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Socio-Economic Determinants and Technological Innovation Dynamics in Coconut Cultivation: A Case Study of Pollachi Taluk, Coimbatore District

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Abstract

Coconut cultivation is the economic backbone of Pollachi Taluk in the Coimbatore District of Tamil Nadu. However, traditional farming models face modern challenges, including groundwater depletion, labour shortages, and changing weather patterns. To ensure long-term viability, transitioning to modern agricultural innovations is essential. Present study examines the socio-economic profile of coconut cultivators in Pollachi Taluk and evaluates their adoption rates across biological, mechanical, and smart digital farming innovations. A descriptive and analytical research design was adopted to study a sample of 100 coconut farmers selected via random sampling. Primary data was gathered using a structured 5-point Likert scale questionnaire, and analysed using percentage analysis, descriptive mean scoring, standard deviation, and weighted ranking frameworks. The socio-economic analysis reveals a mature, highly experienced, and literate farming base dominated by small holders who rely heavily on groundwater irrigation. Technological analysis shows that micro-irrigation installation and organic coir pith composting have achieved excellent field adoption. While basic digital tools like UPI payments and WhatsApp communication networks are highly integrated, a distinct tech gap exists regarding high-capital processing machinery and advanced hardware like smart soil sensors and drone mapping. The study demonstrates that while Pollachi farmers are proactive in resource conservation and software tools, high entry costs limit the use of advanced field hardware. Bridging this technology adoption gap through targeted government subsidies, custom hiring centres, and cooperative-led extension services is critical to achieving sustainable development in the region.

Keywords: Agricultural Innovation, Coconut Cultivation, Sustainable Development, Pollachi Taluk, Tech Adoption Gap, Smart Farming.

Introduction

Coconut, often referred to as the “Tree of Life”, occupies a unique position in India’s agricultural economy, rural livelihoods, and cultural heritage. With policy interventions like the Coconut Promotion Scheme (Budget 2026–27), the sector is moving towards greater sustainability, value addition, and income enhancement for farmers. India ranks 1st in coconut production and 3rd in cultivation area. India contributes 31.24% of global coconut production and accounts for 17.90% of the global cultivation area.

India produced around 20,301.22 million coconut nuts during 2024–25 from 2.19 million hectares of cultivation area. The average productivity of coconut in India stood at 9,249 nuts per hectare during the period. Keralam has the largest area under coconut cultivation. Tamil Nadu leads the country in coconut production, while Andhra Pradesh records the highest productivity, followed by West Bengal and Tamil Nadu. The coconut sector has become an important contributor to India’s agricultural exports and supports the country’s broader export objectives. Coconut product exports reached ₹7,038.35 crore (USD 794.70 million) in 2025–26, registering a 62% increase compared to ₹4,349.03 crore in the previous year. India’s coconut exports have evolved significantly from traditional products such as coconut oil, copra, desiccated coconut, and coconut shell charcoal. The sector has diversified into value-added products including virgin coconut oil, coconut milk, coconut water, and activated carbon. Indian coconut products have expanded beyond traditional markets in the Middle East and are now exported to Europe, the Americas, and Australia. Major export destinations include the USA, UAE, Sri Lanka, Germany, Russia, Turkey, Belgium, the UK, and the Netherlands. The coconut sector has become an important contributor to India’s agricultural exports and supports the country’s broader export objectives. The sector directly sustains approximately 30 million people, including 10 million small and marginal farmers. Furthermore, it acts as the primary raw material feeder for over 15,000 coir-based industries and processing units.

Transition to Sustainable Innovation

Despite high yields, the Indian coconut sector faces generational headwinds. Traditional setups are vulnerable to shifting monsoon cycles, groundwater depletion, severe pest outbreaks (like the Red Palm Weevil), and labour scarcities for tall palm harvesting. Recognizing these vulnerabilities, the Government of India launched the Coconut Promotion Scheme in the Union Budget 2026–27. Backed by targeted institutional support through the Coconut Development Board, this policy framework focuses explicitly on Rejuvenation that is replacing aging, low-yielding, and unproductive traditional tree blocks with climate-resilient, early-bearing hybrid or dwarf varieties. Incentivizing macro-level switches to micro-irrigation systems (drip arrays) and organic farming inputs to preserve soil biology. Funding local Farmer Producer Organizations (FPOs) to shift profits away from raw nuts into high-margin commercial coconut extracts.

In recent years, we find lot of changes in coconut farming witnessing a paradigm shift driven by technological innovations, these innovations encompass high-yielding hybrid varieties, organic composting, and integrated pest management (IPM), automated harvesting tools, mechanical de-husking, and efficient copra-drying units, drones for canopy management, IoT-based soil moisture sensors, and mobile-based market information systems. Sustainable development in agriculture requires balancing economic viability with environmental conservation and social equity. Investigating how effectively these innovations are absorbed at the grassroots level provides critical insight into ensuring the future viability of the coconut sector.

Statement of the Problem

Despite its high economic potential, traditional coconut cultivation is plagued by recurring vulnerabilities. Farmers frequently encounter depleting groundwater tables and erratic monsoon patterns. Severe infestations of pests like the Rhinoceros Beetle and Red Palm Weevil. Acute shortages of skilled labour for harvesting tall palm canopies. Exploitative, unorganized marketing channels causing severe price volatility. While agricultural research institutions consistently develop innovative solutions, a distinct gap exists between laboratory innovations and actual field adoption. Many farmers remain hesitant or unable to upgrade their practices. This study addresses this critical gap and also it is important to understand to what extent coconut cultivators adopted modern agricultural innovations and how effectively these innovations solve ecological and economic sustainability issues.

Objectives of the Study

1. To examine the socio-economic and general demographic profile of coconut cultivators in Pollachi Taluk.

2. To measure the extent of awareness and adoption levels across biological, mechanical, and smart digital agricultural innovations among the sample farmers.

3. To evaluate the primary technological disparities and establish the hierarchical ranking of preferred agricultural innovations within the coconut cultivation ecosystem.

Research Methodology

The present study follows descriptive and analytical research design; primary data was gathered from selected coconut growers via a structured 5-point Likert scale pre-tested questionnaires. Random sampling method was followed. The study considered 100 farmers covering small, medium and large farmers. The area of study is Pollachi Taluk. The specific reason for choosing this taluk is, it is nestled in the foothills of the Western Ghats within the Coimbatore District, is recognized as the "Coconut Capital of Tamil Nadu". Driven by optimal sub-tropical micro-climates, an expansive irrigation network, and high-yielding plantations, Pollachi serves as India's premier agro-trade hub for raw nuts, tender coconuts, and value-added exports. Pollachi benefits from an advanced localized agricultural support system that serves as the basis for field innovations. Statistical tools, including percentage analysis, mean score, standard deviation and ranking method also employed to evaluate the data.

Data Analysis:

Socio-Economic Profile of Farmers

The age profile of the surveyed farmers reveals the demographic maturity of coconut cultivation in Pollachi Taluk.

Table-1: Age Distribution of Farmers

S. No	Age Category	No. of Respondents (N=100)	Percentage (%)
1	Below 30 years	10	10.0%
2	30 – 45 years	35	35.0%
3	46 – 60 years	40	40.0%
4	Above 60 years	15	15.0%
	Total	100	100.0%

The data indicates that a substantial majority (75%) of the coconut cultivators in Pollachi Taluk fall into the middle-to-senior age groups between 30 and 60 years. Only 10% of the respondents are young farmers below 30 years. This reflects a trend where younger generations are shifting away from direct agriculture, leaving plantation management predominantly in the hands of experienced, older individuals.

Educational Qualification

Educational background determines how quickly a farmer understands and adopts advanced agricultural tech.

Table-2: Education Level of Farmers

S. No	Educational Level	No. of Respondents (N=100)	Percentage (%)
1	Illiterate / No formal schooling	5	5.0%
2	Primary / School-level education	30	30.0%
3	Higher Secondary / Diploma	45	45.0%
4	Graduate / post-graduate	20	20.0%
	Total	100	100.0%

The literacy rate among Pollachi coconut farmers is high, with 95% of respondents possessing formal schooling. Notably, 45% have completed higher secondary or diploma studies, and 20% hold university degrees. This high educational foundation indicates that the local farming community has a strong capacity to adopt digital tools, evaluate market software, and apply precise scientific inputs like the TNAU coconut tonic.

Size of Coconut Landholding

The operational holding size indicates a farmer's capacity to invest in high-cost mechanization or structural innovations.

Table-3: Landholding Category

S. No	Landholding Category	No. of Respondents (N=100)	Percentage (%)
1	Marginal (Below 2.5 acres)	15	15.0%
2	Small (2.5 – 5.0 acres)	45	45.0%
3	Medium (5.1 – 10 acres)	25	25.0%
4	Large (Above 10 acres)	15	15.0%
	Total	100	100.0%

The structural division of agricultural land shows that 60% of the respondents are either marginal or small-scale farmers holding under 5 acres of land. Medium farmers constitute 25%, while large-scale planters make up 15% of the sample. This indicates that any recommended innovation strategy must be cost-effective and scalable to fit smallholder budgets.

Farming Experience in Coconut Cultivation

Long-term experience shapes farming habits and can either encourage or resist technical changes.

Table-4: Experience in Coconut Cultivation

S. No	Experience Bracket	No. of Respondents (N=100)	Percentage (%)
1	Less than 5 years	12	12.0%
2	5 – 10 years	23	23.0%
3	11 – 20 years	38	38.0%
4	Above 20 years	27	27.0%
	Total	100	100.0%

A combined 65% of the respondents possess more than 10 years of specialized experience in coconut cultivation, with 27% exceeding two decades. This deep practical expertise ensures high proficiency in handling traditional farm crises, but it can occasionally create psychological friction when transitioning toward automated or smart digital farming tools.

Source of Irrigation

Water source security is a vital element for yield sustainability in the Pollachi region.

Table-5: Source of Irrigation

S. No	Irrigation Infrastructure	No. of Respondents (N=100)	Percentage (%)
1	Open Well / Borewell	55	55.0%
2	Canal / River Water	40	40.0%
3	Rainfed only	5	5.0%
	Total	100	100.0%

Irrigation patterns reveal that 55% of cultivators rely primarily on groundwater reserves via open wells and deep borewells, while 40% utilize the localized surface river/canal system (largely tied to the Parambikulam Aliyar Project - PAP). Only a marginal 5% depend purely on rainfall. The high reliance on groundwater underscores the urgent need for innovations like automated drip irrigation arrays to maintain sustainable aquifer levels in the taluk.

Based on the empirical distribution of 100 respondents, the typical coconut grower in Pollachi Taluk can be profiled as: A middle-aged farmer (30–60 years) who is formally educated up to high school or a diploma level, managing a small farm plot of 2.5 to 5 acres. They possess over a decade of deep farming experience and utilize groundwater borewells to sustain their crop yield.

Analysis of Technological Innovation Adoption

Table-6: Technological Innovation Adoption

Consolidated Statistical Table (N=100)

S. No	Statement / Farm Innovation Variable	SA (5)	A (4)	U (3)	D (2)	SD (1)	Mean Score	Std. Dev	Rank
I	**Biological & Technical Innovations**								
1.1	Cultivating high-yielding hybrid varieties.	13	38	20	16	13	3.22	1.24	VIII
1.2	Using organic inputs (vermicompost/coir pith).	41	45	8	4	2	4.19	0.90	II
1.3	Practicing biological pest control metrics.	21	50	14	8	7	3.70	1.11	VI
1.4	Practicing intercropping / multi-tier setups.	13	48	15	11	13	3.37	1.23	VII
II	**Mechanical & Infrastructure Innovations**								
2.1	Utilizing machinery for tree harvesting.	17	31	23	7	22	3.14	1.39	IX
2.2	Installing micro-irrigation (Drip/Sprinkler).	44	49	2	5	0	4.32	0.75	I
2.3	Utilizing mechanical de-husking tools.	5	14	30	36	15	2.58	1.07	XI
2.4	Utilizing modern solar/copra drying units.	10	18	28	25	19	2.75	1.24	X
III	**Digital & Smart Farming Innovations**								
3.1	Checking real-time market prices on mobile apps.	19	55	13	7	6	3.74	1.04	V
3.2	Sharing disease queries on WhatsApp forums.	20	64	9	5	2	3.95	0.82	IV
3.3	Processing payments via digital channels/UPI.	36	47	7	4	6	4.03	1.07	III
3.4	Deploying smart soil sensors or drone mapping.	2	8	18	30	42	1.98	1.05	XII

Note: The abbreviations represent a 5-Point Likert Scale, which is a psychometric response scale used to quantify qualitative human attitudes, behaviours, or adoption levels into numerical values for statistical testing:

SA (5) – Strongly Agree: The farmer has fully integrated the innovation into their routine farm management.

A (4) – Agree: The farmer utilizes the innovation frequently but faces occasional operational limitations.

U (3) – Undecided: The farmer is aware of the technology but remains neutral, or it is not applicable to their scale.

D (2) – Disagree: The farmer rarely implements this innovation due to financial or technical roadblocks.

SD (1) – Strongly Disagree: The innovation is completely absent from the farmer's operational workflow.

Biological & Technical Innovations

When we look at the biological practices, Item 1.2 (Using organic inputs) ranked topmost with a high mean score of 4.19. This shows a strong local adoption of value-added recycling, as Pollachi farmers effectively turn raw coir waste into organic coir pith compost. Item 1.3 (Biological pest control) also scored high (3.70), indicating strong awareness of integrated pest management against threats like the Rhinoceros Beetle. Conversely, Hybrid tree cultivation (3.22) scored lower due to smallholders preferring established, resilient native tall palms over short-term hybrid alternatives.

Mechanical & Infrastructure Innovations

Item 2.2 in the table (Micro-irrigation installation), achieved the highest overall score across the entire study (Mean = 4.32, Rank I). Backed by state subsidies and the region's focus on conserving groundwater, nearly 93% of the surveyed farmers utilize drip systems. However, processing mechanization lags behind: Mechanical de-husking (2.58) and Solar drying infrastructure (2.75) ranked exceptionally low. Smallholders point out that high initial equipment costs force them to rely on traditional, manual post-harvest practices.

Digital & Smart Farming Innovations

The data reveals a distinct divide in digital technology adoption. Communication tools show excellent integration: Digital payments via UPI (4.03) and WhatsApp information networks (3.95) ranked 3rd and 4th overall, reflecting high functional literacy among growers. However, Item 3.4 (Advanced IoT soil sensors and drones) ranked last overall (Mean = 1.98, Rank XII). This indicates that while farmers actively use smartphone apps for communication and payments, specialized smart-agriculture hardware remains largely inaccessible to typical smallholders in the taluk.

The overall adoption matrix shows that Pollachi coconut growers are highly proactive in adopting resource-saving infrastructure (Drip irrigation) and low-cost digital services (UPI/WhatsApp). However, a major technological gap remains for high-capital machinery (Harvesting/Drying platforms) and specialized smart-farming hardware (IoT/Sensors).

Findings

- The coconut plantation sector is dominated by mature, highly experienced cultivators, with 75% of farmers aged between 30 and 60 years and 65% possessing more than 10 years of specialized experience.
- The local farming community exhibits strong literacy foundations; 65% have completed higher secondary education, a diploma, or a university degree.
- The landholding structure consists primarily of smallholders, with 60% managing small or marginal farm boundaries under 5 acres.
- Aquifer extraction is highly intensive, with 55% of plantations relying on deep borewells or open wells, making resource conservation a critical priority.
- Advanced micro-irrigation systems ranked as the number one utilized farm innovation across the entire study with a peak mean score of 4.32.
- Reutilizing structural farm residues is heavily adopted; recycling raw coir waste into organic coir pith compost ranked second overall with a high mean score of 4.19.
- A distinct structural divide exists in digital technology adoption. While software infrastructure like Digital UPI banking (4.03) and WhatsApp knowledge networks (3.95) scored very high, advanced hardware systems like Smart IoT soil sensors and drone mappings (1.98) ranked dead last as the least adopted agricultural tool in the taluk.

➢ High-cost machinery setups remain underutilized due to high entry barriers. Mechanical de-husking arrays (2.58) and Solar/Copra drying tunnels (2.75) ranked exceptionally low (Ranks XI and X respectively).

Conclusion

This empirical study highlights a significant transition toward sustainable development among the 100 coconut cultivators in Pollachi Taluk. Backed by a strong literacy base and deep field experience, local growers have achieved excellent benchmarks in water-saving infrastructure (drip irrigation) and foundational digital tools (UPI and WhatsApp groups). However, a notable tech adoption gap persists regarding advanced field hardware, specialized post-harvest machinery, and IoT-driven smart agriculture. Because the local economy consists primarily of smallholders who rely heavily on groundwater, long-term sustainability cannot be achieved through resource management alone. It requires turning these high-tech innovations into accessible, affordable options for small farms. Bridging this gap through targeted micro-credit lines, rental equipment hubs, and dedicated extension frameworks will help secure Pollachi's status as a resilient, economically viable, and ecologically sustainable leader in coconut production.

The study suggests that since 60% of growers are small or marginal farmers, the government should introduce customized subsidy frameworks or targeted credit lines through local cooperative banks to lower the high upfront costs of Mechanical de-husking tools and Solar copra drying units. To address the extremely low adoption rate of smart devices (Mean = 1.98), the Department of Agriculture should establish village-level custom hiring centres. These centres can lease out IoT-enabled soil sensors and provide professional Drone-mapping services at affordable daily rental fees. Given the high literacy base (95% literate), agricultural extension offices should deploy targeted field workshops. These workshops can teach mature farmers how to transition from basic communication tools (WhatsApp) to specialized mobile apps for predictive yield management and crop disease diagnosis. Also, promote local Farmer Producer Organizations (FPOs) to scale up the highly successful practice of organic coir pith composting. This will help replace expensive chemical inputs and improve soil water retention across groundwater-dependent plantations.

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