maharashtra with 1.10 M ha and 1.01 M ha respectively. In terms of production Karnataka was highest with 3.27 MT followed by Madhya Pradesh (2. 58 MT), Bihar (2. 40 MT) and Tamil Nadu (2.38 MT), whereas productivity was highest in Tamil Nadu (6.5 MT/ha) followed by Andhra Pradesh (6.0 MT/ ha) and Punjab (3.7MT/ha). In Thoothukudi district, the major cereals crops grown were Black gram (54337 ha), Green gram (34360 ha) followed by maize (33211ha) (Statistical Hand Book 2016 -2017). There was an increasing trend in cultivation of maize crop in Thoothukudi district.

MATERIALS AND METHODS

Thoothukudi district is purposively selected for the study. Maize is grown in an area of 15650 ha with an average productivity of 5152 kg/ ha and production of 80622 tonnes during 2015 – 2016 (Statistical Hand Book 2016-2017). A two-staged random sampling technique was adopted for the selection of sample respondents. Thoothukudi District has 12 blocks in which kovilpatti block was selected on the basis of maximum area under the crop. At first stage Kovilpatti block was selected and in the second stage four villages (Lingampatti, Thittankulam, Avalnatham, Pandavarmangalam) were selected based on the highest area under maize crop. From each village 30 sample farmers were selected randomly thus a sample size of 120 farmers. Primary data were collected using pre-tested interview schedule through personal interviews.

Objective of the study

Maize is the major crop growing in this area. At this stage it is essential to conduct study to understand the production and marketing pattern of maize. The objective of the study was to analyse the resource use efficiency of maize in Thoothukudi district.

Production Function

Cobb-Douglas production function was used for the study as it provides adequate fit to data, adequate degrees of freedom and computational simplicity. The general form of Cobb-Douglas production function was $y = ax_i^{bi}$ where, 'y' is the output. Despite its limitations, Cobb-Douglas production function is used in Agriculture production economics due to: i) computational manageability with this algebraic form and ii) adequate fit to data. The regression parameters represent the elasticity and represents the marginal productivity of the input and the output at the geometric mean level. Therefore, it has the greatest use in diagnostic analysis. Hence, the Cobb-Douglas production function was used for the study and is estimated using regression analysis.

The Cobb-Douglas production function used was:

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} \quad \text{----------} \quad (1)$$

where,

Y	=	Yield of maize (kg/ha)
a	=	Intercept
X_1	=	Seeds (kg/ha)

X_2 = Farm Yard Manure (FYM) (kg/ha)
X_3 = Quantity of N (kg/ha)
X_4 = Quantity of P (kg/ha)
X_5 = Quantity of K (kg/ha)
X_6 = Plant protection chemicals (kg/ha)
X_7 = Machine labour (hours/ha)
X_8 = Human labour (mandays/ha)
U = Error term
b_i = Output elasticity

The above equation was converted into estimable form by logarithmic function which follows the linear form:

$$\ln Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + b_8 \log X_8 + u \log e.$$

The significance of coefficient were tested using t-test.

Allocative efficiency

(Farrel, 1957) introduced the concept of efficiency by employing frontier production function. The Marginal Value of Product (MVP) is equated with Marginal Factor Cost (MFC). If the marginal one unit of input is greater than the price of the input, then the resources are under utilized.

$$r = MVP/MFC \text{ ---------- (2)}$$

where, $MVP_i = \beta_i \frac{\bar{Y}}{\bar{X}} X P_y$

MVP_i = Marginal Value of Product of i^{th} input
$\bar{Y}$ = Geometric mean of the value of output
$\bar{X}$ = Geometric mean of i^{th} input
β_i = Estimated coefficient
P_y = Price of output

Technical efficiency

Technical efficiency is the ratio of actual gross return to the potential gross return that could be obtained in the i^{th} farm at given level of farm resources (Timmer, 1971). The farm is said to be technically most efficient if $Y = Y^*$. A producer is said to be technically efficient if the gross return is maximum for the given level of input resources and technically inefficient if the farm fails to produce the frontier level of gross return at given input level of resources.

$$\text{Technical efficiency of } i^{th} \text{ farm} = \frac{Y_i}{Y_{i*}}$$

Where,

Y_i is actual gross return from cultivation of crop on i^{th} farm

Y_{i*} is the potential gross return obtainable from cultivation of crop on i^{th} farm

RESULTS AND DISCUSSION

The regression coefficients were estimated by employing the Cobb-Douglas production function. The R^2 was 0.73 which indicates that 73 per cent of the variations in the yield were influenced by explanatory variables. The estimated production function coefficient is presented in Table 1. It is evident from the table that inputs like seeds, nitrogen, potash and machine labour were positive and significant. Inputs like farm yard manure, potash, plant protection chemicals, and human

labour were non-significant. Hence, increase in inputs like seed (0.07 per cent), nitrogen (0.20 per cent), potash (0.21 per cent), machine labour (0.62 per cent) would increase the yield of maize crop. Similar studies were conducted in (Hamsa et al., 2017) major food crops under Rainfed Conditions in Central Dry Zone of Karnataka.

Table 1: Resource use efficiency of rainfed maize in Kovilpat4ti bock of Thoothukudi District

S. No	Particulars	Regression Coefficient	Std. Error	t- value	Significance
1	Quantity of Seeds (Kg/ha)	0.0740	0.034	2.142	**
2	FYM (tonnes /ha)	0.1780	0.158	1.122	NS
3	Quantity of N (Kg / ha)	0.2054	0.096	2.126	**
4	Quantity of P (Kg / ha)	0.0826	0.144	0.573	NS
5	Quantity of K (Kg / ha)	0.2129	0.108	1.966	*
6	Plant Protection Chemicals (litres / ha)	0.0567	0.102	0.554	NS
7	Machine Labour (Hours / ac)	0.6222	0.622	3.608	***
8	Human Labour (mandays / ac)	-0.0878	0.087	-0.006	NS

Note: ***, ** and * indicate significance at 1, 5 and 10 per cent levels of significance respectively.

Allocative efficiency

The allocative efficiency of resource used in maize production under rainfed condition was estimated using marginal value of product and marginal factor cost. It could be seen from table 2 that ratio of MVP to MFC was greater than one in each case. It indicates that resources are seeds, nitrogen, potash and machine labour were used at sub optimal level and there is a possibility of increasing the yield of maize. Similar, study was done in (Sharma et al., 2016)

Table 2: Allocative efficiency of resource use in maize production

S. No	Particulars	Regression Coefficient	MVP/MFC	Decision
1.	Quantity of Seeds (Kg/ha)	0.0740	15.42	Under utilized
2.	Quantity of N (Kg / ha)	0.2054	8.67	Under utilized
3.	Quantity of K (Kg / ha)	0.2129	3.20	Under utilized
4.	Machine Labour (Hours / ac)	0.6222	14.15	Under utilized

Technical efficiency in rainfed maize

The technical efficiency was worked by using Timmer's method and the mean technical efficiency of maize farmers were furnished in table 3. In Maize production most of the sample farmers (55.56 per cent) were under medium efficiency group with 80-90 per cent technical efficiency followed by 38.89 per cent in low efficiency group (below 80 per cent) and in high efficiency group (91 % and above) there is a minimum of 5.56 per cent were technically efficient. The overall mean technical efficiency of sample farmers under maize production was found to be 81.75 per cent respectively.

Table 3: Technical efficiency under maize production

S. No	Particulars	Mean Technical efficiency
1.	High efficiency group (91% and above)	5.56
2.	Medium efficiency group (80-90%)	55.56
3.	Low efficiency group (below 80%)	38.89
	Mean efficiency	**81.75**

SUMMARY AND CONCLUSION

The functional analysis revealed that in maize production under rainfed condition the inputs like seeds, nitrogen, potash and machine labour were positive and significant whereas inputs like farmyard manure, phosphorous, plant protection chemicals and human labour were non-significant. In case of allocative efficiency all the significant inputs had a ratio of MVP to MFC greater than one indicating that inputs are under utilized and there is a possibility of increasing the yield by increasing the input use. The majority of sample farmers were under medium efficiency group in technical efficiency.

The economic efficiency of maize growers in Kovilpatti block of Thoothukudi District can be enhanced by adopting the improved package of practices. Using a better quality inputs for seeds, fertilizers etc. at cheap credit to enhance the production of maize.

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