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RESEARCH PAPER

An Economic Performance and Resource Use Efficiency of Groundnut Cultivation in Bikaner District of Rajasthan

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ABSTRACT

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop in India. It belongs to the Fabaceae family. It is widely grown for its oil, protein and minerals. This study analyzed the economics of groundnut production in Bikaner district of Rajasthan, focusing on growth trends, cost structures, resource use efficiency and major problems faced by farmers. In 2024-25, groundnut was grown on 57.54 lakh hectares producing 118.96 lakh tonnes, with Gujarat and Rajasthan contributing over 60 percent of the total production. Multistage sampling procedure was followed to fulfill objectives of cost of cultivation and resource use efficiency of groundnut in Bikaner district. The Bikaner district was selected for present study since it held prime position in both area and production of groundnut in Rajasthan. In next stage, Shri Dungargarh and Nokha tehsils of Bikaner were selected purposively based on highest cultivated area under the crop. Furthermore, 120 farmers were selected from randomly selected four villages of notified tehsils for agriculture year 2024–25. Various cost concept measures and Cobb-Douglas production function technique were used to analyse the collected and compiled information of selected respondents. It could be observed from the findings that about 50 per cent respondents were belonged to large size farm category and remaining 50 per cent were scattered almost equally among small and medium category of land holding. The average cost and net returns of groundnut cultivation was found at ₹ 56,839 and ₹ 91,627 per hectare, respectively in Bikaner district. The finding of resource use efficiency indicated that most of the inputs like seed, manure, fertilizer, irrigation and human labour were used in over quantities while plant protection chemicals were used in less quantity but had a positive effect on output. Study indicated that there is need to optimize input use, improve extension services and adopt better crop protection methods to increase productivity and profitability in studied area. The study recommended rational use of inputs, improved pest control and stronger farmer support services to enhance the sustainability and profits of groundnut farming in Bikaner.

HIGHLIGHTS

- About 50 per cent respondents were having farm size of larger than 10 hectare.
- The average B-C ratio of groundnut growers was ₹ 1.62.
- Only plant protection chemicals were used in less quantity and had affirmative effect on production.

Keywords: Groundnut, cost of cultivation, returns, resource use efficiency

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Among the nuts, groundnut (*Arachis hypogea L.*) is popularly called as almond of poor man since it is full of nutrients such as protein, carbohydrate, vitamin-E, fiber, essential minerals, calcium, iron, zinc, etc. and cheaper than almond (Sanni *et al.* 2024). Apart from these, peanut oil, peanut flour and even peanut shells are protein rich fuel for birds and domestic animals' feed (Agrocrops, 2023). Under alkaline soil (pH > 8.0) and high tempraturery (29°C and above) climate condition, fruits can be develope but essential nutrients like iron and zinc could not be available therefore, temprate and tropical climate conditions find suitable for its cultivation (Ojha *et al.* 2024).

Besides of groundnut, India also cultivates various edible oilseed crops *viz.*, soybean, sesame, mustard, sunflower, safflower, niger seed, etc. (IBEF, 2024). During 2024-25, about 17 per cent share of oilseed was contributed by groundnut in India (DAE&S, GoR 2024-25). Collectively Gujarat and Rajasthan states called cane of groundnut oil because they contributed more than 50 per cent groundnut area and production of the country in 2024-25. Aprt from these, Tamil Nadu, Madhya Pradesh, Karnataka, Andhra Pradesh and Maharashtra states are also good contributor of grountnut in India.

Groundnut is cultivated throughout the state in Rajasthan. However, soil and climate conditions of arid zone such as Bikaner, Jodhpur, Churu, Jaipur, Jaisalmer and Jalore districts find suitable for its cultivation. These districts have contributed about 91 per cent production from 86 per cent cultivated area of groundnut in 2022-23. In Rajasthan, Bikaner district is occupied first position in area and production of groundnut with 7.32 lakh tones production and 2.43 lakh hectare areas in 2023-24. Therefore, Bikaner district is selected to examine the inputs costs and their application efficiency in groundnut farming. Throughout the world, various agriculturists of many research institutes have been applied economic analysis and resource use efficiency techniques to study the profit and resource use efficiency of oilseed crops at different locations. It can explain the overuse and under use and efficient use of farm inputs and their contribution in the production of crops. Though, these studies were concentrated on other oilseed crops *viz.*, soybean, mustard, sesamum, niger seed, castor, sunflower, linseed and safflower in different part of the country. However, the study on cost of cultivation and resources use efficiency of groundnut cultivation in Rajasthan particularly in Bikaner district is limited. Therefore, it is essential to identify the cost and resources use efficiency over time and space in cultivation of groundnut. Such type of research study might help to groundnut cultivators in order to decide the selection of crops on their farm and optimum time for disposing off their farm produce to get better return. Many policy makers also benifited by such types of studies to known the changes in cropping pattern at regional, national or even international level. Looking out into above mention facts this study was conducted with specific objectives of (1) to examine the cost of cultivation of groundnut in Bikaner district of Rajasthan and (2) to asses the resource use efficiency of groundnut in Bikaner district of Rajasthan.

MATERIALS AND METHODS

This study was conducted to examine the performance of input use in terms of cost and efficiency of groundnut cultivation. In this regard, primary data were collected on socioeconomic status, input use and output performance of farmers in groundnut cultivation. After Gujarat, Rajasthan is the second largest state in terms of area and production of groundnut in the country. At district level performance, Bikaner is occupied prime position in production and area under groundnut crop. Therefore, Bikaner district was purposively selected for present study. The Bikaner district is scattered in eight tehsils namely Shri-Dungargarh, Nokha, Bikaner, Kolayt, Lunkarser, Chathergarh, Pugal and Khajuwala. Out of these, two tehsils *viz.*, Sri-Dungargarh and Nokha were selected purposively on the basis of highest area and production of groundnut in Bikaner. In the next stage of sampling, total eight villages were selected, four village from each selected tehsil. To collect primary data on socioeconomic status, input use and profitability parameters total 120 groundnut growers were selected randomly. During agriculture year 2024-25, the primary data were collected by using personal interviewed and interaction method in the study area. Based on size of land holding, farmers were categorized into three groups *viz.*, small (< 2 ha.), medium (2-10 ha) and large (10 ha <) farmers.

Analytical tools: The cost of cultivation and profit analysis of groundnut were worked out by using following cost concepts:

Cost A_1: It includes all expenditure made on operational activities of groundnut cultivation

Cost A_2 = Cost A_1 + Rent value paid for leased land (if any)

Cost B_1 = Cost A_1 + Interest on fixed capital assets (other than land)

Cost B_2 = Cost B_1 + Rental value of own land + Rental amount paid for leased land

Cost C_1 = Cost B_1 + Imputed value of family labour

Cost C_2 = Cost B_2 + imputed value of family labour

Cost C_3 = Cost C_2 + 10 per cent of cost C_2 as management cost

B. Income measures: It is surplus amount of money received after substracting different type of costs. For the calculation of profitability of groundnut cultivation in study area, following income measures were used:

$$\text{Gross Farm Income} = Qm \times Pm + Qb \times Pb$$

Where;

Qm = Quantity of main product

Pm = Price of main product

Qb = Quantity of by-product

Pb = Price of by-product

Farm Business Income = Gross Farm Income – Cost A_1 (cost A_2 in case of tenant operated land)

Family Labour Income = Gross Income – Cost B_2

Farm Net Income = Gross Income – Cost C_2

B-C ratio is the returns per unit cost of investment.

Cost of production (₹/Quintal) =

$$\frac{\text{Total cost of cultivation (per ha)}}{\text{Total quantity of output produced (per ha)}}$$

$$\text{Operational cost ratio} = \frac{\text{Total variable costs (per ha)}}{\text{Gross income (per ha)}}$$

$$\text{Fixed cost ratio} = \frac{\text{Total fixed cost (per ha)}}{\text{Gross income (per ha)}}$$

$$\text{Gross cost ratio} = \frac{\text{Total cost (variable cost + fixed cost) per ha}}{\text{Gross income (per ha)}}$$

$$\text{Input output ratio} = \frac{\text{Gross cost of cultivation (per ha)}}{\text{Gross income (per ha)}}$$

Resource Use Efficiency: Allocative efficiency is an economic measure of resource use. A production activity said to be allocatively efficient when *VMP* of a factor is equal to *MFC*. To analyze resource use efficiency in groundnut production, the following form of Cobb-Douglas production function was used:

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} u$$

To make computation procedure simple, the above production function was transformed into log linear form as given below:

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + \log \mu$$

Where; Y = Output (₹/ha), X_1= Value of seed (Qtls. / ha), X_2 = Value of fertilizers (Kg./ha), X_3 = Farm yard manure (Qtls./ha), X_4 = Plant protection materials (No. of spray/ha or value of spray), X_5 = Irrigation charges (No./ha), X_6 = Human labour charges (Hrs./ha), X_7 = Machine labour charges (Hrs./ha), a = Constant, b_1 to b_7 = regression coefficients of respective variable and u = Error term.

Regression coefficients alongwith their significance, standard errors, and coefficients of multiple determination (R^2) were calculated for each input used in groundnut cultivation.

According to Fasai (2006) and Goni *et al.* (2007) the efficiency of resources used were computed by using following formula:

$$RE = \frac{VMP_{xi}}{MFC_{xi}}$$

Where; *RE* = Resources use efficiency coefficient, *VMP* = Value of Marginal Product, *MFC* = Marginal Factor of Cost of inputs

$$VMP = b_i \times \frac{\bar{Y}_i}{\bar{X}_i}$$

Where;

b_i = Input co-efficient of i^{th} input

$\overline{Y}_i$ = Geometric mean of gross returns of i^{th} input

$\overline{X}_i$ = Geometric mean of input of i^{th} input

The *MVP* of particular input recourse is computed by the product of output elasticity of that input, unit price of output and the ratio of mean output values.

The *MFC* of input were obtained from the data collected on the unit price of inputs.

The following decision rules use to identify the utilization pattern of respective resource:

1. When $r = 1$, resource is used efficiently
2. When $r > 1$, resource is underused
3. When $r < 1$, resource is overused

This evaluation is based on the ratio of *MVP* to *MFC* which is denoted by small '*r*'.

RESULTS AND DISCUSSION

Socio-economic status of groundnut growers in study area: The findings of socio-economic status of groundnut growers are presented in table 1. It is worth noting from the table that majority of groundnut growers (55%) were belonged to age group of above 50 years followed 30.8 per cent from middle age group (36 to 50 years) and remaining 14.2 per cent fallen in the young age group (35 years). In terms of education, 30.8, 29.2, 27.5, 6.7 and 5.8 per cent respondents were having primary, secondary, illiterate, higher secondary and graduates level of education respectively. Similar results were earlier confounded by Tukaram (2015).

Regarding caste, most of the farmers belonged to the OBC category (55.8%) followed by the unreserved (24.2%) and SC (20%) category. There were no respondents from the ST or MBC categories.

With respect to annual income, 52.5 per cent ofgroundnut farmers fell in the high-income group followed medium-income group (37.5%) and low income group (10.0%). Similar relationship has been reported by Vekariya (2024). In case of source of income, about 56.7 per cent farmers had been engaged in both agriculture and livestock followed by agriculture and other source (28.3%) and solely agriculturist (15%). In the mean time, 49.17, 26.67 and 24.17 per cent groundnut growers were belonged to large, medium and small category farmers, respectively. During 2014, Yogi examined a comparative economics of conservation versus conventional agricultural practices in Haryan and reported similar findings of economic analysis. In the study area, most of the farmers (60.83%) had 5 to 6 members in their familties, followed 29.17 per cent family with more than 7 members and remaining 10 per cent farmers had less than 4 members in their family.

Table 1: Socio-economic profile of groundnut growers in Sri Dungargarh and Nokha tehsils of Bikaner district

Indicator	Shri Dungargarh (n = 60)	Nokha (n = 60)	Overall (n = 120)
Age			
Young(up to 35 years)	13 (21.67)	4 (6.67)	17 (14.2)
Middle(36 to 50 years)	21 (35.00)	16 (26.67)	37 (30.8)
Old(above 50 years)	26 (43.33)	40 (66.66)	66 (55.00)
Education level			
Illitrate	15 (25.00)	18 (30.00)	33 (27.50)
Primary Education	10 (16.67)	27 (45.00)	37 (30.80)
Secondary	24 (40.00)	11 (18.33)	35 (29.2)
Higher Secondary	7 (11.67)	1 (1.67)	8 (6.66)
Graduate and post graduate	4 (6.66)	3 (5.00)	7 (5.80)
Social Caste			
SC	8 (13.33)	16 (26.67)	24 (20.00)
ST	0 (0.00)	0 (0.00)	0 (0.00)
OBC	29 (48.33)	38 (63.33)	67 (55.8)
MBC	0 (0.00)	0 (0.00)	0 (0.00)
Unreserved	23 (38.34)	6 (10.00)	29 (24.2)
Annual income			
Low (up to ₹ 2 lakh)	5 (8.33)	7 (11.67)	12 (10.00)
Medium (₹ 2 to 4 lakh)	19 (31.67)	26 (43.33)	45 (37.5)
High (above ₹ 4 lakh)	36 (60.00)	27 (45.00)	63 (52.5)
Occupation			
Agriculture	10 (16.67)	8 (13.33)	18 (15.0)
Agriculture + livestock production	32 (53.33)	36 (60.00)	68 (56.70)
Agriculture + Other	18 (30.00)	16 (26.67)	34 (28.3)
Land holding size			
Small farmer (< 2.00 ha)	13 (21.67)	16 (26.67)	29 (24.17)
Medium farmer (2 to10 ha)	14 (23.33)	18 (30.00)	32 (26.67)
Large farmer (above 10 ha)	33 (55.00)	26 (43.33)	59 (49.17)

Indicator	Shri Dungargarh (n = 60)	Nokha (n = 60)	Overall (n = 120)
Family Size (No. of members)			
Below 4	5 (8.33)	7 (11.67)	12 (10.00)
5 to 6	40 (66.67)	33 (55.00)	73 (60.83)
Above 7	15 (25.00)	20 (33.33)	35 (29.17)

Source: *Primary Survey (2024-25).*

Note: *Figures in parentheses show in per cent of groundnut growers.*

Examine the cost of cultivation of groundnut in Bikaner district of Rajasthan

It offered a comparative assessment of the various cost components incurred by selected groundnut growers of different categories. Furthermore, it also examined the returns derived from groundnut farming by farmers. Groundnut cultivation involves the application of various farm inputs such as human labour, machine labour, seeds, farm yard manure, fertilizers, plant protection chemicals and irrigation, some of these may vary according to farm size. The applications of physical farm inputs by different category farmers were presented in table 2. It is revealed from the table that highest family labour was employed by small category farmers at 34 mandays per hectare followed by medium (19.88 mandays/ha) and large (11.5 mandays/ha) size category farmers. The average use of owned family labour was 21.79 mandays per hectare in the study area. In contrast, hired human labour was increased with the farm size in groundnut cultivation. The hired human labour was employed at 17.75, 29.83 and 33.8 mandays per hectare by small, medium and large category farmers respectively. The average use of hired human labour was 27.13 mandays per

Table 2: Utilization patterns of farm inputs in groundnut cultivation in Bikaner district of Rajasthan

Farm inputs	Small	Medium	Large	Overall	Rate per unit (₹)
Human labour (in man days/ha)					
Family labour	34.00	19.88	11.50	21.79	320
Hired labour	17.75	29.83	33.80	27.13	400
Machine labour (hrs./ha)					
Owned	3.31	5.90	6.45	5.22	300
Hired	6.23	3.95	3.56	4.58	500
Seed (Kg./ha)	131.08	124.52	116.30	123.97	55
Manures (FYM) (Qtl./ha)	12.08	10.22	7.30	9.87	150
Fertilizer (in Kg./ha)					
Nitrogen (Urea)	27.08	23.09	20.60	23.59	7.00
Phosphorus (DAP)	29.08	32.95	37.80	33.28	32.00
Potassium (MOP)	9.50	11.33	14.40	11.74	13.50
Plant Protection Chemicals (No.of sprays/ha)	1.00	2.00	4	2.33	300.00
Irrigation (No./ha)	24.33	21.81	18.4	21.52	320.00
Intrest on working capital	882.35	1247.75	1191.90	1107.33	—
Depreciation (₹/ha)	744.79	1684.08	2794.10	1740.99	—
Intrest on fixed capital	684.61	1104.65	1397.05	1062.10	—
Rental value of owan land	13250.00	14058.28	13200.00	13502.76	—
Misscellous charges	442.50	470.56	513.00	475.35	—
Total Cost	56447.75	57931.59	56137.64	56839.00	
Quantity of output product (in Qtl./ha)					
Main product	20.75	24.91	29.40	25.02	—
By- product	14.17	18.95	24.80	19.31	—
Value of output product (in ₹/ha)					
Main product	125458.33	137022.64	161700.00	141393.66	—
By- product	4958.33	7579.54	8680.00	7072.62	—
Gross income (₹/ha)	130416.67	144602.18	170380.00	148466.28	—

Source: *Primary Survey -2024-25, conducted by research scholar.*

hectare in groundnut cultivation. The results were indicated that large category farmers were relied more on hired human labour because of increased workload and their capacity to pay.

Utilzation of owned machine labour reported similar pattern as of hired human labour for groundnut cultivation. The small, medium and large category farmers were used owned machine labour at 3.31, 5.90 and 6.45 hours per hectare respectively, in groundnut cultivation. In contrast, use of hired machine labour was declined with the increase in size of land holding. The small, medium and large category farmers were applied hired machine at 6.23, 3.95 and 3.56 hours per hectare in groundnut farming. On overall average basis, the owned and hired machine labours were employed at 5.22 and 4.58 hours per hectare respectively. The use of seed declined with the increase in the size of land holding. The highest seed quantiy was used by small category farmers at 131.08 kg per hectare followed medium and large category farmers at 124.52 and 116.30 kg per ha respectively. The average seed quantity of groundnut cultivation was recorded at 123.97 kg per hectare in the study area. The results were indicated that large category farmers applied groundnut seed in lesser quantity because they could be technically sound than small and medium category farmers. The application of FYM also declined with the increase in the size of land holding. The small, medium and large category farmers were applied FYM at 12.08, 10.22 and 7.30 quintals per hectare respectively, in groundnut cultivatioon. On an average, farm yard manure was applied at 9.87 quintals per hectare in the study area. The results indicated that large category farmers relied more on application of chemical fertilizers.

The application of urea was decreased with the increase in size of land holding of farmers. In the groundnut farming, maximum qunaity of urea was applied by small farmers (27.08 kg//ha) followed by medium and large category farmers at 23.09 and 20.6 kg/ha, respectively. In contrast, application of DAP and MOP were increased with the size of land holding. In the study area, small, medium and large category farmers were applied DAP at 29.08, 32.95 and 37.80 kg/ha, respectively. In the same way, MOP was also applied at 9.50, 11.33 and 14.40 kg per hectare on small, medium and large category farms, respectively. The results indicated that this pattern was mainly due to the variation in cost of fertilizers. Larger category farmers could afford costlier inputs like phosphorus and potassium because of their better financial capacity, whereas smaller farmers preferred nitrogen (urea) due to its lower price and affordability.

Plant protection chemicals were used more intensively with the increase in the size of land holding. The small, medium and large category farmers were applied 1, 2 and 4 times plant protection chemical sprays respectively on his groundnut farm. It could be conclude from the results that large farmers applied plant protection chemical more frequently to reduce pests and diseases losses in groundnut. In contrast, small farmers mostly used manual methods like hand weeding because they had limited access of financing facility. The maxmum numbers of Irrigation (24.33) were applied by small category farmers followed by medium and large category farmers applied 21.81 and 18.40 irrigations respectively, in groundnut crop. Similar results were reported by Tukaram (2015) in his study.

The interest on working capital paid by small, medium and large farmers was ₹ 882.35, ₹ 1,247.75 and ₹ 1,191.90 per hectare, respectively. It increased from small to medium farms but slightly decreased for large farms. Irrespective of farm size, the average interest on working capital was ₹ 1107.33 per hectare of groundnut growers. The results indicated that the interest on working capital was augmented from small to medium category farmers due to higher input costs, improper use of credit and poor management of owned farm resources. The depreciation cost for small, medium and large farmers was ₹ 744.79, ₹ 1,684.08 and ₹ 2,794.10 per hectare respectively. It increased with the increase in size of land holding under groundnut. The average depreciation on farm building, inputs, machinery, etc. was ₹ 1,740.99 per hectare. The results indicated that higher depreciation on larger farms was due to greater investment in farm machinery and equipment, which increased with the scale of operation.

The interest on fixed capital for small, medium and large farmers was ₹ 684.61, ₹ 1,104.65 and ₹ 1,397.05 per hectare respectively. It increased with the increase in size of land holding. The average

interest on fixed capital was ₹ 1,062.10 per hectare. The results indicated that groundnut growing large farmers incurred higher interest amount due to greater investment in fixed assets such as land, machinery and buildings.

The rental value of own land for small, medium and large farmers were ₹ 13,250, ₹ 14,058.28 and ₹ 13,200 per hectare, respectively. It increased from small to medium farms but slightly decreased for large size land holding farmers. The average rental value of own land was ₹ 13,502.76 per hectare. It could be conclude from the results that rental value of own land was higher for medium farms due to better land quality or location, while large category farmers showed a slight decline, possibly due to variation in land use patter or valuation methods.

The total cost of cultivation was found to be ₹ 56,447.75, ₹ 57,931.59 and ₹ 56,137.64 per hectare for small, medium and large category farmers, respectively. The average total cost of cultivation was ₹ 56,839.00 per hectare. It could be observed from the findings that medium farmers had the highest cost per hectare, whereas small farmers spent slightly less and large farmers spent the least. This may be due to medium farmers relying more on paid inputs, while large farmers reduced their costs through mechanization and efficient large scale farming.

The quantity of output per hectare increased with the increase in size of land holding. The production of main product (nuts) was 20.75, 24.91 and 29.40 quintals per hectare on small, medium and large category farms, respectively. The average production of groundnut in Bikaner district was 25.02 quintals per hectare. Similarly, the production of by-product was recorded at 14.17, 18.95 and 24.80 quintals per hectare, respectively in the study area. The average production of by-product was found 19.31 quintals per hectare. Findings of analysis indicated that larger category farmers were achieved higher yields of both (main and by-products) due to better availability and management of recourses, use of improved farming practices, etc.

The gross income per hectare increased with the size of land holding occupied by the farmers. The groundnut growers were received ₹ 130,416.67, ₹ 144,602.18 and ₹ 170,380.00 per hectare income under small, medium and large category farmers, respectively. The average gross income of groundnut growers in Bikaner district was ₹ 148,466.28 per hectare. The results indicated that groundnut growing larger size farmers earned higher gross income as compared to small and medium category. It could be due to better utilization of resources and economies of scale in cultivation practices of groundnut.

Table 3: Groundnut cultivation costs of different category farmers in Bikaner district (in ₹/ha)

Costs	Small farmer	Medium Farmer	Large farmer	Overall
Cost A_1	31633.15	36408.17	37860.60	35300.64
Cost A_2	31633.15	36840.04	39060.60	35844.59
Cost B_1	32317.75	37512.82	39257.64	36362.74
Cost B_2	45567.75	51571.10	52457.64	49865.50
Cost C_1	43197.75	43873.31	42937.64	43336.23
Cost C_2 (or Total cost)	56447.75	57931.59	56137.64	56839.00
Cost C_3	62092.53	63724.75	61751.41	62522.89
Cost of production (₹/Qtl.)	2720.374	2325.336	1909.444	2318.38
Gross returns	130416.67	144602.18	170380.00	148466.28
Net returns	73968.91	86670.59	114242.36	91627.29
Return per rupee	2.31	2.50	3.04	2.61

Source: *Primary Survey- 2024-25, conducted by research scholar.*

The cost of groundnut cultivation on different farm sizes in Bikaner district of Rajasthan is presented in table 3. It is revealed from the table that cost A_1 incurred by the small, medium and large size land holding farmers were ₹ 31,633.15, ₹ 36,408.17 and ₹ 37860.60 per hectare respectivley. The overall average cost A_1 for groundnut cultivation was ₹ 35300.64 per hectare in Bikaner district.

Like cost A_1, cost A_2 of groundnut cultivation was also enhanced with the increase size of land holding. In the study area, cost A_2 of groundnut cultivation was recorded at ₹ 31,633.15, ₹ 36,840.04 and ₹ 39,060.60 per hectare of small, medium and large category farmers, respectively. The average cost A_2 of groundnut cultivation was found ₹ 35,844.59 per hectare in Bikaner.

In the same way, cost B_1 was also increased with the size of land holding occupied by groundnut growers in Bikaner district. The small, medium and large category farmers were incurred cost B_1 at ₹ 32,317.75

₹ 37,512.82 and ₹ 39,257.64 per hectare, respectively. The average cost B_1 of groundnut cultivator was ₹ 36,362.74 per hectare in Bikaner district.

In case of cost B_2, small, medium and large category farmers had incurred ₹ 45,567.75, ₹ 51,571.10 and ₹ 52,457.64 per hectare respectively. The average cost B_2 of groundnut cultivators was recorded at ₹ 49,865.50 per hectare in the study area. Cost C_1 was recorded at ₹ 43,197.75, ₹ 43,873.31, and ₹ 42,937.64 per hectare for small, medium and large category farmers, respectively whereas the average cost C_1 was ₹ 43,336.23 per hectare. In the same way cost C_1 was recorded at ₹ 56,447.75, ₹ 57,931.59 and ₹ 56,137.64 per hectare for small, medium and large category farmers, respectively while the average cost C_1 was ₹ 56,839.00 per hectare. Cost C_2 of small, medium and large category farmers was observed at ₹ 62,092.53, ₹ 63,724.75 and ₹ 61,751.41 per hectare, respectively. During same time, the average cost C_2 of groundnut cultivation was shoughted at ₹ 62,522.89 per hectare in the study area.

The cost of production per quintal of groundnut was ₹ 2,720.37, ₹ 2,325.34 and ₹ 1,909.44 for small, medium and large farmers, respectively. The average cost of production across all farm sizes was ₹ 2,318.38 per quintal. It was found that the cost per unit decreased with the increase in the size of landholding.

The overall finding indicated that the majority of costs increased with farm size in groundnut cultivation in Bikaner district because medium and large farmers used more inputs and better technology. However, large farmers had lower cost per unit due to economies of scale and higher productivity. Overhead costs increased with farm size due to more investment in machinery and fixed assets.

In case of income generated from groundnut cultivation across different farm sizes, it could be seen that gross return was expanded with groundnut cultivation area of large farmers in Bikaner district. For the small, medium and large category farmers, the gross returns were estimated at ₹ 1,30,416.67, ₹ 1,44,602.18 and ₹ 1,70,380 per hectare, respectively. The average gross return of groundnut cultivation was ₹ 1,48,466.28 per hectare in the study area.

It could be conclude from results that small farmers got less gross returns because they did not have enough machines and money at the right time, which reduced their production. On the other hand, medium and large farmers earned more because they got better yield and used their resources more effectively.

In the same way, net returns increased with farm size in groundnut cultivation in Bikaner district. The net returns for small, medium and large farm size categories were ₹ 73,968.91, ₹ 86,670.59 and ₹ 1,14,242.36 per hectare, respectively. The average net return across all farm sizes was ₹ 91,627.29 per hectare. It was found that small farmers got lower net returns because of lower productivity and higher cost per unit of input. Medium and large farmers earned more net returns as they got better output and managed their inputs more efficiently.

In contrast, return per rupee also increased with the size of land holding. It was found to be ₹ 2.31, ₹ 2.50 and ₹ 3.04 for small, medium and large farm categories, respectively. The average return per rupee across all farm sizes was ₹ 2.61. It was observed that large farmers earned higher returns per rupee mainly due to better productivity and more efficient use of inputs, while small farmers received lower returns because scarcity of financial support and limited availability of resources.

Resource use efficiency of groundnut cultivation in Bikaner district

The groundnut production factors in Bikaner district are shown in table 4. The estimated results of the Cobb-Douglas production function for groundnut cultivation in the Bikaner district of Rajasthan.

The model estimated eight parameters, which included the intercept (constant) and seven independent input variables: seed (X_1), manure (X_2), fertilizer (X_3), plant protection chemicals (X_4), irrigation (X_5), human labour (X_6) and machine labour (X_7).

The intercept coefficient represents the contribution of factors that are excluded from model. It was estimated at 76.15 and found to be highly significant. Indicating a positive baseline level of gross returns when all input variables were held constant. The regression coefficient of selected variables indicates change in dependent variable as a result of an additional unit change in input.

The findings of analysis indicated that the regression coefficient of plant protection chemical (2.02) was positive and significant at 5 per cent level of significance. The estimated regression coefficient of human labour (0.01), machine labour (0.03) were affirmative and non-significant. In case of manure (-0.15), fertilizer (-0.04) and irrigation (-0.07), the regression coefficient were negative and non-significant. Were as regression coefficient of seed (-0.045) was negative but significant at 1 per cent level of significant.

Table 4: Estimation of Cobb-Douglas production function in groundnut cultivation in Bikaner District of Rajasthan

Independent variable	Coefficients	Standard Error	Calculated t-value
Constant	76.15	7.42	10.27
Seed (X_1)	-0.45***	0.06	-7.90
Manure (X_2)	-0.15^{NS}	0.09	-1.61
Fertilizer (X_3)	-0.04^{NS}	0.05	-0.85
Plant Protection Chemicals (X_4)	2.02**	0.90	2.25
Irrigation (X_5)	-0.07^{NS}	0.10	-0.69
Human labour (X_6)	0.01^{NS}	0.03	0.35
Machien labour (X_7)	0.30^{NS}	0.19	1.57
	1.62		
F Value	91.39		
(R^2)	0.851		

Source: *Author's computation based on primary data.*

Note: *,** *** and* ^{NS} *indicates statistical significance at the 1, 5 percent levels and non-significant respectively.*

The sum of the estimated coefficients ($\sum b_i$) was 1.62, which indicates increasing returns to scale, meaning that proportionate increases in all inputs resulted in a more than proportionate increase in output, indicating potential gains from scaling up resource use.

The model's overall goodness of fit was high, with a coefficient of determination (R^2) of 0.851. This suggested that approximately 85.1 per cent of the variation in gross returns from groundnut cultivation was explained by the set of input variables included in the model.

Although several individual explanatory variables were not statistically significant on their own, collectively they explained a significant portion of the variation in gross returns. Similar relationship has been reported by Vekariya (2024).

Efficiency ratio of independent variables

Based on the estimated parameters of groundnut cultivation system in Bikaner district, the efficiency ratios ("*r*" values) for seed, manure, fertilizer, plant protection chemicals, irrigation, human labour and machine labour were shown are given in table 5.

Table 5: Efficiency ratio in groundnut cultivation in Bikaner District of Rajasthan

Independent Variable	Geometric Mean	MVP	MFC	$\frac{MVP}{MFC} = (r)$
Seed	4.82	-0.30	1.00	-0.30
Manure	2.30	-0.20	1.00	-0.20
Fertilizer	4.21	-0.03	1.00	-0.03
PPC	1.23	5.26	1.00	5.26
Irrigation	3.08	-0.07	1.00	-0.07
Human labour	3.89	0.01	1.00	0.01
Machien labour	2.29	0.43	1.00	0.43

Source: *Author's computation based on primary data.*

The ratio of marginal value of product to marginal factor cost of respective input indicates to resources use efficiency that input.

The results indicated that most inputs were over utilized, as their efficiency ratios were less than one. Specifically, the efficiency ratios for seed (-0.30), manure (-0.20), fertilizer (-0.03), irrigation (-0.07), human labour (0.01) and machine labour (0.43) revealed that the application of these resources exceeded the level that would have maximized profit. The negative values for seed, manure and fertilizer clearly suggested that additional spending on these inputs actually led to a reduction in revenue, indicating inefficient use.

Human labour showed a very low positive efficiency ratio (0.01), implying that its use had nearly no effect on increasing returns. This finding indicated inefficiency in the use of labour in the region, as additional labour inputs did not lead to a significant increase in output. Machine labour also appeared to be overused, as its ratio (0.43) showed that additional investment yielded only a fraction of the cost in returns.

Among all inputs, only plant protection chemicals had an efficiency ratio greater than one (5.26). This indicated that PPC was underutilized, and increasing

its use could have significantly enhanced the output and profitability. The results suggested that farmers were not investing enough in plant protection measures, despite their potential to improve crop health and yield. Pavithra, *et al.* (2025) conducted a study on resource use efficiency of farming system in Koramangala Challaghatta valley project area of Karnataka state and found that farmers can reduce resource use without affecting output levels. Tu, V.H. (2017) also reported similar finding in Vietnam, highlighting resource use efficiency and economic gains in sustainable rice production.

CONCLUSION

The present study was undertaken to assess the growth trends, cost and return structure, resource use efficiency and constraints associated with groundnut cultivation in Bikaner district of Rajasthan. Bikaner is holding prime position for area and productivtion of groundnut in Rajasthan therefore; Bikaner district was purposively selected for present study.

In Bikaner district, groundnut cultivation was consontrated throughout the its geographical broundary. Among eight tehsils, two tehsils namely Shri Dungargarh and Nokha were selected purposeviley for the study. A structured survey was conducted across 120 groundnut farmers, categorized into small, medium and large category farm size groups. The socio-economic analysis revealed that the majority of farmers (55%) were above 50 years of age group, a majority (55.8%) belonged to OBC categories and 75 per cent lived in nuclear family systems. Groundnut occupied the largest share of cropped area during the *Kharif* season, while wheat dominated *Rabi* cultivation. The total average cost of cultivation was ₹ 56,839 per hectare. Farmers achieved an average yield of 25.02 quintals of groundnut and 19.31 quintals of by-product per hectare. Gross income averaged ₹ 1,48,466.28 per hectare and net returns ₹ 91,627.29 per hectare. The average return per rupee invested was ₹ 2.61, indicating that farmers earned ₹ 2.61 for every rupee spent on groundnut cultivation. The analysis of resource use efficiency in groundnut cultivation indicated that plant protection chemicals had a significant and positive impact on yield, with an efficiency ratio greater than one. Seed showed a significant but negative effect, while other inputs were statistically non-significant. The sum of the coefficients (1.62) indicated increasing returns to scale.

RECOMMENDATIONS AND POLICY IMPLICATIONS

Based on findings of primary and secondary data analysis, following recommendations and policies are suggested.

(i) To enhance the yield of groundnut in Bikaner district, promotional activities on plant protection chemicals use should be organize for farmers.

(ii) Trained to groundnut growers on efficient use of seeds, fertilizers, manure, irrigation and labour to reduce waste and costs.

(iii) Provide access to high-yielding and disease-resistant groundnut seeds at affordable prices.

(iv) Facilitate affordable machinery access and custom hiring to reduce human labour costs.

(v) Implement integrated pest management programmes to control diseases and pests attack on groundnut field effectively.

(vi) Promote crop insurance and crop subsidies along with low-interest credit facilities to manage risks in groundnut cultivation.

(vii) Subsidize and support to adoption of water saving irrigation system (sprinkler irrigation) in arid zone.

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