Resource Use Efficiency of Groundnut in Anantapur District of Andhra Pradesh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Groundnut is an important oilseed and Anantapur district of Andhra Pradesh occupies a prominent position both in acreage and production. Data was obtained from forty farmers using structured questionnaire and the input-output relation of groundnut production via Cobb-Douglas production function was examined in this study. It was found that the sum of elasticities was 0.73. The result of the t' test proved that in groundnut farms $\Sigma\ b_i$ was less than one, it indicates decreasing returns to scale, which indicates some of the inputs are excessively used. The production elasticities for human labour, bullock labour, machine labour charges, seed cost and pesticides were positive and significant where as farm yard manure and fertilizers cost was negative which showed that increase in these costs result in decrease in output. The MVP of selected input variables were estimated to be 25.08, 4.21, 6.74, 1.87, 17.34, -19.46 and -7.67 showing that FYM and fertilizers are over utilized and the rest of the variables are underutilized. The groundnut production in the study area would be profitable.

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1. INTRODUCTION

India is the largest producer of oilseeds in the world and the Indian oilseed sector occupies an important position in the agricultural economy of the country. India is the fifth largest vegetable oil economy in the world, next only to USA, China, Brazil and Argentina. India accounts for 12-15% of oilseeds area, 7-8% of the oilseed production, 6-7% of the vegetable oils production, 9-12% of vegetable oils import and 9-10% of the edible oils consumption [1,2]. Oilseed crop contribute significant proportion to agricultural GDP. According to Ministry of agriculture, Government of India, area under cultivation is decreasing and groundnut yields are also low. Major groundnut growing states in India are Andhra Pradesh, Gujarat, Maharashtra, Karnataka and Tamil Nadu.

The area, production and productivity of groundnut crop in Andhra Pradesh during 2005-2006 to 2017- 2018 is presented in Table 1. The area under groundnut crop in Andhra Pradesh was fluctuated between 1876 hectares in 2005-2006 and 735 hectares in 2017-2018. This shows the decline in the area by more the fifty percent. The reason for this declining trend in area under groundnut may be attributed to inadequate and uneven rainfall and change in the cropping pattern in Andhra Pradesh. The production of groundnut crop was also fluctuated from year to year which is shown in the Table 1 [3]. The highest production was noticed in the year 2007-2018 with 2604 ('000 t). The

productivity of groundnut was highest in two out of thirteen years under study (1451 kgs in 2007-08 and 1,426 kgs in 2017-18). The reason for this may be due to good monsoons during these two years under. The productivity is very low with a variation of 557 kgs per hectare to 954 kgs per hectare in eleven out of 13 years [4].

The major districts where groundnut is grown in Andhra Pradesh are Anantapur, Kurnool, Chittoor, Cuddapah, Warangal, Nalgonda, Srikakulam, Visakhapatnam and Mahaboobnagar districts. Anantapur district is the drought prone area receiving lowest rainfall and soils also have low moisture holding capacity and groundnut is the only crop suitable for the soils and climate of Anantapur. The oil content of the groundnut seed varies from 44 to 52%, depending on the varieties and agronomic conditions. Groundnut finds extensive use as a cooking medium as refined oil. It is also used in soap making, and manufacturing cosmetics and lubricants [7]. Groundnut kernels are also eaten raw, roasted or sweetened and consumed as confectionary also used in cattle and poultry rations. There is a lot of demand for groundnut in and around the world. The uses of groundnut make it an excellent cash crop for domestic markets as well as for foreign trade in several developing and developed countries [8,9]. Anantapur district farmers who mostly depend on groundnut production are greatly affected by the fluctuations in the yield so there is every necessity to know the factors influencing the

Table 1. Area, production and yield of groundnut-Andhra Pradesh

Particulars	Area (' 000 ha)	Production ('000 Tonnes)	Yield (kg ha-1)
2005-06	1876.00	1366.00	728.14
2006-07	1334.00	743.00	556.97
2007-08	1795.00	2604.00	1450.69
2008-09	1766.00	1554.10	880.01
2009-10	1301.00	1006.00	773.25
2010-11	1622.00	1458.00	898.89
2011-12	1307.00	844.00	645.75
2012-13	1345.00	1115.00	829.00
2013-14	1642.40	1414.30	861.00
2014-15	1072.00	597.20	557.00
2015-16	915.00	873.00	954.00
2016-17	1144.00	664.22	581.00
2017-18	735.00	1048.41	1426.00

Source: [3,5,6]

production of groundnut. The present study estimates the production function for groundnut production and analyzes resource use efficiency in groundnut production in the study area. By resource use efficiency we mean, the allocation and utilization of different scarce resources in an optimum way so that the marginal productivity of every resource input is just offset its marginal cost. An efficient farmer allocates his land, labour, water and other resources in an optimal manner, so as to maximise his income, at least cost, on sustainable basis. However, there are countless studies showing that farmers often use their resources sub-optimally [10].

2. MATERIALS AND METHODS

In Andhra Pradesh, Anantapur district is selected based on the highest area under groundnut crop. The district economy is principally agrarian with a developing industrial sector. Prominent crops include groundnut, sunflower, rice, cotton, maize, chillies, sesame, and sugarcane. Anantapur town is known as Groundnut City. This district lies in the rain shadow area of the state and suffers from frequent droughts. Anantapur district is selected as it has the highest groundnut area under cultivation. After selection of the district, the highest groundnut growing Mandal/Tehsil (Kalyandurg) in the district is selected. From the mandal/tehsil two villages namely Eastkodipalli and Thimmasamudram villages were selected and twenty farmers from each village were identified by simple random sampling technique making a sample of forty farmers in the study area. The data was collected through personal interview with the help of well structured pre-tested interview schedule designed for the purpose. The interview schedule covered aspects such as general farm and household characteristics, socioeconomic parameters like education, details on cultivation practices adopted in groundnut cultivation and cost of cultivation incurred by the farmers. The present paper studied the Resource use efficiency of groundnut farmers in Anantapur district of Andhra Pradesh.

2.1 Data Analysis

Regression model is a casual relationship between two or more independent variables and a dependent variable [11,12]. Multiple regression was used to develop production function for groundnut production and was used to measure the resource use efficiency [13]. The implicit form of the model is as follows

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, U_i)$$

Different functions, linear, semi-log, double-log and exponential were tried and the double log (Cobb-Douglas) was chosen for the analysis based on the goodness of fit (economic, econometric and statistical criteria). The Cobb-Douglas function / log linear production fitted with seven independent variables namely machine labour (X_1), bullock labour (X_2), human labour (X_3) seed cost (X_4), FYM (X_5), fertilizers (X_6), and plant protection chemicals (X_7). The model adopted was as follows.

$$lnY = In_a + b_1 InX_1 + b_2 InX_2 + b_3 InX_3 + b_4 InX_4 + b_5 InX_5 + b_6 InX_6 + b_7 InX_7 + In\mu$$

$Y = Returns\ per\ hectare\ in\ rupees$

$a = Intercept$

$X_1 = Machine\ labour\ charges\ in\ rupees$

$X_2 = Bullock\ labour\ charges\ in\ rupees$

$X_3 = Human\ labour\ charges\ in\ rupees$

$X_4 = Seed\ cost\ in\ rupees$

$X_5 = FYM\ cost\ in\ rupees$

$X_6 = Fertilizers\ charges\ in\ rupees$

$X_7 = Plant\ protection\ chemicals\ in\ rupees$

$b_1\ to\ b_7 = Respective\ elasticity\ co-efficients$

For testing the regression co-efficients or production elasticities 't' value was calculated using the formula.

$$t = \frac{b_i}{S.E\ OF\ b_i}$$

Where,

b_i = Regression co-efficient or production elasticity of input x_i
S.E of b_i = Standard error of b_i

2.2 Returns to Scale

The sum total of production elasticities of all the inputs ($\Sigma\ b_i$) indicate returns to scale. If $\Sigma\ b_i$: 1 Constant returns to scale, $\Sigma\ b_i$: > 1 increasing returns to scale and $\Sigma\ b_i$: < 1 decreasing returns to scale.

2.3 Marginal Value Products

Marginal value productivity indicates the expected increase in gross returns forthcoming from the use of an additional unit of relevant input, while the level of other inputs remaining unchanged.

A resource or input factor is considered to be used most efficiently if its marginal value product is just sufficient to affect its cost. Equality of marginal value product to factor cost is the basic condition that must be satisfied to obtain efficient resource use. In Cobb Douglas production function, marginal value product (MVP) of xi, the ith input factor is given by the following formula.

$$MVP \ of \ Yi = \ \overline{Y} \Big/ \ \overline{Xi} \ * b_i$$

Where,

$\overline{Y}$ = Geometric mean of output Y

$\overline{Xi}$ = Geometric mean of input X_i

bi = Regression co-efficient of X_j

After computation of marginal value product of a variable, it is to be compared with its acquisition cost or opportunity cost. If the variable in the production function is taken in rupee terms, then the acquisition cost of unit of that input will be one rupee. When the input is expressed in physical units, then the marginal value product must be compared with the actual acquisition cost of one physical unit of that input.

Resource-use efficiency is worked out by computing the ratio of marginal value product to opportunity cost. If the ratio is less than one, it indicates that too much of the particular resource is being used under the existing price conditions and vice versa. If MVP to factor cost ratio is equal to one, it indicates efficient resource use.

3. RESULTS AND DISCUSSION

In order to maximize the profits from an enterprise, the optimum use of resources is very much imperative which is based on the productivity of resources, used in the production activity of a crop. The analysis of resource use efficiency revealed whether the inputs are used efficiently in the crop production. Cobb-Douglas production function was fitted to the data in order to estimate the functional relationship between the dependent variable and independent variables. The dependent variable was yield per hectare and selected input variables are human labour charges, bullock labour charges, machine labour charges, seed cost, farm yard manure cost, fertilizers and pesticides costs. Production elasticities and their respective standard errors are given in Table 2 in groundnut farms. It is observed from the Table that the coefficient of multiple regression (R^2) was 0.712. Hence in groundnut farms about 71.2 per cent of variation in output could be explained by the selected input variables i.e., human labour charges, bullock labour charges, machine labour charges, seed cost, farm yard manure cost, fertilizers and pesticides cost. The results are in confirmation with [14] who told that among the all factors of production seed, fertilizers, irrigation and human labour observed as key factors in production of groundnut with 78 per cent in study.

It is observed that the production elasticities for human labour was 0.472 positive and significant at 1% level of probability, bullock labour was 0.122 but not statistically significant, machine labour was 0.759 and significant at 1% level of probability, seed was 0.233 but not statistically significant, plant protection chemicals was 0.272 and significant at 1% level of probability [15]. The production elasticities for FYM was -0.727 and significant at 1% level of probability, fertilizers was -0.401 and significant at 10% level of probability. This indicated that an increase of human labour by 1% would increase the output by 0.472% and an increase of machine labour by 1% would increase the production by 0.759 %, an increase of plant protection chemicals by 1 % would increase the output by 0.272%, an increase in FYM cost by 1% would decrease the gross returns by 0.727%, increase in fertilizers cost by 10% would decrease the production by 0.401% [16,17,18].

3.1 Returns to Scale in Groundnut Farms in Anantapur District

The sum of elasticities of resources is an indicator of the returns to scale. It was found from the Table 2 that the sum of elasticities was 0.73. The result of the 't' test proved that in groundnut farms $\Sigma \ b_i$ was less than one, it indicates decreasing returns to scale, which indicates some of the inputs are excessively used.

The estimated coefficients were used to compute the Marginal Value Product (MVP) and its ratio with Marginal Fixed Cost (MFC) used to determine the economic efficiency of resources

used. The model was estimated as follows; r = MVP/MFC Where, r is efficiency ratio; MVP is marginal value product of variable inputs and MFC is marginal factor cost (price per unit input). Based on economic theory, a farm maximises profits with regards to resource use when the ratio of the marginal return to the opportunity cost is one [19]. The values are interpreted as follows;

If r<1; resource is excessively used or overutilized hence reduction in use of that resource will enhance the profitability from that resource

If r>1; resource is under-used or being underutilized hence increasing the use of that resource will enhance the profitability from that resource.

If r= 1; resource is efficiently used, that is optimum utilization of resource and hence the point of profit maximization

The return to scale refers to the effect of a change in all the factors by same proportion upon output and it is indicated by sum of the regression coefficient estimated in the Cobb-Douglas production function. When the sum of regression coefficients is greater than, equal to or less than unity, the return to scale is increasing, constant or diminishing respectively

The summation of the regression coefficient (partial elasticity coefficient of Cobb-Douglas function) of the independent variables considered for the study is found less than unity indicating the fact that decreasing return to scale is prevailing in the study area [20].

3.2 Resource Use Efficiency in Groundnut Farms in the Study Area

The marginal value products of factors taken in conjunction with their opportunity costs/market costs indicate the efficiency of resource use. Marginal value products that are higher than the opportunity cost of factors indicate the scope of raising the output profitability through the increased use of resources concerned whereas those less than the opportunity / market costs depict the unprofitable nature of use. Any factor input is considered to be used most efficiently if its MVP is just sufficient to offset its cost. Equality of MVP to factor cost is, therefore, the basic condition that should be satisfied to find the efficient use of resources. The MVPs, opportunity costs, the ratio of MVP to OC of groundnut farms is presented in Table 3. The MVP of human labour, bullock labour, machine labour, seed cost, farm yard manure, fertilizers and Pesticides were estimated to be 25.08, 4.21, 6.74, 1.87, -19.46, -7.67 and 17.34.

Table 2. Production function estimates in groundnut farms in Anantapur district

S. no.	Variable	Elasticity	Standard error
1	Constant (log a)	4.705	3.249
2	Human labour charges (Rs), X_1	0.472**	0.067
3	Bullock labour charges(Rs), X_2	0.122	0.117
4	Machine labour charges (Rs), X_3	0.759**	0.194
5	Seed cost (Rs), X_4	0.233	0.251
6	FYM cost (Rs), X_5	-0.727**	0.164
7	Fertilizers cost (Rs), X_6	-0.401*	0.231
8	Plant protection chemicals cost (Rs), X_7	0.272**	0.087
9	R^2	0.712	
10	Returns to scale	0.73	

*Note: ** Significant at 1 % level of probability. * Significant at 10 % level of probability*

Table 3. Ratios of marginal value product of input factors to their marginal cost

Inputs	Description of inputs	MVP	OC	MVP/OC
1	Human labour	25.08	1	25.08
2	Bullock labour	4.21	1	4.21
3	Machine labour	6.74	1	6.74
4	Seed	1.87	1	1.87
5	FYM	-19.46	1	-19.46
6	Fertilizers	-7.67	1	-7.67
7	Plant protection chemicals	17.34	1	17.34

4. CONCLUSION

The MVPs compared to the respective opportunity cost, the ratio is positive and greater than unity for human labour, bullock labour, machine labour, implies that optimal use of labour will result in the work done on time might enhance the yield and similarly seed and pesticides indicated the underutilization probably due to occurrence of drought and there is scope for increasing the returns by enhancing the input application. The MVPs are negative and the ratios between the MVPs and their respective acquisition costs are less than unity in case of FYM and fertilizers indicating that these are over utilized. Thus it would be profitable to reduce these inputs till it reached optimality [21]. So therefore in the study area the groundnut yields will work out by using the underutilized input but some of them cannot be just increased without prioritizing some minor irrigation facility.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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