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An Empirical Study on Groundnut Cultivation Practices in Rainfed Zones of Namakkal District, Tamil Nadu

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Abstract: *Groundnut, a vital oilseed crop in India, plays a significant role in both domestic consumption and export earnings. Tamil Nadu is among the key producers, with cultivation spread across semi-arid regions receiving 500 to 1250 mm of rainfall annually. In 2023–2024, India exported over 680,000 metric tonnes of groundnut valued at USD 860 million, with major export destinations being Indonesia, Vietnam, and Malaysia (APEDA, 2024). Within Tamil Nadu, approximately 6.3 lakh hectares were dedicated to groundnut farming, yielding nearly 11 lakh tonnes, with 70% of cultivation under rain fed conditions (Ministry of Agriculture, GoI, 2023). This study focuses on Namakkal district, a prominent rained cultivation zone, to investigate the factors influencing cultivation practices, cost structure, sowing schedules, and the adoption of value-added practices by farmers. Primary data were collected from 120 farmers using a random sampling method, and the analysis was performed using Chi-square tests, Regression models, and Correlation analysis. The results reveal a significant association between farm size and sowing seasons, and a strong positive correlation between land area and production volume. Regression analysis confirms that the cost of land preparation is the most influential factor affecting overall operating costs. This paper highlights the need for better price realization, training in value addition, and policy support to enhance productivity and profitability for rainfed groundnut farmers*

Keywords: Rainfed Agriculture, Groundnut Cultivation, Cost of Cultivation, Sowing Season, Value Addition, Tamil Nadu, Regression Analysis, APEDA

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1. Introduction

Agriculture remains the cornerstone of rural livelihoods in India, employing more than 40% of the population and contributing nearly 17% to the national Gross Value Added (GVA) in 2023 (Ministry of Agriculture & Farmers' Welfare, 2023). Among the diverse crops cultivated across India's agro-climatic regions, groundnut (Arachis hypogaea) holds a prominent position. Groundnut, also known as peanut, is a dual-purpose crop grown both for its oilseed and protein-rich kernel. It has an important place in the Indian dietary system and serves as a critical input in edible oil production, animal feed, and value-added food industries. India is the second-largest producer of groundnut globally after China. According to APEDA (2024), India exported over 680,698 metric tonnes of groundnuts in 2023–24, earning a revenue of USD 860.68 million, reflecting a 21% increase over the previous year. This growth is attributed to strong demand from Southeast Asian countries such as Indonesia, Vietnam, Malaysia, and the Philippines. Despite such macroeconomic significance, groundnut cultivation remains highly vulnerable at the micro-level, particularly in rainfed regions like those found in Tamil Nadu. Tamil Nadu contributes approximately 10–12% of India's groundnut production, with a cultivated area of about 6.3 lakh hectares and an annual production of nearly 11 lakh tonnes (Government of Tamil Nadu, Department of Agriculture, 2023). The major groundnut-producing districts in the state include Salem, Erode, Cuddalore, Thiruvannamalai, and Namakkal. Importantly, nearly 70% of the groundnut cultivation in Tamil Nadu is rainfed, making it particularly susceptible to climate variability, soil constraints, and input cost pressures (ICAR, 2023).

1.1 Groundnut as an Agro-Economic Crop

Groundnut is a short-duration crop with significant economic returns under the right conditions. It requires well-drained sandy loam soils and grows well in areas with moderate rainfall ranging from 500 to 1250 mm annually. Its ability to fix nitrogen also improves soil fertility, making it a suitable rotational crop. In India, groundnut is cultivated during both Kharif and Rabi seasons, although rainfed farming is predominantly carried out in the Kharif season due to dependence on monsoon rains. The cost-benefit ratio in groundnut farming is favorable when market prices are stable and input costs are managed efficiently.

However, issues such as erratic rainfall, pest infestation, market volatility, and lack of irrigation facilities severely affect yield and profitability, especially in rainfed areas. According to the 3rd Advance Estimates of the Ministry of Agriculture (2023), groundnut production in India was estimated at 10.29 million tonnes, slightly down from the previous year due to uneven rainfall in key producing states.

1.2 The Challenge of Rainfed Agriculture

Rainfed agriculture is defined as cultivation that entirely depends on natural rainfall without supplementary irrigation. While it represents over 60% of India's net sown area, it contributes only 40% to total agricultural production (NITI Aayog, 2023). In Tamil Nadu, the reliance on rainfed farming is particularly high in the western districts, where irrigation infrastructure is limited. Groundnut, being a hardy crop, is widely cultivated in these rainfed zones.

However, rainfed farming presents serious challenges such as:

- Unpredictable monsoons: Inconsistent and delayed rainfall impacts sowing patterns and germination.
- Soil degradation: Limited organic content and overexploitation lead to reduced productivity.
- Low returns: Farmers receive suboptimal prices due to lack of value addition and market access.

Limited access to credit and inputs: Marginal farmers struggle to afford quality seeds and fertilizers.

In the context of Namakkal District, located in the semi-arid zone of Tamil Nadu, rainfed farming is the norm. The region receives an average annual rainfall of 850–900 mm, mainly from the southwest monsoon. This makes the district suitable for groundnut cultivation, but also exposes it to production risks.

1.3 Groundnut Cultivation in Namakkal: A Regional Overview

Namakkal is a major agricultural district with significant production of oilseeds, pulses, and millets. Groundnut cultivation here is mostly undertaken by small and marginal farmers, typically owning less than 2 hectares of land.

The agro-climatic conditions, coupled with traditional farming knowledge, make groundnut a favorable crop. However, input costs have risen, especially for labor, seed procurement, and pest control, while price realization remains inconsistent. According to local agricultural records (Department of Agriculture, Namakkal, 2023), the average yield of groundnut in the district is about 1.2 to 1.5 tonnesper hectare, depending on rainfall distribution and farm practices. Value addition activities such as oil extraction, peanut butter production, and feed manufacturing are still at a nascent stage in this region. The lack of infrastructure for storage, transportation, and processing further compounds the income uncertainty for farmers.

1.4 Need for Value Addition and Modern Practices

In recent years, awareness about value-added products in groundnut farming has increased. Farmers are gradually shifting from selling raw pods to processing nuts for oil, peanut cakes, and animal feed. According to a study by Gautam & Singh (2023), value-added groundnut products can increase farmer income by 30–40%, provided proper training, machinery, and market linkage are available.

Moreover, adopting improved practices such as:

- Seed treatment
- Drip irrigation (where feasible)
- Use of pest-resistant varieties

Crop rotation with legumes

Can enhance yield and reduce vulnerability. However, rainfed farmers often lack the resources and institutional support to implement such changes. This calls for region-specific studies that understand local constraints and suggest practical solutions.

1.5 Export Demand and Market Trends

India's groundnut export market is expanding. Between 2020 and 2023, exports grew by nearly 30% in volume and 40% in value (APEDA, 2024). With countries like China facing shortfalls in domestic production due to climatic extremes, Indian exporters have stepped in to fill the demand gap. However, most export-quality nuts are sourced from irrigated belts of Gujarat and Andhra Pradesh. Tamil Nadu's farmers, particularly in rainfed districts like Namakkal, are not yet fully integrated into the export supply chain.

This is mainly due to lack of awareness about grading standards, packaging, and quality certification. Addressing these gaps can open up new opportunities for rainfed farmers and contribute to inclusive agricultural growth.

1.6 Justification for the Study

Despite the importance of groundnut in Tamil Nadu's agrarian economy, there is limited empirical research focused on rainfed cultivation practices, especially in Namakkal. Previous studies have addressed productivity and marketing (Perumal, 2000; Gangisetty et al., 2016), but few have analyzed the intersection of farm size, cost structure, sowing season, and value addition in rainfed settings. Moreover, with rising climate variability and changing rainfall patterns, the need to understand the dynamics of cost and productivity in rainfed agriculture is more urgent than ever. Farmers require evidence-based strategies to make informed decisions on crop planning, input usage, and post-harvest management. This study aims to fill that research gap by providing insights into the groundnut cultivation.

2. Review of Literature

A well-structured review of existing literature serves as the backbone of any empirical study. It not only provides academic grounding but also helps in identifying key gaps in knowledge. The present study draws from a diverse range of literature national and international to understand the dynamics of groundnut cultivation in rainfed regions, particularly focusing on cost structures, productivity, market behavior, and the potential for value addition.

Bhattacharyya and Mitra (2016) conducted a regional analysis of groundnut production instability in eastern India and found that erratic monsoon behavior and dependence on outdated farming methods significantly impacted yields. The authors emphasized the vulnerability of rainfed farming systems in the absence of climate-resilient infrastructure, urging policy makers to prioritize investment in weather forecasting and drought management programs tailored to oilseed crops.

Choudhary, Rathore, and Sharma (2017) examined the economic viability of groundnut cultivation in Gujarat's Porbandar district. Their study revealed that labor and seed inputs constituted nearly half of the total cultivation cost. Rainfed farmers, in particular, lacked access to bulk purchasing or mechanization tools, leading to higher unit costs.

They argued that financial incentives and cost-sharing schemes are essential to encourage rainfed cultivation in resource-poor areas.

Rao and Raju (2020) investigated cultivation practices in Tamil Nadu and observed that most small and marginal farmers still followed traditional sowing and land preparation methods, especially in rainfed zones. Despite awareness about improved practices, adoption remained low due to absence of localized extension services and lack of formal credit. Their study underlined the need for integrated service delivery models that support both technical training and input access.

Nishant (2019) explored long-term production trends and decomposition of yield variables in Maharashtra. He concluded that productivity gains were more apparent in irrigated zones compared to rainfed regions. Farmers in rainfed belts faced higher uncertainty and had limited capacity to absorb input cost shocks. The study suggested that institutional innovations such as farmer cooperatives could reduce vulnerability and enhance productivity.

Gautam and Singh (2023) provided strong evidence on the economic impact of value-added processing in semi-arid groundnut farming regions. They found that the transition from selling raw pods to processed products like peanut butter and cold-pressed oil increased farmers' net income by 30–40%. The study argued that with adequate access to machinery, branding, and market linkages, rainfed farmers could tap into domestic and export-oriented value chains.

A ground-level study by Gangisetty et al. (2016) in Anantapuram district highlighted market constraints in rainfed farming. Farmers were compelled to sell immediately after harvest at prices far below market potential due to poor storage infrastructure and lack of bargaining power. The authors stressed the importance of establishing Farmer Producer Organizations (FPOs) and regulated markets to counterbalance middlemen exploitation.

Yash and Singh (2018) conducted a comparative analysis of sorghum and groundnut in Maharashtra. While groundnut showed higher gross returns, the associated input costs—especially in rainfed areas—were also higher. Their findings suggest that insurance schemes and water conservation technologies could help stabilize earnings in low-rainfall zones.

Paul, Faruk, and Rambabu (2021) explored agronomic strategies to boost yields in rainfed areas of Andhra Pradesh. Their research showed that practices like intercropping, compost usage, and appropriate seed spacing significantly improved crop performance.

They recommended that agricultural universities and Krishi Vigyan Kendras (KVKs) play a more proactive role in conducting on-field trials and farmer trainings in rainfed zones.

In Gujarat, **Rathore et al. (2020)** studied cooperative oil extraction units established by groundnut farmers. The cooperatives not only provided better prices but also offered technical guidance and quality control mechanisms. The study showcased the potential of community-led processing units in improving farmer income and promoting entrepreneurship in rural areas. Lastly, a global report by the Food and Agriculture Organization (FAO, 2022) emphasized the significance of climate-resilient agricultural models, particularly for countries with large rainfed areas like India. The report highlighted that rainfed farmers require early access to weather advisories, seed banks, and mobile-based advisory services. It proposed that future development policies must explicitly prioritize rainfed zones to achieve inclusive agricultural growth. Together, these studies build a comprehensive narrative about the multifaceted challenges and opportunities in groundnut cultivation, particularly under rainfed conditions. They highlight the urgent need for integrated support systems combining financial incentives, extension services, value chain integration, and localized policy interventions to ensure sustainable and profitable groundnut farming in districts like Namakkal.

3. Research Gap

Although several studies have examined groundnut production and marketing in India, there is limited empirical research focused specifically on rainfed cultivation in Namakkal District, Tamil Nadu. Most existing literature either generalizes across irrigated and non-irrigated regions or lacks insight into cost behavior, sowing practices, and value addition specific to rainfed zones. The absence of localized data on how factors like farm size, seasonal decisions, and input costs affect productivity in rainfed systems creates a critical gap.

4. Research Objectives

Ø To study the practices and challenges faced by groundnut cultivators in the rainfed zones of Namakkal District.

Ø To examine the effects of seasonal sowing on groundnut yield and productivity.

Ø To assess the cost of cultivation and evaluate the economic viability of groundnut farming in rainfed areas.

5. Statement of the Problem

Groundnut cultivation in Tamil Nadu has long been a livelihood activity for thousands of farmers, particularly in rainfed zones where irrigation is limited or absent. In Namakkal District, a majority of groundnut farmers operate under such rain-dependent conditions. These farmers face multiple challenges: unpredictable monsoons, rising input costs, fluctuating market prices, and limited access to modern farming equipment or storage infrastructure. Despite its economic potential, especially in the context of growing export demand and opportunities for value-added processing, the profitability of groundnut farming in rainfed areas remains uncertain. Many small and marginal farmers are unable to cope with sudden changes in rainfall, pest infestations, or shifting market dynamics. Moreover, most value addition happens outside the district or is controlled by middlemen, leaving cultivators with only marginal profits. While government reports and national-level studies provide generalized data, there is a lack of district-specific empirical analysis that addresses the actual economic viability of rainfed groundnut cultivation. Questions such as "How farm size affect sowing and yield?", "What are the major cost-driving components?", and "How can local farmers benefit from value-added opportunities?" remain largely unexplored in Namakkal. This study aims to bridge that knowledge gap by conducting a focused analysis of groundnut cultivation practices, costs, challenges, and economic outcomes in the rainfed areas of Namakkal District.

6. Methodology of the study

This study follows a descriptive and empirical research design to explore the cultivation practices, economic viability, and seasonal effects in groundnut farming under rainfed conditions. The methodology is framed to ensure that the findings are both statistically valid and grounded in field realities.

6.1 Study Area

The research was conducted in Namakkal District of Tamil Nadu, which lies in the semi-arid agro-climatic zone. The region is known for groundnut cultivation, largely under rainfed conditions due to limited irrigation facilities. Its typical annual rainfall ranges between 850 to 950 mm, mostly received during the southwest monsoon. The soil type is primarily red loam, which supports oilseed cultivation.

6.2 Nature and Sources of Data

The study is based on primary data, collected directly from groundnut farmers through field surveys and structured interviews. A well-designed questionnaire was used to capture information on land size, sowing period, input costs, challenges, and value-added practices. In addition, secondary data related to rainfall, production statistics, and export trends were gathered from sources such as:

- Agricultural Department, Government of Tamil Nadu
- APEDA (2023–24 reports)
- ICAR and FAO databases
- Previous academic literature

6.3 Sampling Design

A random sampling method was employed to select respondents. The sample consisted of 120 groundnut farmers from different blocks in Namakkal District. Care was taken to ensure representation from all farm-size categories:

Ø Small (<2 acres)

Ø Medium (2–5 acres)

Ø Large (>5 acres)

This stratified approach enabled the study to assess differential impacts across landholding sizes and socio-economic backgrounds.

6.4 Tools for Data Analysis

To analyze the collected data, both descriptive and inferential statistics were used. The following tools and tests were applied using SPSS software:

Chi-square Test: To determine the association between farm size and sowing season. Regression Analysis: To evaluate the relationship between input costs (e.g., land preparation, seed, maintenance) and overall operating cost.

Spearman's Correlation: To examine the relationship between land area and production volume. These statistical k were chosen to draw meaningful conclusions about the influencing factors, economic feasibility, and challenges of rainfed groundnut cultivation.

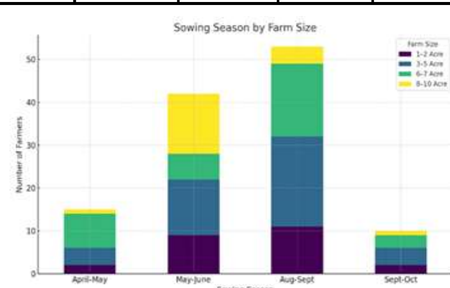
7. Data Analysis

The following section presents the analysis of primary data collected from 120 groundnut farmers in the rainfed zones of Namakkal District. The key variables examined include: Farm Size: Classified into 1–2 acres, 3–5 acres, 6–7 acres, and 8–10 acres. Sowing Season: Categorized into April–May, May–June, August–September, and September–October. Annual Income: Grouped into below ¹ 2 lakhs, ¹ 2–2.5 lakhs, ¹ 2.5–3 lakhs, and above ¹ 3 lakhs. Cultivation Challenges: Including less rainfall, seasonal variation impact, and price fluctuation. Input Costs: Covering land preparation, maintenance, labor, and seed procurement. Operating Cost & Yield: Dependent variables used in regression analysis. The analysis applies Chi-square tests, regression models, and correlation analysis to evaluate the relationships between these variables.

7.1 Analysis 1: Association between Farm Size and Sowing Season

Table 1: Sowing Season by Farm Size

Farm Size	April-May	May-June	Aug-Sept	Sept-Oct	Total
1–2 Acre	2	9	11	2	24
3–5 Acre	4	13	21	4	42
6–7 Acre	8	6	17	3	34
8–10 Acre	1	14	4	1	20
Total	15	42	53	10	120

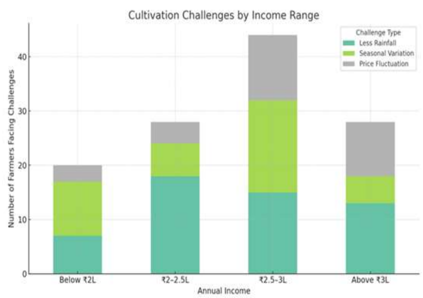


Chi-Square Value: 42.52 (Significant at 0.01 level). The Chi-square test reveals a statistically significant relationship between farm size and preferred sowing season among groundnut farmers in Namakkal's rainfed areas. The data suggests that larger farm holders (8–10 acres) tend to initiate sowing during May–June, possibly due to better resource availability and land preparation capabilities ahead of monsoon. Conversely, medium-sized farms (3–5 acres) show a preference for August–September, likely timed with rainfall onset. Small and marginal farmers (1–2 acres) display less consistency in their sowing windows, indicating dependence on immediate rainfall and limited access to predictive tools or irrigation. These findings highlight how landholding size influences cultivation timing under rainfed conditions.

Association between Income Range and Cultivation Challenges

Table 2: Challenges Faced by Income Group (Number of Farmers)

Income Range	Less Rainfall	Seasonal Variation	Price Fluctuation	Total
Below ₹2L	7	10	3	20
₹2–2.5L	18	6	4	28
₹2.5–3L	15	17	12	44
Above ₹3L	13	5	10	28
Total	53	38	29	120



Chi-Square Value: 52.61 (Significant at 0.01 level). The Chi-square analysis confirms a significant association between a farmer's income range and the type of challenge predominantly experienced during groundnut cultivation. Farmers in the ¹ 2.5 to ¹ 3 lakh income group are the most affected by seasonal variation (17 cases) and price fluctuation (12 cases), indicating their vulnerability during market transitions or erratic rainfall. On the other hand, farmers earning less than ¹ 2 lakh reported less rainfall and seasonal challenges as major barriers, suggesting limited access to drought management or alternative cropping methods. The stacked bar chart visually demonstrates that while all income groups experience some form of difficulty, higher-income farmers are better able to withstand seasonal variability but still face market price volatility. These insights call for targeted support: affordable crop insurance, real-time market intelligence, and better post-harvest infrastructure for rainfed farmers.

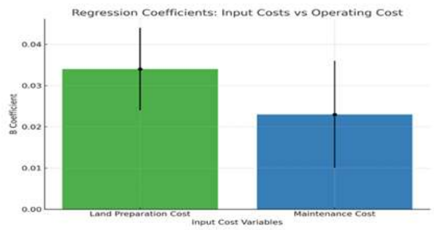
Analysis 3: Regression – Effect of Input Costs on Operating Cost

Table 3: Regression Model Summary

R	R Square	Adjusted R²	F-value Sig. (p)	Durbin-Watson
0.92	0.793	0.855	118.304 0.000	1.618

Table 4: Regression Coefficients

Input Factor	B Coefficient	Std. Error	Significance (p-value)	Impact
Land Preparation Cost	0.034	0.01	0.003 (Significant)	High
Maintenance Cost	0.023	0.013	0.107 (Not Significant)	Low

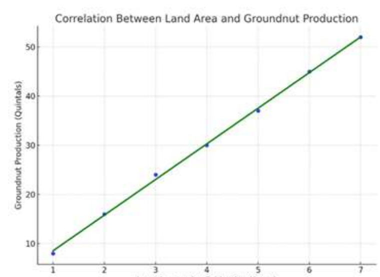


The regression analysis establishes a strong and statistically significant relationship between input costs and overall operating cost in rainfed groundnut cultivation. The model explains 79.3% of the variation in operating cost (R^2 = 0.793), with the F-value = 118.304 indicating that the regression model is a good fit at the 1% significance level. Among the input factors, the cost of land preparation has a significant positive impact (B = 0.034, p = 0.003) on operating cost. This reflects the critical role of pre-sowing field operations, especially in rainfed zones where timely land preparation is essential to capture the short rainfall window. In contrast, maintenance costs during the growing season do not significantly affect the total operating cost (p = 0.107), likely due to variability in labor use or inconsistent pest management.

The bar chart with error bars visually reinforces the influence of land preparation cost compared to maintenance cost, highlighting where input optimization could improve economic efficiency for farmers.

Analysis 4: Correlation Between Land Area and Groundnut Production

Visual: Scatter Plot with Trend Line



The scatter plot above illustrates the positive correlation between the size of land under cultivation and groundnut production. The trend line confirms that as land area increases, the quantity of groundnut produced also rises proportionally.

Table 5: Spearman's Correlation Result

Variables	Land Area	Groundnut Production
Land Area	1.000	0.764**
Production	0.764**	1.000

Note: Correlation is significant at the 0.01 level (2-tailed)

The Spearman correlation coefficient (ñ = 0.764, $p < 0.01$) indicates a strong and statistically significant relationship between the area under cultivation and total groundnut production. This implies that larger farms consistently yield more output, reinforcing the conclusion that farm size directly influences agricultural productivity. This also reflects better resource use efficiency among larger farmers who can afford timely inputs and mechanized operations. The upward trend in the chart visually supports this relationship, making it evident that scaling up landholding could be a strategy to enhance yield in rainfed agriculture provided other resources like seeds, labor, and land preparation are efficiently managed.

8. Conclusion

This study has provided a comprehensive analysis of the cultivation practices, economic viability, and challenges associated with groundnut farming in the rainfed zones of Namakkal District, Tamil Nadu. Through a blend of descriptive and inferential statistics, key insights were drawn regarding how factors such as farm size, sowing season, and input costs influence the productivity and sustainability of rainfed groundnut cultivation. The Chi-square test revealed a significant relationship between farm size and sowing season, indicating that larger landholders can better plan around rainfall and manage timely sowing. The analysis of cultivation challenges across income groups showed that middle-income farmers face acute issues related to seasonal variation and price fluctuation, while low-income farmers are more affected by unpredictable rainfall. The regression model established that land preparation cost is a major factor affecting overall operating cost, pointing toward the need for cost-effective tillage and soil management strategies.

Meanwhile, the Spearman's correlation demonstrated a strong positive relationship between land size and production, confirming the economic advantage of larger operational scale under rainfed conditions. Importantly, the study highlights that despite environmental and market-related hurdles, there exists significant potential for improving profitability through value addition and resource optimization. Policymakers and agricultural extension bodies must prioritize rainfed farmers by facilitating access to credit, storage, localized processing units, and climate-resilient farming practices. With timely intervention, Namakkal's rainfed groundnut sector can become more productive, profitable, and resilient, contributing meaningfully to both local livelihoods and broader oilseed self-sufficiency in Tamil Nadu.

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