Economic Affairs, Vol. **69**(04), pp. 1653-1663, December 2024
DOI: 10.46852/0424-2513.5.2024.15

AESSRA

RESEARCH PAPER

Production Dynamics of Groundnut in Odisha

Subhashree Mishra*, H.N. Atibudhi, R.K. Mishra and Debabrata Swain

Department of Agricultural Economics, Faculty of Agricultural Sciences, Institute of Agricultural Sciences, SOADU, BBSR, Odisha, India

*Corresponding author: subhashreem269@gmail.com (**ORCID ID:** 0009-0000-8907-0117)

Received: 15-09-2024 **Revised:** 02-11-2024 **Accepted:** 25-11-2024

ABSTRACT

One of the significant oilseeds grown in Odisha, groundnut accounts for more than 68% of all oilseeds produced in the state. Odisha's groundnut productivity, however, is lower than the national average. The state has a great deal of potential to increase peanut production and productivity. The goal of the current study was to examine the groundnut crop's economics. The sampling has been done for the selection of Tehsils, clusters of villages, and groundnut farmers of different farm-size classes. The groundnut was selected because of the largest area under cultivation. The district of Odisha was specifically selected for the current study. Data were analyzed using various cost concepts, compound annual growth rate (CAGR), resource use efficiency, allocation efficiency, and technical efficiency of groundnut both at farm level and size group level to study the changes over time in different periods for the state of Odisha. The economics and efficiency of groundnut production were investigated in this study in Odisha (2008–09, 2012–13 and 2016–17). It discovered a peak B: C ratio of 1.41 in 2016–17 using Cobb-Douglas and stochastic frontier production models. In the aforementioned periods, explanations accounted for 61%, 55%, and 65% of the variation in groundnut productivity among farms in Odisha.

HIGHLIGHTS

- Over the past 60 years, groundnut production, yield, and area have increased.
- Odisha and India have been inconsistent, with significant levels of unpredictability.
- Odisha's groundnut growth pattern and trend in area, yield, and production differ from India's.
- Farmers typically operate in a low to medium technical efficiency regime, resulting in insufficient output from available resources.
- To boost peanut output, utilize technology such as high-yielding cultivars, hybrids, crop diversification, and effective crop management.

Keywords: Economics, Groundnut crop, CAGR, Cuddy-Della Valle index, Production function

India's most important food crop and main source of oilseeds is the groundnut. With a year-round cultivation area of 55–60 lakh hectares and a production of about 80 lakh tonnes, India leads the world, behind only China. Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Rajasthan, and Tamil Nadu account for the total cultivated area for the 2016 national crop. The majority of groundnut farmers fall in the category of small and marginal farmers. In regions with low average rainfall, farmers who do not have access to supplemental irrigation grow the crop with few resources. Among oilseeds, groundnut is the most popular crop in India. It occupies a dominant position in the country's edible oil economy. Since it consists of about 25% protein, 45% edible oil, and 26% carbohydrate, among other important components, it is commonly referred to as the "poor man's almond".

Peanut milk, a dairy-free beverage made from groundnuts and other legumes, leaves behind an

How to cite this article: Mishra, S., Atibudhi, H.N., Mishra, R.K. and Swain, D. (2024). Production Dynamics of Groundnut in Odisha. *Econ. Aff.*, **69**(04): 1653-1663.

Source of Support: None; **Conflict of Interest:** None

oilcake rich in nitrogen (7-8%), phosphorus (1%), and potash (1%), useful as organic manure and animal feed. India's demand for oilseeds is growing rapidly and is expected to quadruple by 2020. To meet this demand, current oilseed production must triple. India leads in oilseed output and area, with primary oilseeds (groundnut, sesamum, rapeseed, mustard, linseed, and castor) covering 212.24 lakh hectares, about 15% of the net sown area. Including other oilseeds, the acreage rises to 20%. States like Haryana, Madhya Pradesh, Rajasthan, and West Bengal have increased production through higher acreage and productivity, while Maharashtra, Tamil Nadu, and Himachal Pradesh improved through productivity alone. Conversely, states like Odisha saw declines in acreage, productivity, and production.

Oil seed scenario: in Odisha

The legume or "bean" family includes the peanut or groundnut (*Arachis hypogaea*) species. In the Paraguayan valleys, the peanut was most likely initially domesticated and grown.

In 2010, India produced 5.64 million metric tonnes of groundnuts, with an average yield of 1140 kg per hectare across 4.93 million hectares. Groundnuts are an important oilseed, food, and feed crop, accounting for approximately 15% of India's total edible oil production. India, the world's largest consumer of edible oils, cultivates more than 7 million acres of groundnuts, accounting for 83% of South Asia's total. Between 2000 and 2010, groundnut farming decreased by 1.62 million hectares due to the transition to crops such as soybean, maize, and Bt cotton. However, groundnut agriculture is spreading into non-traditional locations, particularly in Agro-Ecological Zone 4. Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, and Maharashtra, all located in Agro-Ecological Zones 2, 3, and 5, produce 90% of India's groundnuts. Approximately 85% of groundnuts are planted during the rainy season (June/July to October/November), with the other 15% planted in the post-rainy season (October/November to February/March or January/February to May/June), frequently using leftover soil moisture in rice fallows. Groundnut is largely a rainfed crop with high production fluctuation. It is grown as a single crop or intercropped with others, usually during the wet season.

In India, 80% of groundnuts are crushed for oil extraction, 11% for seed production, 8% for food, and 1% for export. FAOSTAT 2012 ranks India as the fifth-largest exporter of unshelled groundnuts and the twelfth-largest exporter of shelled nuts. Groundnut oil cake and haulms are used to feed livestock. National groundnut production was 6.3 million tonnes in 2002 and 5.64 million tonnes in 2010, with no imports required to meet the 2002 demand of 6.4 million tonnes. The IMPACT model predicts an output of 8.3 million tonnes and a consumption of 9 million tonnes between 2015 and 2017, with demand and output predicted to increase by 1.86% from 2000 to 2015.

From 2015 to 2018, groundnuts accounted for more than 68% of Odisha's oilseed production and 34% of its oilseed acreage. However, groundnut agriculture in Odisha has fallen from 318 thousand hectares in 1995-96 to 210 thousand hectares in 2017-18, representing a 0.93% yearly decline.

Over the same period, groundnut production decreased from 4.66 lakh metric tonnes to 3.74 lakh metric tonnes. The Odisha Agricultural Statistics has reported that the crop's yield has grown from 1465 kg/ha to 1783 kg/ha. The state cultivates groundnuts during the kharif (fall crop sown at the start of the summer rains) and rabi (grain crop sown in September and harvested in the spring) seasons. Groundnut acreage in Rabi, which is primarily rain-fed, accounts for 67% of the total. The ensuing aims are what drove the current study's motivation.

Objectives of the study

- To calculate the growth rate of groundnut output, yield, and area in Odisha.
- Cost structure and profitability of Odisha's groundnut harvests.
- Analysis of the groundnut crop's production function in Odisha.

Significance of the study

This study analyzed the structural patterns, growth trends, and resource efficiency of these two crops. Groundnuts account for 34% of total oilseed area.

Methodology

The state of Odisha served as the location for the current study. Through the use of multistage stratified sampling, the main study data were selected. The highest area of the groundnut led to its selection. The current probe has been focused on the Odisha region. Methodology can be defined as the logical sequence of steps taken to solve a problem. The procedural elements of the method utilized in the current study are discussed under the following headings:

Analytical Framework

(a) Cost concepts

The study used the cost concepts and items of cost in value terms currently considered in the cost of cultivation scheme as follows;

Cost A1 = Total paid-out costs.

These include (i) the value of hired human labour (ii) the value of hired bullock labour (iii) the value of owned bullock labour (iv) the value of owned machine labour (v) the value of hired machine labour (v) the value of seed (vi) the value of insecticides and pesticides (vii) the value of manure (viii) the value of fertilizers (ix), and (x) the value of hired bullock labour. Depreciation on equipment and tools (xi) Irrigation costs (xii) Land-related revenue (xiii) Working capital interest (XIV) Unrelated costs

Cost A2 = Cost A1 + Land lease payments made.

Cost B1 = Cost A1 plus interest on the fair market value of owned fixed capital assets (excluding rent). Cost B2= Cost B1 + Rental value of owned land + Rent paid for leased-in land

Cost C1= Cost B1 + Imputed value of family labour

Cost C2= Cost B2 + Imputed value of family labour

Cost A2 + FL= Cost A2 + Imputed value of family labour

The study's profitability metrics were as follows:

Return over A2 + FL cost = Gross value of output – (A2 + FL) cost

Net return (NR) = Gross value of output – C2 cost

Margin over A2 + FL cost = Implicit price – (A2+FL) cost

Net margin (NM) = Implicit price – C2 cost

Implicit cost = Value of main product/yield

(b) Average and percentage

Using both time-series and cross-sectional data, the characteristics of the cost of cultivation and profitability using the simple average were calculated. For all farmers and various sizes of farmers, the absolute change and the percentage variance in groundnut cultivation productivity and profitability were calculated.

(c) Compound Annual Growth Rate (CAGR)

The compound annual growth rate was used to determine the annual growth rate of production expenses, input costs, price, profitability, and real input and output quantities. An exponential growth equation was used in the inquiry. The exponential representation of the growth equation is as follows: The yearly growth rate of production costs, input costs, price, profitability, and real input and output quantities were calculated using the compound annual growth rate. The investigation made use of an exponential growth equation. The growth equation's exponential form looks like this:

$$y_t = ab^t U_t \qquad \ldots(i)$$

Where,

y_t = Variable under consideration at period t

t = Time element which takes the value 1, 2, 3……n

a and b are parameters to be estimated where b = (1 + g), where g is the rate at which y grows every year concerning its value in the preceding year

U_t = Disturbance term

Equation (i) is transformed logarithmically, and the result is,

$$Log y_t = log\ a + t\ log\ b + log\ U_t \qquad \ldots(ii)$$

This might be stated as,

$$y_t^* = a^* + t\, b^* + U_t^* \qquad \ldots(iii)$$

Where,

$y_t = log\ y_t$; $a^* = log\ a$; $b^* = log\ b$ and $U_t^* = log\ U_t$

One way to express the estimated compound growth rate is as follows:

$$g = (antilog\ b^* - 1)*100 \qquad \ldots(iv)$$

The t-statistic was used to determine the significance of the coefficients, and the R^2 value was used to determine the relevance of the model.

(d) Resource use efficiency

Efficiency can be defined as the capacity to produce the most output from the fewest number of inputs, the capacity to produce the most output from a given set of inputs, or a combination of the two. To produce a certain amount of output, efficient farms either need less input than others do, or they produce more with a given set of inputs. The effectiveness of resource usage at the farm level was examined using several production function types.

Finally, Cobb-Douglas production functions were chosen using Mallow's Cp criteria, the number of theoretically relevant variables it circumscribes, and the coefficient of multiple determination R^2. For each crop, the models with the highest proportion of theoretically pertinent variables, the highest R2 values, and the lowest Cp values were chosen. SAS 9.3 was used to complete these operations.

Cobb-Douglas' general equation was in the following form:

$$Y = \beta_0 \times \prod_{i=1}^{n} X_i^{\beta_i} \times e^u \qquad \ldots(i)$$

Where,

Y = Output in q ha^{-1} or `ha^{-1}

X_i = vector of input

β_i = Estimated coefficient of i^{th} input

u = Error term

The variables defined in the model are as follows,

Y = Output in q ha^{-1} or `ha^{-1}

$X1$ = Area under study crop in hectare

$X2$ = Total human labour in hours ha^{-1}

$X3$ = Casual labour in hours ha^{-1}

$X4$ = Family labour in hours ha^{-1}

$X5$ = Tractor use in hours ha^{-1}

$X6$ = Machine labour use in hrs ha^{-1}

$X7$ = Seed in kg ha^{-1} (Cost of seedling in `ha^{-1} in case of paddy)

$X8$ = NPK applied in kg-nutrients ha^{-1}

$X9$ = Nitrogen applied in kg-nutrients ha^{-1}

$X10$ = Phosphorus applied in kg-nutrients ha^{-1}

$X11$ = Potassium applied in kg-nutrients ha^{-1}

$D1$ = Regional dummy for zone 1

$D2$ = Regional dummy for zone 2

(e) Allocative efficiency

From the data from multiple regression, the allocative efficiency (AE) of each input was determined as follows,

$$AE = MVP_{Xi} / MFC_{Xi}$$

$$MVP_{Xi} = \beta_i \left(\frac{\overline{Y}}{\overline{X}_i} \right)$$

Where,

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

$\overline{Y}$ (GM) = Geometric mean of output

β_i =Estimated coefficient or elasticity of i^{th} input

P_Y = Price of output

MVP_i = Marginal value productivity of i^{th} input

MFC_{Xi} = Marginal factor cost of the i^{th} input

(f) Technical Efficiency

The Cobb-Douglas version of the stochastic frontier production function was used to determine technical efficacy at the farm level for various crops. The stochastic frontier model separates the error term into a one-sided efficiency component and a two-sided random error that represents random events outside the organization's control. According to stochastic frontiers (Battese, 1991; Coelli *et al.* 1998), some departures from the frontier are explained by chance events (representing measurement mistakes and statistical noise) and others are explained by firm-specific inefficiencies. Each farm's technical efficacy and maximum probability estimations were determined using the Tim Coelli and Arne Henningsen (2013) R Frontier package version 1.0.

The Cobb-Douglas version of the stochastic frontier production function is given by.

$$Y = \beta_0 \times \prod_{i=1}^{n} X_i^{\beta_i} \times e^{(v-u)}$$

Where,

Y = Output in q ha^{-1} or ` ha^{-1}

X_i = Vector of inputs (same as equation (i) in section 3.3.2)

β_i = Estimated coefficient of ith input

$v_i = v_i$ is a symmetrical random term and assumed to be normally distributed [N(0, σ_v^2)]

u_i = Farm-specific technical inefficiency assumed to follow a half normal distribution

A producer faces own stochastic production frontier $f(X_i, \beta)\ exp\ (v_i)$; a deterministic component $exp\ (v_i)$ that applies to all producers as well as producer-specific part. The farm's unique technical efficiency can be expressed as follows:

$$TE_i = \frac{f(X_i, \beta)\exp(v_i - u_i)}{f(X_i, \beta)\exp(v_i)} = \exp(-u_i)$$

Where,

f = Form of the production function in Cobb-Douglas theory

TE = Technical capability of each farm ($0 < TE_i \leq 1$)

The resulting technical efficiency score was then divided into a number of class intervals, and the distribution of farmers within each interval, as well as their descriptive data, were examined.

RESULTS AND DISCUSSION

1. Compound growth rate in Area, yield, and production and their instability in groundnut

The growth rates for area, yield, output, and instability for groundnut in India and the state of Odisha during the past 60 years are shown in Tables 1 and 2, respectively. For the entire period from 1960 to 2019, the groundnut area in the nation experienced a negative growth rate of -0.6%, which was significant at the 1% threshold of significance. In the comparable time frame, India's yield and production both had positive and substantial growth rates of 1.3% and 0.7%, respectively. The crop's decadal growth rate was incredibly erratic. From 1960 to 1970, the region grew positively but not significantly; from 1980 to 1990, it turned negative but not significantly from 2090 to 2000. At the 1% level of significance,

Table 1: Groundnut area, yield, and production compound annual growth rate (%): India and Odisha

India				Odisha			
Decades	**Area**	**Yield**	**Production**	**Decades**	**Area**	**Yield**	**Production**
1960-70	0.34 NS	0.34 NS	0.69 NS	1960-70	9.15 ***	-4.2 *	4.56 **
1970-80	-0.32 NS	0.93 NS	0.61 NS	1970-80	8.51 ***	-0.58 NS	7.87 ***
1980-90	1.7 *	1.2 NS	2.92 NS	1980-90	-5.07 ***	-1.93 NS	-6.89 ***
1990-00	-2.75 ***	0.56 NS	-2.21 NS	1990-00	2.06 **	4.72 ***	6.88 ***
2000-10	-0.8 NS	2.76 NS	1.94 NS	2000-10	-3.96 ***	0.74 **	-3.24 **
2010-19	-0.54 NS	2.96 NS	2.41 NS	2010-19	1.4***	0.8***	2.2***
1960-2019	--0.6***	1.3***	0.7***	1960-19			

Note: **, ** and *** are noteworthy at the 10 per cent, 5 per cent and 1 per cent level of significance respectively.*

Table 2: Cuddy-Della Valle Instability Index for Area, Yield and Production of Groundnut: Odisha in Comparison to India

India				Odisha			
Decades	**Area**	**Yield**	**Production**	**Decades**	**Area**	**Yield**	**Production**
1960-70	3.47	12.45	12.15	1960-70	NA	NA	NA
1970-80	2.81	12.09	13.6	1970-80	NA	NA	NA
1980-90	7.25	12.84	18.47	1980-90	8.39	7.63	9.6
1990-00	2.34	13.3	13.34	1990-00	3.34	12.95	13.46
2000-10	6.19	20.17	23.03	2000-10	7.02	7.6	12.72
2010-19	6.87	15.76	18.3	2010-19	6.64	1.51	8.05
1960-19	4.87	1.91	3.83	1970-2019	2.50	4.48	2.05

it once more becomes negative and significant. The area of the crop decreased significantly over the following two decades. Production and yield growth rates showed negligible yearly increases over several decades. From 1960 to 2019, the yield increased by 1.3% overall, which is significant at a 1% level of significance. Additionally, production saw positive growth of 0.7%, which was noteworthy at the 1% level of significance. From 1960 to 1970 and 1970 to 1980, respectively, groundnut saw area growth rates of 9.15% and 8.51% in Odisha. The region experienced negative growth rates in the years 1980–1990 and 2000–2010. The state of Odisha's crop production and productivity growth were inconsistent. The government of Odisha must address this by adopting appropriate policy measures.

According to the Cuddy Della-Valle index, growth rates varied from 2.34 to 7.25 percent for areas, 1.91 to 20.17 percent for yields, and 3.83 to 23.07 percent for production. This suggests that the growth rate of the crop in the nation is extremely unstable. Similar results were found in the state of Odisha, where the Cuddy Della-Valle index varied from 2.50 to 8.39% for area, 1.51 to 12.95% for yield rate, and 2.05 to 23.03% for production. Appropriate policy measures at the state and central government levels are required to address the issue and ensure that the nation is self-sufficient in the production of groundnut crops.

Structure of Input Use Pattern for Groundnut in Odisha

The structure of cultivation costs serves as a crucial foundation for agricultural price fixing and farm management decision-making. It frequently has to do with the agricultural sector's policy of price support. Farmers may get more indebted as a result of the inconsistent and insufficient income flow (Darling, 1925; NSSO, 2005b; Narayanamoorthy and Kalamkar, 2005; Government of India, 2007; Reddy and Mishra, 2009; Deshpande and Arora, 2010). According to some recent studies, one of the causes of farmer suicides may be a stagnation in real income and a relatively greater increase in input prices than output prices (Kalamkar and Narayanamoorthy, 2003; Narayanamoorthy, 2006;2007; Deshpande and Arora, 2010; Sainath, 2010).

Table 3 displays the input cost per unit that was used. The table showed that the cost % shift between 2012–13 and 2008–09 was fairly considerable. The cost per unit changed by 112.35, 114.13, 253.80, 206.63, and 127.16 percent per kilogram for seed, fertilizer, human labour, and animal labour, respectively, in 2016–17 over 2008–09. Additionally, the implicit cost showed a 127.16 percent rise. In contrast, the change in unit cost in 2016–17 was less significant than it was in 2012–13. According to the table, animal labour had a 92.79 percent increase, followed by human labour and seed, which saw increases of 55.06 and 32.41 percent, respectively. The price of fertilizer increased negatively by -2.37 percent.

Input use pattern in Groundnut in Odisha

The pattern of input consumption in the groundnut crop in Odisha is shown in Table 4. The table made it clear that work was the biggest input for producing groundnuts, followed by seed. The dynamics of input use in the years 2016–17 and 2008–09 showed a significant decline in the use of fertilizer, animal work, and human labour, but a significant increase of 6.18 percent in the use of seed inputs. The dynamics of input use in 2016–17 over the year 2012–13 showed a significant decline

Table 3: Per Unit cost of inputs used in groundnut production

Years	States	Seed (Kg.)	Fertilizer (Kg. Nutrients)	Manure (Qtl.)	Animal Labour (Pair Hrs.)	Human Labour (Man Hrs.)	Implicit Rate (₹/Qtl.)
2008-09	Odisha	26.88	15.71	32.07	12.21	9.09	2246.48
	% Change over 2008-09	112.35	114.13	0	206.63	253.80	127.16
2012-13	Odisha	43.11	34.46	66.92	19.42	20.74	4225.92
	% Change over 2012-13	32.41	-2.37	—	92.79	55.06	20.78
2016-17	Odisha	57.08	33.64	0	37.44	32.16	5103.09

Table 4: Input use pattern in groundnut production

Years	States	Seed (Kg.)	Fertilizer (Kg. Nutrients)	Manure (Qtl.)	Animal Labour (Pair Hrs.)	Family Labour (Man-Hours)	Attached labour (Man-hours)	Casual labour (Man-Hours)	Human Labour (Man Hrs.)
2008-09	Odisha	131.37	80.32	8.01	139.71	618.65	7.85	331.06	957.56
	% Change over 2008-09	6.18	-30.52	—	-56.07	-6.37	4.84	26.23	-19.69
2012-13	Odisha	130.27	97.08	3.27	107.81	639.93	9.99	352.45	1002.37
	% Change over 2012-13	7.08	-42.51	—	-43.06	-19.15	-25.22	-30.71	-23.27
2016-17	Odisha	139.49	55.81	0	61.38	517.37	7.47	244.21	769.05

Table 5: Component wise cost of cultivation of groundnut per hectare

Years	State	Operational Cost	Family Labour	Hired labour	Animal Labour	Machine Labour	Insecticides	Seed	Fertilizer and Manure	Interest on Working Capital
2008-09	Odisha	16779.72	5785.37	2922.39	1706.29	523.3	49.9	3531.04	1518.4	333.16
	Per cent	100.00	34.4	17.4	10.1	3.1	0.29	21	9	1.9
2012-13	Odisha	34108.16	13334.02	7454.91	2093.79	1184.91	0	5615.66	3563.77	629.5
	Per cent	100.00	39	21.8	6.1	3.4	0	16.4	10.4	1.8
2016-17	Odisha	39635.83	17089.09	7638.74	2298.14	1909.63	0	7962.06	1877.55	683.2
	Per cent	100.00	43.1	19.2	5.7	4.8	0	20	4.7	1.7

in the use of fertilizers, animal work, and human labour, but a relative increase of 7.08% in the input usage of seeds. The use of all other inputs decreased noticeably in the years 2016–17; however, the input of seeds climbed significantly.

2 . Cost of cultivation of Groundnut

1. Component Wise Cost of Cultivation of Groundnut

The operational cost of groundnut cultivation per hectare in the state, according to data shown in Table 5, was greatest in the year 2016–17 and came in at ₹ 39635.83, followed by ₹ 34108.16 and ₹ 16779.72 in the years 2012–13 and 2008–09, respectively. The component-wise cost structures indicated that the labour cost ranged from 50 to 60 percent of the total variable costs of production followed by seed cost which accounted for 20 percent followed by animal labour about 10 percent, machine labour about 5 percent, and fertilizer accounted for 4 percent. The findings advocate for using labour-saving machinery to reduce the cost of production and increase profitability. Similarly, the use of fertilizers is needed for significant increases to enhance productivity and profitability levels.

Fixed costs per unit are higher when production is low because they are not strongly correlated with the amount of production. Small farmers, therefore, struggle with large fixed costs. An account of the fixed costs of groundnut farmers presented in Table 6 indicated that the fixed cost per hectare of groundnut was ₹ 8485.44 in the year 2008-09, it increased to ₹ 16850.72 in 2012-13 and declined to ₹ 14186.58 to-wards 2016-17. The changing dynamics of the rental value of land accounted for wide variation in its value. It was clear that the rental value of one's land played a big role in fixed costs, followed by interest on fixed capital.

Tables 7 and 8 showed the fixed costs variable costs and total costs of production in terms of cost A2 and cost C2. As envisaged from the tables above, the overall variable cost ranged from 66.41 percent to 73.64 percent in different periods. Similarly,

Table 6: Major Components of Cost of Cultivation: Fixed Costs (₹/ha)

Years	States	Fixed Costs	Rental Value of Owned Land	Rent Paid for Leased-in-Land	Land Revenue, Taxes, Cesses	Depreciation on Implements & Farm Building	Interest on Fixed Capital
2008-09	Odisha	8485.44	7310.62	—	12.59	326.8	835.43
2012-13	Odisha	16850.72	15188.54	14.97	11.2	336.73	1299.28
2016-17	Odisha	14186.58	11734.54	—	14.89	449.43	1987.72

Table 7: Major Cost Components in groundnut cultivation (₹/ha)

Sl. No.	Year	Variable cost	Fixed cost	Total c_2 cost
1	2008-09	16779.72 (66.41)	8485.44 (33.59)	25265.16 (100.00)
2	2012-13	34108.16 (66.93)	16850.72 (33.07)	50958.88 (100.00)
3	2016-17	39635.83 (73.64)	14186.58 (26.36)	53822.41 (100.00)

Note: *Figures in the parentheses indicate percentages.*

Table 8: Cost of production with cost A2 and Cost C2

Years	State	Yield/ Hectare	Cost of Cultivation (₹ /Hectare)		Cost of Production (₹/qtl.)	
			Cost C2	Cost A2	Cost C2	Cost A2
2008-09	Odisha	12.80	25265.16	11333.74	1973.47	891.95
	% Change over 2008-09	23.28	101.69	86.50	63.64	50.19
2012-13	Odisha	15.78	50958.88	21137.03	3229.33	1339.58
	% Change over 2012-13	13.75	5.61	8.86	44.20	35.34
2016-17	Odisha	17.95	53822.41	23011.06	2998.47	1281.95

the fixed cost varied from 26.36 percent to 33.59 percent in the corresponding period. The paid-out cost, or cost-A2, for the fiscal year 2008–09 was only ₹ 11333.74, due to trends in structural changes in the cost of growing groundnuts in Odisha. The cost A2 registered a significant increase to the tune of ₹ 21137.03, and ₹ 23011.06 in the year 2012-13 and 2016-17, respectively. Similarly, cost C2, the total cost was ₹ 25265.16 in 2008-09, registered a significant increase of 101.62 percent to ₹ 50958.88 in the year 2012-13 and 5.61 percent to ₹ 53822.41 in the year 2016-17. The cost A2 per quintal of groundnut production was 891.95 in 2008-09 but increased to 1885.79 in the year 2012-13 and it further increased to ₹ 2552.18 in the year 2016-17.

2. Per Hectare Profit from Groundnut

It is crucial to take into account the cost base when calculating return because it should represent all of the farmer's expenses. Three cost models were employed in the current study to consider this: A2, A2 + FL (all paid out cost plus imputed value of family labour), and C2 cost. In addition to looking at output, prices, and profitability for groundnut in Odisha, this section also looks at how the structure of cultivation costs has changed over time.

It was evident from Table 9 that the yield rate of groundnut was 12.80 Q/ha in 2008-09, it registered an increase of 23.28 percent to the level of 15.78 Q/ha. in 2012-13. In 2016-17 it further registered a 13.75 per cent increase to 17.95 quintals. During the period, the MSP of groundnut also registered a significant increase. From 2008-09 to 2012-13 there was a 76.19 percent increase, and in 2016- 17, it registered a 14.05 percent increase in MSP, with the overall being 100.95 percent per hectare. The gross value of output from groundnut varied from ₹ 26880 to ₹ 75749 per hectare. The overall average total return from one hectare of groundnut was ₹ 53671.67. The profits over A2 + FL from the crop

Table 9: Profitability in Groundnut Production (₹ /ha)

Years	States	Yield of Groundnut (Q/ha)	MSP of Groundnut (₹/Q)	Gross Income (₹/ha)	Profit over A2 + Family Labour (₹)	Profit over-C2 (₹)	Profit over-A2 (₹)
2008-09	Odisha	12.80 (23.28)	2100.00 (76.19)	26880.00 (17.85)	17119.11 (67.01)	1534.84 (83.90)	25466.2 (46.26)
2012-13	Odisha	15.78 (13.75)	3700.00 (14.05)	58386.00 (29.73)	28591.94 (7.19)	7427.12 (95.22)	37248.97 (41.58)
2016-17	Odisha	17.95	4220.00	75749.00	30649.80	21926.59	52737.94

Note: *Figures in the parentheses indicate percentages.*

Table 10: Output-Input Ratio of Groundnut Production

Years	States	Gross Income	Cost C2	Cost A2	Output -Input ratio (Based on C2 cost)	Output-Input ratio (Based on A2 cost)
2008-09	Odisha	26800.00	25265.16	11333.74	1.06	2.36
2012-13	Odisha	58386.00	50958.88	21137.03	1.15	2.76
2016-17	Odisha	75749.00	53822.41	23011.06	1.41	3.29

were ₹ 17119.11, ₹ 28591.94, and ₹ 30649.80 for the years 2008-09, 2012-13, and 2016-17 respectively. The profit registered a 67.01 percent increase in 2012-13 over the year 2008-09 and a 7.19 percent increase in 2016-17 over the year 2012-13 with an overall increase of 79.04 percent. The profit over C2 in the corresponding period increased to 83.90 percent and 95.22 percent respectively. The overall profit over C2 registered a substantial increase over the study period. Similarly, the profit over A2 i.e. in the case of tenant farmers increased to the extent of 46.26 percent in 2012-13 over the year 2008-09 and 41.58 percent in 2016-17 over the year 2012-13 with an overall increase of 107.09 percent. This indicates that tenant farming is equally profitable as groundnut farming. However, farmers in Odisha have to take a commercial approach to growing groundnut to maximize their income.

Table 10 indicates the output-input ratio taking total cost and operational cost into consideration. As envisaged from the table even if ground nut is considered as a commercial crop, it was not very remunerative in Odisha. The output-input ratio was only 1.06 in 2008- 09, it increased to 1.15 and 1.41 for 2012-13, and 2016-17, respectively. Based on cost A2, it was 2.36 in 2008-09, it increased to 2.76 and 3.29 in 2012-13 and 2016-17. This might be due to the fixed cost component, which was not included in cost A2.

3. Production function analysis of groundnut crop in Odisha

Table 11: Cobb-Douglas production Function for groundnut production in Odisha

	Year 2008-09	Year 2012-13	Year 2016-17
Intercept	6.369*** (1.705)	2.274 (5.052)	-18.387* (9.854)
Area under groundnut (ha.)	-0.088 (0.095)	-0.010 (0.130)	-0.110 (0.164)
Casual labour (Man-hours/ha)	-0.008 (0.012)	-0.009 (0.021)	-0.003 (0.022)
Hired animal labour (Pair-hours/ha)	0.000 (0.045)	-0.006 (0.066)	0.001 (0.043)
Owned animal labour (Pair-hours/ha)	-0.002 (0.048)	-0.017 (0.047)	-0.008 (0.042)
Seed (kg. /ha.)	-0.651** (0.358)	0.240 (1.026)	3.841* (2.050)
Nitrogen fertilizer (kg-nutrients/ha)	0.014 (0.018)	0.066** (0.031)	-0.094** (0.036)
Phosphatic fertilizer (kg-nutrients/ha)	0.059*** (0.023)	0.000 (0.025)	0.063 (0.053)
Potashic fertilizer (kg-nutrients/ha)	0.005 (0.014)	-0.013 (0.029)	0.062 (0.054)
Owned machine labour (hours/ha)	0.130*** (0.058)	-0.005 (0.046)	0.013 (0.036)
Hired machine labour (hours/ha)	0.096*** (0.025)	0.102*** (0.035)	0.054* (0.030)
Dummy for small farmers	-0.027 (0.114)	-0.085 (0.221)	0.280 (0.241)

Dummy for semi-medium Farmers	-0.039 (0.012)	-0.023 (0.229)	0.159 (0.245)
Dummy for medium Farmers	-0.160 (0.137)	-0.248 (0.250)	0.105 (0.271)
Dummy for large farmers	-0.198 (0.157)	-0.417 (0.307)	-0.147 (0.385)
Multiple R^2	0.6177	0.5571	0.6529
Adjusted R^2	0.5281	0.3557	0.4997
F- Statistic	6.894***	2.767***	4.263***
Residual Standard Error	0.2992	0.3418	0.4034
Number of Observation	80	49	50

Table 12: Resource use efficiency in groundnut production in Odisha

Resources	2008-09	2012-13	2016-17
Seed	-0.048		
Nitrogenous Fertilizer		0.034	-0.005
Phosphatic Fertilizer	0.025		
Owned Machine hours	0.254		
Hired Machine Hours	0.179	0.237	0.024

Farmers seek profit maximization by aligning resource allocation with monetary marginal

Table 13: Stochastic Frontier Production Function for determining technical efficiency for Groundnut Production in Odisha in 2016-17

Particulars	Coefficients	Standard Error	t-value	p-value	Significance
Intercept	-18.0098	0.995248	-18.0958	< 0.00002	***
Area under groundnut (ha.)	-0.10498	0.975862	-0.1076	0.9143	
Family labour (man-hours/ha)	0.205696	0.770038	0.2671	0.7894	
Casual labour (Man-hours/ha)	-0.00366	0.508381	-0.0072	0.9943	
Hired animal labour (Pair-hours/ha)	-0.0174	0.460438	-0.0378	0.9699	
Owned animal labour (Pair-hours/ha)	-0.00037	0.540194	-0.0007	0.9995	
Seed (kg. /ha.)	3.849033	0.882074	4.3636	0.00001279	***
Nitrogen fertilizer (kg-nutrients/ha)	-0.11517	0.340402	-0.3383	0.7351	
Phosphatic fertilizer (kg-nutrients/ha)	0.095738	0.519993	0.1841	0.8539	
Potashic fertilizer (kg-nutrients/ha)	0.06489	0.786476	0.0825	0.9342	
Owned machine labour(hours/ha)	0.025095	0.574487	0.0437	0.9652	
Hired machine labour (hours/ha)	0.092036	0.398441	0.231	0.8173	
Dummy for small size group	0.25768	0.97385	0.2646	0.7913	
Dummy for semi-medium size group	0.170264	0.997081	0.1708	0.8644	
Dummy for medium Size group	0.117125	0.997361	0.1174	0.9065	
Dummy for large size group	-0.14844	0.997059	-0.1489	0.8817	
Sigma square	0.224193	0.912126	0.2458	0.8058	
Gamma	0.661134	0.820562	1.1935	0.2327	
Sigma square U	0.219555	0.935549	0.2347	0.8145	
Sigma square V	0.004638	0.182428	0.0254	0.9797	
Sigma	0.47349	0.963194	0.4916	0.623	
Sigma U	0.468567	0.998308	0.4694	0.6388	
Sigma V	0.068103	1.339359	0.0508	0.9594	
Lmbda	47.33843	1917.327	0.0247	0.9803	

Log likelihood value: -89.23

Cross-sectional data

Total number of observations=50

Mean technical Efficiency:0.722

returns. Allocative efficiency was assessed using the MVP/MFC ratio for the groundnut crop (Table 12). Findings indicate suboptimal resource allocation in the pooled sample, suggesting room for improvement.

CONCLUSION

The bulk of groundnuts are grown in rain-fed production methods, which have higher variability and instability in terms of yield and production. As a result, farmers' revenue from farming groundnuts is uncertain. A regressive component of the oilseed crop sector is the scarcity of high-quality seeds from enhanced cultivars, as well as the inadequate groundnut seed chain.

To attain self-reliance in edible oil production and reduce dependency on imports, the government should increase groundnut and other oilseed production. There is a growing recognition that the opportunity to increase oilseed production through area expansion is limited. Crop intensification in underutilized farming settings, such as rice fallows, can lead to an expansion of area under oilseeds. These tactics promote crop intensification without losing productivity or acreage for other crops. To boost peanut production, utilize technology such as high-yielding cultivars, hybrids, crop diversification, and effective crop management. To improve resource efficiency in groundnut cultivation, key physical inputs (e.g. seed, fertilizers, pesticides, irrigation water), financial (credit facilities, crop insurance), and technical inputs (technology distribution, extension services) must be available in major crop ecological zones. Selective farm mechanization in oilseed farming, including sowing, inter-cultural activities, and groundnut digging, may be implemented. The secondary data demonstrated that inefficiencies also persisted in the peanut processing industry. Together with an unfriendly and inconsistent import policy, a weak and ineffective marketing system has hurt both producers and processors of oilseeds.

REFERENCES

Acharya, S.P., Basavaraja, H., Kunnal, L.B., Mahajanashetti, S.B. and Bhat, A.R.S. 2012. Growth in area, production and productivity of major crops in Karnataka. *Karnataka J. Agril. Sci.*, **25**(4): 431-436.

Badar, H., Javed, M.S., Asghar, A. and Batool, Z. 2002. Production and marketing of constraints limiting groundnut production in Punjab, *Int. J. Agriculture and Biology*, **4**(2): 267-271.

Balaji, P., Padmanabhan, N.R., Shivkumar, S.D. and Chinnaiyan, P. 2001. "Price spread, marketing efficiency and constraints in marketing of groundnut in Tiruvvannamalai, Tamil Nadu", *Indian Journal of Agricultural Marketing*, **15**(2): 36-42.

Behera, B.S., Das, M., Behera, A.C. and Behera, R.A. 2015. "Weather based irrigation scheduling in summer groundnut in Odisha condition", *Int. J. Agricultural Science and Research*, **5**(5): 247-260.

Choudhary, R., Rathore, D.S. and Sharma, A. 2017. "An Economics Analysis of Production and Marketing of Groundnut in Porbandar District of Gujarat", www.ccsniam.gov.in, *Economic Affairs*, **62**(3): 547-553.

Girei, A.A., Dauna, Y. and Dire, B. 2013. "An economic analysis of groundnut (*Arachis hypogea*) production in Hong Local Government Area of Adamawa State, Nigeria", *Journal of Agricultural and Crop Research*, pp. 84-89.

Jadhav, K.L., Thakare, G.G. and Wadkar, S.S. 1993. Resource productivity in summer groundnut production in Sindhudurg district of Maharashtra, *Ind. J. Agricultural Economics*, **48**(3): 401-402.

Narayanamoorthy and Kalamkar. 2005. "8 Farm Profitability in Andhra Pradesh: A Temporal Analysis". https://academic.oup.com/book/36138/chapter/314378140, Pages 184 - 206

Odisha Agriculture Statistics, 2018. Directorate of Agriculture and Food Production, Odisha.

Patnaik, S.C. and Naik, D. 1987. Production and marketing of groundnut in Orissa, *Ind. J. Agricultural Marketing*, pp. 69-79.

Raut, V., Thakar, K.P., Chaudhari, D.D. and Workneh, Y.S. 2015. Cost of cultivation of Kharif groundnut in Sabarkantha district of Gujarat state, *International Research Journal of Agricultural Economics and Statistics*, **6**(1): 186-188.

Sunil Kumar Babu, Naidu, G.S. and Prasad, Y.E. 2002. Studied sale pattern and marketing of groundnut-A case study in Andhra Pradesh, *Journal of Agricultural Marketing*, **45**(2): 21-22.