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Sugriv Kumar Maurya

Department of Agricultural
Economics, Janta
Mahavidyalaya, Ajeetmal,
Auraiya, Uttar Pradesh, India

RR Kushwaha

Department of Agricultural
Economics, A.N.D. University of
Agril. & Tech. Kumarganj,
Ayodhya, Uttar Pradesh, India

Hraday Kumar

Department of Agricultural
Economics & Statistics,
B.R.D.P.G. College. Deoria,
Uttar Pradesh, India

Corresponding Author:**Sugriv Kumar Maurya**

Department of Agricultural
Economics, Janta
Mahavidyalaya, Ajeetmal,
Auraiya, Uttar Pradesh, India

Resource use efficiency of groundnut (*Arachis hypogaea* L.) cultivation in Gorakhpur district of Eastern UP

Sugriv Kumar Maurya, RR Kushwaha and Hraday Kumar

Abstract

Groundnut (*Arachis hypogaea* L.) has important place in all the oilseed crops in India. India is the second largest producer of groundnuts in the world. The study was based on intensive enquiry of 100 farmers, which selected randomly from 5 sampled villages in Khorabar block of district Gorakhpur. Average per hectare investment on fixed capital came to Rs.69637.12. Overall, per hectare cost of cultivation of groundnut came to Rs. 20516.28, on an average per hectare gross income and net income were worked out to Rs.35620.00 and Rs.15103.72 respectively. Overall, average input output ratio on the cost C₂ basis was worked out 1:1.73. In this study, it was observed that cost of cultivation, gross return and net return were found highest on marginal farms due to heavy investment on fixed and variable costs. In case of human labour, tractor power, seed and irrigation, the marginal value productivities observed positive on all the categories of farms indicating further scope of increasing the investment in groundnut cultivation.

Keywords: Resource use efficiency, groundnut, cultivation

Introduction

Groundnut (*Arachis hypogaea* L.) is believed to be a native of Brazil (South America), since many closely related species are found there. Groundnut is grown on a large scale in almost all the tropical and sub-tropical countries of the world. It is an income and employment oriented commercial crop and very much helpful for manufacturing vegetable oils in India. India is the third largest vegetable oil producing country in the world, next to USA and China. Groundnut is one of the major commercial oil seed crops in India and ranked first in area and second in production in the world, with an area 4.75 million hectare and production 9.17 million tones, (2019-20). Cultivation of groundnut is mostly confined to the southern state of India, viz., Gujrat, Andhra Pradesh, Tamilnadu, Karnataka, Maharastra. Other groundnut producing states are Madhya Pradesh, Rajasthan, Orissa, Uttar Pradesh, and Punjab. About 70 per cent of the area and 75 per cent of the total production of groundnut are concentrated in Gujrat, Andhra Pradesh, Tamilnadu and Karnataka. During 2016-17 Uttar Pradesh occupied 0.09-million-hectare area and 0.09 million tones production of groundnut. Groundnut is an income and employment-oriented crop, but it has very low productivity in Gorakhpur district. Keeping in view the above-mentioned fact the present study entitled "Resource use efficiency of groundnut production in Gorakhpur district of eastern UP" was undertaken with following specific objectives; ^[1] To study operational area and size of farms ^[2] To work out the per hectare investment on fixed capital, and ^[3] To work out the cost, return and input-output relationship ^[4] To work out the resource use efficiency of groundnut production on different size of farms.

Research Methodology

District Gorakhpur was selected purposively, because of highest area under groundnut in eastern U.P. and convenience of the investigator. All the 19 block of Gorakhpur district was arranged in descending order according to area under groundnut cultivation and one block namely Khorabar from top was selected for this study. A list of all 91 villages of the selected block was prepared and 5 villages were selected randomly out of them. A list of all the groundnut growers of the selected 5 villages was prepared and divided in three groups viz. marginal (below 1 ha), small (1-2 ha) and other (medium and large) farms (above 2 ha). The number of large farms was very less hence medium and large farms were merged altogether. A random sample of 74 marginal farms, 17 small farms, and 9 other farms (medium and large) were selected randomly. Thus, 100 farmers were selected randomly from 5 selected villages in each category proportionately.

The pretested schedules and questionnaire were used to collect primary data through personal interview. The relevant secondary data was collected from different sources i.e. books, journals, report and record of district and block head quarter. The suitable statistical tools and techniques were used for the analysis of data.

Analysis of data

Tabular analysis was used for analysis of data weighted average; Cropping intensity and cost benefit ratio were worked out with the following formula.

$$\text{Weighted Average (W.A.)} = \frac{\sum W_i X_i}{\sum W_i}$$

$$\text{Cropping Intensity} = \frac{\text{Total Cropped Area} \times 100}{\text{Net sown Area}}$$

Regression analysis

Cobb-Douglas production function was applied to study the resource use efficiency in groundnut production. The mathematical form of Cobb-Douglas production function (Cobb and Douglas, 1928) is

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} e$$

Where,

Y= Per hectare output (₹ /ha.)

X₁= Seed charge (₹ /ha.)

X₂= Manure and fertilizers

X₃= Irrigation

X₄= Human Labour

a= Constant

b₁, b₂, b₃, b₄= elasticity coefficient of the respective input

e= Error term

Log form of the cob- Douglas production function was used for estimating the parameter of the function based on simple data.

$$\log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + e$$

Marginal value product (MVP)

The marginal value product of input was estimated by taking partial derivatives to return with respect to input concerned, at the geometric mean level of input.

$$\text{MVP}(X_i) = \frac{b_i Y}{X_i}$$

Where,

b_i = Production elasticity with respect to X_i

y = Geometric mean of Y_i (output values in ₹ /ha)

X_i = Geometric mean of X_i (input values in ₹ /ha)

i = 1,2,3,4

The optimal resource use for the inputs were calculated by the following formula:

$$X_j = \frac{b_j}{b_i} c$$

Where,

X_j = Optimal level

b_j = Regression coefficient of X_j variables

b_i = Sum of regression coefficient, and

C = Cost of all included inputs (Sum of geometric mean of all inputs)

Significance test of the regression coefficients

Having estimated the elasticity coefficients, it is desirable to ascertain the reliability of the estimates. The most commonly used “t” test was applied to ascertain, whether the sample production elasticity coefficients b_j is significantly different from zero or not, at some specified probability level.

“t” calculated = b_j / standard error of b_j

$$\text{Or S.E. of } b_j = \frac{b_j}{t \text{ value}}$$

If calculated “t” value is greater than the table value of “t” at specified probability level and ‘n-k-1’ degree of freedom, b_j is said to be significantly different from zero; k is the number of independent factors and n is sample size. Standard of b_j equals $\sqrt{c_u}$, where is the diagonal element of matrix C. Matrix c_u is the inverse of matrix of corrected sum of squares and corrected sum of cross products of dependent variables. σ² is the estimated variance of the of the error term of equation under estimation.

“F” test was used to test the significance of the regression as a whole

$$F = \frac{\text{Regression mean sum of square}}{\text{Error mean sum of square}}$$

$$= \frac{\text{R.S.S./K}}{\sum e^2/n-k-1}$$

Where,

RSS = Regression sum of square

e² = Error sum of square

MVP of jth input factor was tested using the following formula:

$$t = \text{MVP}_j / \text{S.E. of MVP}_j$$

A fitted function may be considered as the ‘best fit’ with a high value of R² (coefficient of multiple determination) and relatively large number of significant constant coefficients. R² is calculated as:

$$R^2 = \frac{\text{R.S.S.}}{\text{T.S.S.}}$$

Where,

R^2 = Coefficient of multiple determination

RSS = Regression sum of square

TSS = Total sum of square

Result and Discussion

The number of farms in different size groups, owned cultivated area, land leased in, total operational area and average size of farms are given in Table - 1. From selected

villages 74 marginal farms, 17 small farms and 9 other farms (medium and large) were selected for this study. Total operational area came to 94.78 ha, in which marginal, small and other farms (medium and large) contributed 48.52 per cent, 25.67 per cent and 25.81 per cent respectively. The overall average size of farms came 0.94 ha, while average size of marginal farms, small farms and other farms (medium and large) were worked out 0.62 ha, 1.43 ha and 2.71 ha respectively.

Table 1: Operational area and average size of farms

S.N.	Size of farms	Number of farms	Owned cultivated area (ha)	Land leased in (ha)	Total operational area (ha)	Average size of farms
1	Marginal	74	43.73	2.26	45.99 (48.52)	0.62
2	Small	17	23.75	0.58	24.33 (25.67)	1.43
3	Others (medium & large)	9	24.05	0.41	24.46 (25.81)	2.71
	Total	100	91.53	3.25	94.78 (100.00)	0.94

Figure in parenthesis indicate percentage to total amount.

Per hectare investment on fixed capital is given in Table - 2. Overall, per hectare investment on fixed capital came to Rs. 69637.13 which varied from Rs. 57547.74 on other farms (medium and large) to Rs. 81068.92 on marginal farms. On an average investment on tractor was highest i.e. 36.89 per cent

followed by major implements, farm building and tube well, which were 18.74 per cent, 15.16 per cent and 6.87 per cent respectively. It was observed that, there was inverse relationship between size group of farms and per hectare investment.

Table 2: Per hectare investment on fixed capital (amount in Rs.)

S.N.	Particulars	Size of farms							
		Marginal		Small		Others (medium & large)		Overall	
		Value (Rs)	%	Value (Rs)	%	Value (Rs)	%	Value (Rs)	%
1	Farm building	13861.70	17.10	9301.26	15.31	5689.21	9.88	10559.06	15.16
2	Live stock	-	-	-	-	-	-	-	-
(i)	Bullock	800.17	0.99	205.50	0.34	-	-	440.09	0.63
(ii)	Buffalo	6784.08	8.36	2630.49	4.33	2044.15	3.55	4485.15	6.44
(iii)	Cow	5216.35	6.43	3514.18	5.78	1471.79	2.56	3805.01	5.46
(iv)	Others	2791.91	3.44	1360.46	2.24	1042.51	1.81	1968.83	2.83
3	Tractor	23048.48	28.43	25071.92	41.27	31479.96	54.70	25689.62	36.89
4	Pumpset	1604.69	1.98	780.92	1.28	511.03	0.89	1108.65	1.59
5	Electric moter	3913.89	4.82	1829.01	3.01	1492.33	2.59	2747.94	3.94
6	Tubewell	6694.33	8.26	3616.93	5.95	2391.65	4.15	4784.16	6.87
7	Major implement	14922.37	18.40	11744.75	19.33	10944.34	19.02	13052.54	18.74
8	Minor implement	1142.46	1.41	544.80	0.92	410.46	0.71	798.45	1.14
9	Others	288.54	0.35	154.13	0.26	70.31	0.12	197.30	0.28
	Total	81068.97	100.0	60754.35	100.0	57547.74	100.0	69637.12	100.0

The total cost and distribution of cost on different input per hectare under different size of farms are given in Table - 3. Overall total cost per hectare came to Rs. 20516.28, which is varied from Rs. 19154.88 on other farms (medium and large) to Rs. 21838.45 on marginal farms. Maximum total cost was found on marginal farms due to heavy investment on human labour, tractor power, manures and fertilizer and rental value

of land leased in. The further reveals that, overall per hectare maximum cost was incurred on human labour i.e. 36.34 per cent, followed by rental value of owned land, seed and tractor power i.e. 17.06 per cent, 13.16 per cent and 10.85 per cent respectively. Lowest cost was observed by plant protection i.e. only 0.56 per cent.

Table 3: Cost of cultivation of groundnut (amount in Rs./ha)

S.N.	Particulars	Size of farms							
		Marginal		Small		Others (medium & large)		Overall	
		Value (Rs)	%	Value (Rs)	%	Value (Rs)	%	Value (Rs)	%
1	Total human labour	7598.51	34.79	7239.97	37.43	7435.14	38.81	7456.74	36.34
(i)	Family labour	4692.91	21.49	2031.12	10.50	1056.69	5.51	2993.18	14.59
(ii)	Hired labour	2905.60	13.30	5208.85	26.93	6378.45	33.30	4463.56	21.75
2	Tractor	2331.81	10.67	2134.84	11.04	2140.32	11.17	2226.76	10.85
3	Seed	2732.07	12.51	2749.65	14.21	2593.90	13.54	2699.98	13.16
4	Manure & fertilizer	979.88	4.48	625.17	3.23	692.91	3.62	806.15	3.93
5	Irrigation charges	586.56	2.68	526.28	2.72	573.35	2.99	566.33	2.76
6	Plant protection	140.56	0.64	100.27	0.52	88.58	0.46	115.65	0.59
7	Rental value of land leased in	419.20	1.92	180.49	0.93	130.75	0.68	276.83	1.35

8	Interest on working capital	369.71	1.69	338.91	1.75	341.37	1.78	353.71	1.72
9	Depreciation	1413.40	6.47	865.19	4.47	773.14	3.85	117.39	5.45
10	Interest on fixed capital	1766.75	8.09	1081.49	5.59	981.42	4.81	1396.74	6.81
11	Rental value of owned land	3500.00	16.02	3500.00	18.09	3500.00	18.27	3500.00	17.06
	Total	21838.45	100.0	19342.26	100.0	19154.88	100.0	20516.28	100.0

Per hectare cost of cultivation, cost of production per quintal, gross return net return and input-output ratio in groundnut production on different size of farms on cost concept are given in Table – 4. On an average, per hectare cost A₁, cost A₂, cost B₁, cost B₂, cost C₁ and cost C₂ of groundnut production came to Rs.12349.53, Rs. 12626.36, Rs.13746.27, Rs.17523.10, Rs.16739.45 and Rs. 20516.28, respectively. On an average per hectare yield was observed 17.81 quintal which varied from 17.07 quintal on other farms (medium and large) to 18.58 quintal on marginal farms. Overall per hectare gross income came to Rs. 35620.00, which varied from Rs. 34140.00 on other farms (medium and large) to Rs. 37160.00

on marginal farms. Overall per hectare net income was worked out Rs. 15103.72. Family labour income, farm investment income and farm business income were observed Rs. 18096.90, Rs. 20000.46 and Rs. 22993.64 respectively. Average cost of production per quintal of groundnut was observed Rs. 1151.95, while it was accounted Rs. 1175.37 on marginal farms, Rs. 1122.59 on small farms and Rs. 1122.23 on other farms (medium and large). Overall average of input-output ratio on the cost A₁, cost A₂, cost B₁, cost B₂, cost C₁ and cost C₂ basis were worked out to be 1:2.88, 1:2.82, 1:2.59, 1:2.03, 1:2.13 and 1:1.73, respectively.

Table 4: Measures of costs and returns of groundnut (amount in Rs. / ha)

S.N.	Particulars	Size of farms			
		Marginal	Small	Others (medium & large)	Overall
1	Cost A ₁	11459.59	12549.16	13546.02	12349.53
2	Cost A ₂	11878.79	12729.65	13676.77	12626.36
3	Cost B ₁	13226.34	13630.65	14467.44	13746.27
4	Cost B ₂	17145.54	17311.14	18098.19	17523.10
5	Cost C ₁	17919.25	15661.77	15524.13	16739.45
6	Cost C ₂	21838.45	19342.26	19154.88	20516.28
7	Yield (in quintal)	18.58	17.23	17.07	17.81
8	Gross income	37160.00	34460.00	34140.00	35620.00
9	Net income	15321.55	15117.74	14985.12	15103.72
10	Family labour income	20014.46	17148.86	16041.81	18096.90
11	Farm investment income	20588.30	19699.23	19406.54	20000.46
12	Farm business income	25281.21	21730.35	20463.23	22993.64
13	Cost of production/ Qtl	1175.37	1122.59	1122.13	1151.95
14	Input-output ratio (on the cost C ₂ basis)	1:1.70	1:1.78	1:1.78	1:1.73

Resource use efficiency in groundnut cultivation

In order to estimate resource use efficiency in the production of groundnut through Cobb- Douglas production function, human labour, tractor power, seed and irrigation were used as a explanatory variables. The result of the function is given in Table – 5. The coefficient of multiple determination (R^2) of marginal farms, small farms and other farms (medium and

large) were calculated 0.9452, 0.9508 and 0.9393 respectively, R^2 indicates that, 94.52, 95.08 and 93.33 per cent of the variations in the dependent variable (Y) were accounted by the variation in the dependent variables, viz., human labour, tractor power, seed and fertilizer all together on marginal farms, small farms and other farms (medium and large), respectively.

Table 5: Resource use efficiency on different size of farms in groundnut cultivation

Result of function	Variables	Size of farms		
		Marginal farms	Small farms	Others farms (Medium & Large)
Production Elasticity	X ₁	0.2796** (0.0893)	0.4943* (0.2267)	0.1635 (0.3810)
	X ₂	0.1357** (0.0557)	0.1641 (0.1444)	0.1469 (0.1861)
	X ₃	0.2405** (0.0656)	0.2214 (0.1775)	0.1989 (0.1551)
	X ₄	0.2888** (0.0651)	0.0883 (0.1553)	0.3635 (0.2541)
Sum of Elasticity (Return to Scale)	$\sum b_i$	0.9445	0.9683	0.8729
Coefficient of multiple determination	R^2	0.9452	0.9508	0.9393
Marginal Value Productivity	X ₁	1.321	2.340	0.794
	X ₂	2.069	2.740	2.402
	X ₃	3.134	1.874	2.689
	X ₄	17.248	6.074	21.73

Figure in parenthesis indicates standard errors at respective variable.

** Significant at 1 per cent and * Significant at 5 per cent probabilities, level of significance

X₁X₂X₃ and X₄, human labour, tractor power, seed and irrigation,

Return to scale

Return to scale (sum of elasticity) on marginal farms, small farms and other farms (medium and large) were found 0.9445,

0.9683 and 0.8729 respectively. It is, therefore, interpreted that groundnut cultivation is characterized by decreasing return to scale on different size of sample farms. In case of all

categories of farms by increasing all the factors 1 per cent simultaneously result increasing of the returns by less than 1 per cent.

In case of marginal farms, the elasticity of production with respect human labour, tractor power, seed and irrigation were statistically significant reflecting that these input factors contributed to the output significantly. In case of small farms, the elasticity of production with respect human labour was statistically significant and tractor power, seed and irrigation were statistically non- significant. In case of other farms (medium and large farms) all the factors were found statistically non- significant reflecting that all the factors have non- significant contribution in the production.

Marginal Value Productivity (MVP)

In case of human labour, tractor power, seed and irrigation, the marginal value productivities observed positive and more than unity on marginal farms and small farms. In case of other farms (medium and large) marginal value productivity of human labour is positive but less than unity, while tractor power, seed and irrigation are positive and more than unity indicating further scope of increasing the investment in groundnut cultivation.

Conclusion

It was concluded that per farm investment was increased with increase in size of farms and there was inverse relationship between size group of farms and per hectare investment on fixed capital. It was concluded that, total cost of cultivation, gross return and net return were found highest on marginal farms due to heavy investment on variable and fixed cost. On an average input-output ratio on the cost C_2 basis was observed 1: 1.73, which shows that further scope of increasing the investment in the groundnut cultivation. In case of human labour, tractor power, seed and irrigation, the marginal value productivities observed positive on all the categories of farms indicating further scope of increasing the investment in groundnut cultivation.

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