

International Journal of Agriculture Extension and Social Development

Volume 8; SP-Issue 11; November 2025; Page No. 153-156

Received: 02-08-2025
Accepted: 05-09-2025

Indexed Journal
Peer Reviewed Journal

Assessing the economic benefits and socio-technical challenges in the adoption of TNAU coconut tonic in Tamil Nadu

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DOI: <https://www.doi.org/10.33545/26180723.2025.v8.i11Sc.2706>

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Abstract

This study evaluates the economic returns, perceived advantages and challenges linked to the adoption of TNAU Coconut Tonic among coconut farmers in Coimbatore district, Tamil Nadu. A total of 180 farmers comprising 90 tonic users and 90 non-users were selected through simple random sampling and primary data were collected on production costs, yields and farmer perceptions. The cost-benefit analysis indicated that users of the tonic achieved higher yields, gross returns, and net income than non-users, with an input-output ratio of 1.85 compared to 1.58. Weighted average analysis revealed that the most valued benefits were increased nut size and number, yield enhancement up to 20% and reduced button shedding. Garrett's ranking technique identified the major constraints faced by coconut tonic users as the high price of the tonic, limited availability through TNAU outlets and challenges in application. Overall, the results suggest that TNAU Coconut Tonic delivers significant productivity and profitability benefits, but its adoption is limited by cost and accessibility concerns.

Keywords: Coconut cultivation, cost-benefit analysis, TNAU coconut tonic, technology adoption

Introduction

The coconut palm (*Cocos nucifera*), often called the “tree of life” is one of the most important tropical crops, thriving mainly in coastal regions of Southeast Asia and India. Every part of the tree has value from its water, oil, coir and shells used in crafts and industry. Globally, over 60 million tonnes of coconuts are produced each year, with India leading production, especially in Tamil Nadu. Beyond its economic value, the coconut industry supports millions of rural families. However, farmers face ongoing challenges such as aging trees, climate change, pests and nutrient shortages.

To help tackle these problems, Tamil Nadu Agricultural University (TNAU) introduced the Coconut Tonic a specially formulated nutrient-rich liquid applied through root feeding. It's designed to increase leaf chlorophyll, reduce immature nut drop, improve nut size and number and boost yields by up to 20%. Farmers also find that it strengthens palms against pests and environmental stress, while lowering their need for chemical pesticides. The recommended dose is 200 ml per palm, twice a year, ensuring efficient nutrient uptake. Research has shown that farmers using the tonic experience higher yields and incomes, though issues like price and availability can limit adoption ^[1-3].

Overall, TNAU Coconut Tonic is proving to be a simple but powerful tool for sustainable coconut farming helping palms stay healthier, farmers earn better and the coconut industry remain strong for the future.

Objectives

1. To assess the cost and benefit of TNAU Coconut Tonic on farm income.
2. To examine farmer perceptions regarding the advantages of adopting TNAU Coconut Tonic
3. To identify the constraints faced by farmers in implementing TNAU Coconut Tonic practices.

Materials and Methods

The study was conducted in Coimbatore district, Tamil Nadu, focusing on two major coconut-growing blocks: Pollachi East, Pollachi West.

A total of 180 farmers were chosen through simple random sampling, with 45 TNAU coconut tonic users and 45 non-users from each block. The sample was divided equally into two categories:

TNAU Coconut Tonic Users (90 farmers)

Non-Users (90 farmers)

Primary data were gathered through a structured questionnaire covering inputs, yield, pest and disease control and socio-economic factors. Secondary data were sourced from the Coconut Development Board and other published records to provide context on cultivation area, production, and productivity at district, state and national levels ^[4].

Cost-Benefit Analysis

For the year 2023-2024, primary data on establishment expenses, annual maintenance costs, and returns from coconut cultivation were collected to estimate the cost of production and the associated returns.

The Gross Income was computed as:

Gross Income = Main product yield * Unit price

The Net Income was derived using the formula:

Net Income = Gross Income - Total Cost

Weighted Average Analysis

A weighted average analysis was employed to evaluate the benefits derived from the application of the TNAU Coconut Tonic. This approach facilitates the identification of the factor contributing the greatest benefit, based on its assigned weight.

The weighted average is computed using the formula:

Formula,

$$W = \frac{\sum_{i=1}^n w_i X_i}{\sum_{i=1}^n w_i}$$

Where, W = Weighted Average

n = Number of Observation

w_i = Weight applies to X values

X₁ = Decreases button shedding

X₂ = Increased number and size of nuts

X₃ = Increased nut yield by Up to 20 per cent

X₄ = Increased Longevity and Vigour of the Palm

X₅ = Resistance to Pest, Disease and Environmental stresses

$\sum_{i=1}^n w_i X_i$ = Sum of the Observation value and corresponding weight

$\sum_{i=1}^n w_i$ = Sum of the weights

Garrett's Ranking Technique

Garrett's ranking technique was employed to prioritize the factors based on respondents preferences. In this method, each participant was asked to assign a rank to every factor under consideration. These ranks were then converted into corresponding scores using the following formula:

$$\text{Percent position} = \frac{100 (R_{ij} - 0.5)}{N_j}$$

Where, R_{ij} = Rank given for the ith variable by jth respondents

N_j = Number of variables ranked by jth respondents

The calculated percent positions were subsequently matched with Garrett's conversion table to obtain the respective score values. The individual scores for each factor were summed across all respondents, and the mean score for each factor was then computed. The factor with the highest mean score was identified as the most significant factor in influencing the respondents preference [5].

Result and Discussion

Gross and Net Returns in Coconut Farm

Table 1: Gross and Net Returns in Coconut Farm

S. No	Particulars	Value (Users)	Value (Non-Users)	Difference	T test
1.	Average Yield (Nuts)	25,724	19,992	5732	15.96***
2.	Average Price (Rs. / Nut)	18	18	-	-
3.	Gross Income (Rs.)	4,63,032	3,59,856	103176	16.07***
4.	Total Cost	2,49,732	2,28,186	21,546	
5.	Net Income (Rs.)	2,13,300	1,31,670	81,630	15.43***
6.	Net income per nut (Rs.)	8.29	6.58	1.71	-
7.	Input-Output Ratio	1.85	1.58	0.27	-

***Significant at 1 per cent level

A comparison of yield and income between coconut tonic users and non-users reveals clear economic advantages from using the tonic. On average, users harvested 25,724 nuts, which is 5,732 more than the 19,992 nuts obtained by non-users a difference found to be statistically significant at the 1% level (*). With both groups selling at the same market price of ₹18 per nut, this yield gain resulted in a higher gross income for users, amounting to ₹4.63 lakh, compared to ₹3.60 lakh for non-users an increase of ₹1,03,176 also significant at the 1% level. After factoring in production costs, users earned a net income of ₹2.13 lakh, which exceeded the ₹1.32 lakh earned by non-users by ₹81,630, further underscoring the profitability of tonic application. From a cost-benefit perspective, the input-output ratio for users was 1.85 higher than the 1.58 recorded for non-users, indicating that tonic adoption not only boosts yield and income but also generates greater returns for every rupee spent. Analysis of gross returns, net returns and cost-benefit ratios in coconut farming and highlights that input adoption

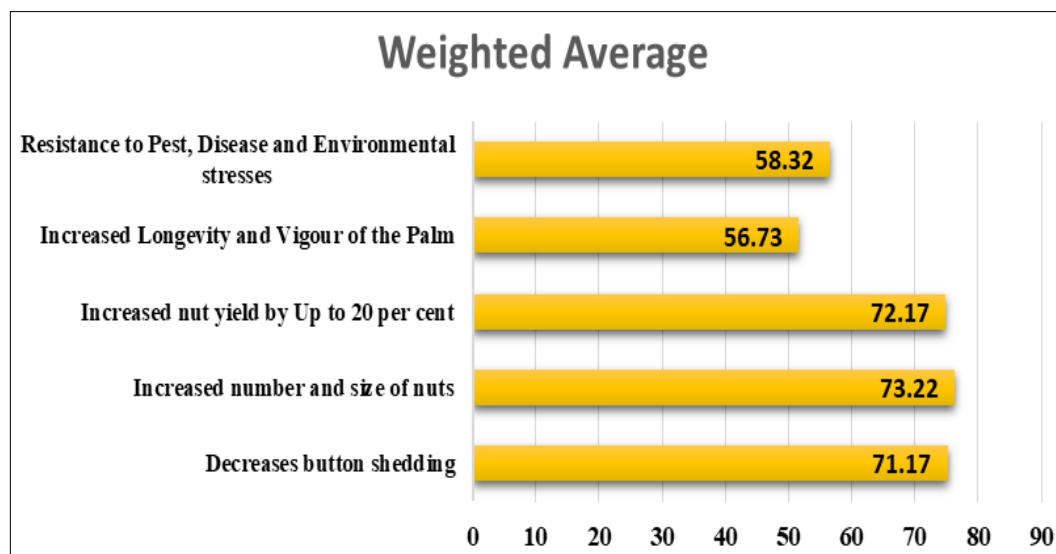
(such as tonic application) results in higher profits and efficiencies [6].

Advantages of Using Coconut tonic

The table 2 and Figure 1 illustrate the primary benefits of using TNAU Coconut Tonic based on weighted average scores. The most notable improvements are in the increased number and size of nuts (73.22) and a rise in nut yield of up to 20% (72.17), followed closely by a reduction in button shedding (71.17). These results highlight the TNAU coconut tonic strong role in boosting coconut growth and reducing premature nut drop, thereby enhancing overall productivity. Meanwhile, moderate benefits are seen in improving resistance to pests, diseases and environmental stresses (58.32), as well as in promoting the longevity and vigour of palms (56.73), indicating a positive impact on tree health and resilience over time. TNAU Coconut Tonic boosts coconut yield by reducing button shedding, improving plant vigour, and enhancing pest/disease resistance [7].

Table 2: Weighted Average Scores of Benefits from Using TNAU Coconut Tonic

S. No	Particulars	Weighted Average
1	Decreases button shedding	71.17
2	Increased number and size of nuts	73.22
3	Increased nut yield by Up to 20 per cent	72.17
4	Increased Longevity and Vigour of the Palm	56.73
5	Resistance to Pest, Disease and Environmental stresses	58.32

**Fig 1:** Weighted Average Analysis of Benefits from TNAU Coconut Tonic

Constraints faced by coconut farmers in use of Coconut Tonic

Constraints faced by coconut farmers in use of coconut tonic in the Coimbatore district, were identified by using Garrett's ranking technique. The most significant constraints faced by coconut farmers are High cost (Rank I), Coconut Tonic is available only at TNAU (Rank II) and Difficulty in application (Rank III). The main challenges in adopting TNAU Coconut Tonic include its high cost, limited availability only through TNAU outlets, and technical difficulties in correct application, which together restrict wider farmer uptake despite its proven agronomic benefits [8].

Table 3: Constraints faced by coconut farmers in use of Coconut Tonic

S. No	Constraints	Mean score value	Rank
1	High cost	75.3	I
2	Lack of awareness	50.15	V
3	Difficulty in application	64.15	III
4	Coconut Tonic is available only at TNAU	64.92	II
5	No difference in yield	44.17	VI
6	Poor Knowledge about proper application	52.7	IV

Conclusion

The adoption of TNAU Coconut Tonic significantly improves coconut productivity and profitability, yielding higher nut output, gross income and net returns compared to non-users. Key benefits include larger nut size, yield increases of up to 20% and reduced button shedding. However, high costs, limited availability and application challenges remain critical barriers to widespread adoption among farmers.

Policy Suggestions

To enhance adoption, policymakers should subsidize tonic prices, expand distribution beyond TNAU outlets, and conduct on-farm demonstrations for better application practices. Strengthening farmer awareness campaigns, integrating the tonic into government horticulture schemes, and promoting public-private partnerships for production and supply could ensure wider accessibility and sustained productivity gains in coconut farming.

Acknowledgements

We would like to extend our heartfelt appreciation to all the individuals and organizations who have contributed to the publications of this research.

Authors' contributions

Author Dinesh D was responsible for designing the study, conducting the statistical analysis, developing the protocol, and drafting the initial manuscript and remaining all authors are contributed and revised the manuscript.

Compliance with ethical standards

Conflict of interest: There is no conflict of interest between the authors.

Ethical issues: "None"

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