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Identification and prioritisation of challenges in coconut cultivation using the RBQ method: Evidence from Coimbatore district, Tamil Nadu

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ABSTRACT

This study identifies and prioritizes the most pressing production, post-harvest, and marketing constraints faced by coconut farmers in the Coimbatore district of Tamil Nadu. Data were collected from 180 farmers using a structured interview schedule, and constraints were prioritized using the rigorous Rank-Based Quotient technique. The socio-economic analysis established that the farming community is dominated by marginal and small farmers (70.0%) operating with low profitability, reinforcing their vulnerability to external shocks. The RBQ analysis, classifying 26 constraints across five thematic areas, revealed that the challenges are predominantly economic and systemic rather than purely technical. Globally, the three most critical constraints, indicating the immediate areas for intervention, were prioritized as: Market Price Volatility (RBQ: 97.1), signifying extreme economic risk; Pest Infestations (Mealy Bug/Whiteflies) (RBQ: 96.3), highlighting acute biotic pressure; and Agricultural Labor Scarcity (RBQ: 95.4), driving up the cost of production. The findings strongly advocate for policy shifts toward market decentralization via FPOs, subsidized mechanization, and enhanced biological control programs to ensure the long-term sustainability of the sector.

Keywords: Coconut farmers, Constraint, Prioritization, Rank-Based Quotient (RBQ)

Introduction

Coconut (*Cocos nucifera*) is a vital plantation crop in the Indian agricultural economy, supporting the livelihoods of millions of farmers through its diverse uses in food, industry, and commerce. Tamil Nadu is one of the leading coconut-producing states, with the Coimbatore district playing a significant role due to its favourable climate and soil conditions. However, despite its economic importance, coconut cultivation in the region is increasingly challenged by a complex web of economic, biological, and infrastructural limitations. These constraints often lead to reduced yields, high cultivation costs, and severe income instability, making the sector vulnerable, especially for the small and marginal landholders who form the backbone of the region's agriculture.

To formulate effective and responsive policy interventions, it is imperative to move beyond simple listing of problems and establish a definitive priority ranking based on the farmers' perception of severity. The present study addresses this gap by employing the Rank-Based Quotient (RBQ) technique. This method provides an objective, weighted index that reflects the relative importance of each constraint as ranked by the respondents. The specific objective of this research is to empirically prioritize the constraints across production, post-harvest, and marketing dimensions and analyse the socio-economic profile of coconut farmers in the Coimbatore District.

Methodology

Study area and sample

The study was conducted in the Coimbatore district of Tamil Nadu, focusing on key coconut-growing blocks. A total sample of 180 coconut farmers was selected using a multi-stage stratified random sampling procedure to ensure representation across different farm sizes and socio-economic groups.

Data collection

Primary data were collected through a structured interview schedule specifically designed for this purpose. The instrument was pre-tested and validated to capture detailed information on:

1. **Socio-Economic Profile:** Variables such as gender, educational status, farm size, age, farming experience, and annual income.

2. **Constraints:** A comprehensive list of 26 constraints, grouped into five major themes (Labor and Production Costs; Pests, Diseases, and Crop Management; Market and Price Volatility; Water and Infrastructure; and Technology and Policy Gaps).

Data analysis

The collected data were subjected to the following analytical techniques:

1. **Percentage Analysis:** Used to summarize the socio-economic and demographic characteristics of the sample.
2. **Rank-Based Quotient (RBQ) Analysis:** Utilized to prioritize the constraints. Farmers were asked to rank the problems within each thematic group according to their perceived severity. The RBQ score for each constraint was calculated using the formula:

$$RBQ = \frac{\sum (f_i * R_i)}{N * \sum R_i} \times 100$$

where:

f_i = Frequency of the i -th rank assigned by the farmers.

R_i = Weight of the i -th rank (The highest rank e.g., 1st, is given the highest weight).

N = Total number of respondents (180).

The constraint with the highest RBQ score is deemed the most severe problem.

Results and discussion

Socio-economic profile of the coconut farmers

The profile analysis of the 180 respondents offers vital insights into the characteristics of the farming population, which informs the interpretation of the constraints.

Table 1. Socio-Economic Profile of Coconut Farmers ($N = 180$)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	129	71.67
	Female	51	28.33
Educational Status	Illiterate	11	6.11
	Primary	33	18.33
	Middle	45	25.00
	Secondary	40	22.22
	Higher Secondary	34	18.89
	Collegiate	17	9.44
Farm Size	Marginal (< 1 ha)	72	40.00
	Small (1-2 ha)	54	30.00
	Semi-Medium (2-4 ha)	27	15.00
	Medium (4-10 ha)	18	10.00
	Large (> 10 ha)	9	5.00
Age	18–30 years	30	16.67
	31–40 years	71	39.44
	41–50 years	54	30.00
	51–60 years	24	13.33
	60+ years	1	0.56
Farming Experience	0–5 years	56	31.11
	6–10 years	77	42.78
	11–15 years	47	26.11
Annual Income	Below ₹1 Lakh	55	30.56
	₹1–2 Lakhs	70	38.89
	Above ₹2 Lakhs	55	30.56
Land Type	Wetland	70	38.89
	Garden Land	61	33.89
	Dry Land	49	27.22

The demographic analysis confirms the dominance of **smallholder agriculture**, with marginal and small farmers constituting a combined **70.0%** of the sample. This structural feature underpins the sector's financial fragility, consistent with previous studies on coconut cultivation in Tamil Nadu ([Rajkumar et al., 2019](#))^[1]. The workforce is predominantly middle-aged (31–50 years, 69.44%) and experienced, yet the minimal representation of the youngest cohort (16.67%) signals a

critical issue of low youth engagement and generational succession. Given that Wetland and Garden Land combined account for over 72% of the land use, the reliance on assured irrigation makes the subsequent analysis of water scarcity highly relevant, a concern commonly reported in official agricultural reports for the region ([TNAU, 2024](#))^[2].

Prioritization of constraints (RBQ analysis)

The RBQ scores provide a robust, evidence-based prioritization. The findings reveal that the most severe constraints are interconnected, pointing to systemic failures in market and institutional support.

Table 2. Priority Ranking of Top 5 Constraints

Overall Rank	Theme	Constraint Statement	RBQ Score
1	Market and Price Volatility	Market prices for coconuts are highly volatile.	97.1
2	Pests, Diseases, and Crop Management	Pest infestations (mealy bug, whiteflies) reduce yields.	96.3
3	Labor and Production Costs	Agricultural labor is often scarce.	95.4
4	Water and Infrastructure	The supply of irrigation water is inadequate.	94.8
5	Market and Price Volatility	Intermediaries exploit farmers, leading to reduced income.	93.8

Table 2.1. Market and Price Volatility

Rank	Constraint Statement	RBQ Score
1	Market prices for coconuts are highly volatile.	97.1
2	Intermediaries exploit farmers, leading to reduced income.	93.8
3	Low prices due to high marketing margins make farming unprofitable.	90.4
4	Cash payments from buyers are often delayed.	86.7
5	The Minimum Support Price (MSP) is inadequate.	82.6

The constraint of **Market prices for coconuts is highly volatile (RBQ: 97.1)** is the definitive primary challenge, confirming that **economic risk** is the greatest source of farmer distress, a trend consistent with the findings of in South Indian markets (George *et al.*, 2020) [3]. This extreme volatility is a direct consequence of the structural constraint of **exploitation by intermediaries (RBQ: 93.8)**. The high RBQ scores in this theme collectively point to a broken market chain that lacks regulation and transparency. The **inadequacy of MSP (RBQ: 82.6)** further confirms the lack of an effective floor price mechanism to safeguard farmer income against cyclical downturns.

Table 2.2. Pests, Diseases, and Crop Management

Rank	Constraint Statement	RBQ Score
1	Pest infestations (mealy bug, whiteflies) reduce yields.	96.3
2	Root wilt disease causes major crop loss.	93.2
3	Farmers lack sufficient knowledge of plant protection methods.	89.7
4	Quality, high-yielding coconut varieties and disease-free seedlings are scarce.	86.1
5	There are significant problems with managing soil nutrients.	82.7
6	Timely availability of quality fertilizers and pesticides is difficult.	79.3

This theme identifies acute **biotic pressure**. The high RBQ for **Pest infestations (RBQ: 96.3)**, particularly whiteflies, validates the severity of the threat noted by Joseph *et al.* (2021) [4], who studied the rapid-spreading nature and impact of these invasive species in South India (Joseph *et al.*, 2021) [4]. This current threat necessitates a paradigm shift in extension focus from endemic diseases like Root Wilt (Mishra *et al.*, 2017) [5] RBQ: 93.2 to rapid-response pest management. The critical finding is the high ranking of **Lack of knowledge of plant protection (RBQ: 89.7)**, which signifies a crucial **extension gap** where scientific knowledge is not adequately reaching the field, hindering the effective management of emerging threats.

Table 2.3. Labor and Production Costs

Rank	Constraint Statement	RBQ Score
1	Agricultural labour is often scarce.	95.4
2	The cost of farm labour is exceptionally high.	92.1
3	Fertilizers, pesticides, and chemical inputs have high costs.	88.6
4	Farm machinery and equipment are expensive.	84.2
5	Timely and affordable credit is unavailable.	79.8

The economic interpretation of this theme is clear: **labour scarcity (RBQ: 95.4)** is the primary cost driver and a fundamental bottleneck in the labour-intensive cultivation process, supporting the observations regarding the critical need for mechanization (Selvaraj *et al.*, 2016) [6]. This constraint directly elevates the **cost of farm labour (RBQ: 92.1)**, eroding the profitability of smallholdings. This pressure, combined with the **high cost of chemical inputs (RBQ: 88.6)**, confirms that the cost-of-production environment is highly challenging, making subsidized mechanization programs a non-negotiable policy imperative.

Table 2.4. Water and Infrastructure

Rank	Constraint Statement	RBQ Score
1	The supply of irrigation water is inadequate.	94.8
2	Storage facilities in the coconut growing areas are insufficient.	89.4
3	Sufficient local processing units are lacking.	85.7
4	Poor road infrastructure affects the transportation of produce.	81.3

The **inadequate irrigation water supply (RBQ: 94.8)** is the dominant abiotic constraint, directly threatening crop survival and yield stability in the semi-arid conditions of the district (TNAU, 2024) [2]. The high ranking of **Insufficient storage facilities (RBQ: 89.4)** is a critical finding in the context of post-harvest management. The lack of decentralized, robust storage forces farmers into immediate sales, linking this infrastructural deficit directly back to the market volatility constraint (Theme A). Development focus should be dual: water-use efficiency (drip/micro-irrigation) and decentralized storage/processing.

Table 2.5. Technology and Policy Gaps

Rank	Constraint Statement	RBQ Score
1	Government support and subsidies for inputs are poor.	92.8
2	Regulated markets and cooperative marketing societies are absent.	90.3
3	Farmers lack updated technical know-how.	86.5

(continued on next page)

Rank	Constraint Statement	RBQ Score
4	Technical guidance and extension visits are infrequent.	84.1
5	The adoption of advanced farm machinery is low.	81.2
6	Access to market news and intelligence is limited.	78.7

The theme highlights critical **institutional and policy failures**. The strong perception of **poor government support (RBQ: 92.8)** indicates that farmers feel the existing schemes are not adequately offsetting high cultivation costs. The **absence of regulated markets and cooperative marketing societies (RBQ: 90.3)** is a structural policy gap whose resolution is mandatory to address the market exploitation noted in Theme A aligning with policy recommendations from **George & Jose (2020)**^[3]. This ranking confirms that farmers prioritize the development of reliable institutional structures over purely technical guidance, though the need for improved know-how remains significant.

Conclusion

The RBQ analysis of constraints facing coconut farmers in Coimbatore District has empirically established that the primary threats are systemic **market and economic risks**, which overshadow technical production constraints. The **Top 3 Critical Constraints** are unequivocally identified as: **Market Price Volatility (RBQ: 97.1)**, **Pest Infestations (RBQ: 96.3)**, and **Agricultural Labor Scarcity (RBQ: 95.4)**. The high RBQ scores for these factors define the key leverage points for policy action.

Policy implications

The study concludes with the following policy implications for enhanced sector sustainability:

1. **Market Decentralization:** Institutionalize the formation and funding of Farmer Producer Organizations (FPOs) to create transparent, regulated collection centers, thereby bypassing intermediaries and mitigating price volatility, a strategy strongly supported by **(NABARD, 2023)**^[7] **NABARD (2023)**^[7] for agricultural resilience.
2. **Biological Crisis Management:** Launch a rapid-response extension program focused exclusively on the biological control and management of mealy bugs and whiteflies, incorporating community-based surveillance and dissemination of resistant germplasm, as recommended by **(Joseph et al., 2021)**^[4] **Joseph et al. (2021)**^[4].
3. **Economic Mitigation:** Introduce targeted, substantial subsidies for specialized farm machinery to mechanize harvesting and dehusking, directly addressing labor scarcity and high production costs, following the recommendations of **Selvaraj & Thirumoorthy (2016)**^[6].

4. **Infrastructural Linkage:** Link subsidies for water-saving technologies (e.g., drip irrigation) with incentives for building decentralized, farm-gate storage facilities to improve post-harvest management.

These integrated, prioritized interventions are essential to restore financial stability and long-term viability to coconut cultivation in the Coimbatore region.

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