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RESEARCH ARTICLE

Market dynamics and socio-economic analysis of timber growers in Tamil Nadu with policy implications

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Abstract

India faces a critical timber deficit, as consumption (Compound Growth Rate (CGR) 5.20 %) continues to outpace domestic production (CGR 1.97 %). By 2030, timber demand is projected to reach 36.70 million cubic metres (MCUM). The study analyses the market structure, demand-supply gap and socio-economic conditions of timber growers across five districts−Tirunelveli, Kanniyakumari, Salem, Dindigul and Thanjavur−representing diverse agro-climatic zones in Tamil Nadu. It uses primary data from 250 growers and secondary data (2000-2023) from International Tropical Timber Organization (ITTO), State Forest Records and Food and Agriculture Organization Statistical Database (FAOSTAT) to estimate CGR of timber production and import trends. Growers are predominantly male (92.4 %), middle-aged (mean 49.91 years), with 29.3 % illiterate and operate fragmented holdings (average 7.49 %). Teak is the dominant species (72.8 % adoption), though species diversification is influenced by landholding size and agro-climatic conditions. Despite 74.8 % attempting direct sales, market inefficiencies persist: complex channels involving 5 intermediaries inflate price spreads to ₹570/cft (vs. ₹440/cft in streamlined channels), reducing farmers' share to 43 %-50 % of consumer prices. Critical constraints include water scarcity (59.04 % Garrett score), drying challenges (64.71 %), broker fees (54.37 %) and grading difficulties (57.45 %). Notably, 90.8 % of growers express readiness for digital market integration. The study recommends policy interventions targeting co-operative marketing, e-platform adoption, input subsidies and logistic optimization to enhance grower agency and bridge the supply gap.

Keywords: CGR; demand-supply gap; marketing channel; price spread analysis; timber market constraints

Introduction

Timber, as a forest product, plays a crucial role in both environmental sustainability and industrial development; timber accounts for 46 % of total commercial forest products in India (1). Tamil Nadu's forest and tree cover stands at 23.71 % of its geographic area, with trees outside forests (TOF) contributing 4.2 MCUM annual increment (2). Nevertheless, domestic supply (0.02 CGR) falls short of consumption and imports (0.05 CGR), creating a widening gap projected at 14.2 MCUM by 2025. As India continues to import wood (CGR of 5 %), local industries including sawmills and furniture manufacturers face acute raw material shortages. In India, forest and tree cover was 80.9 million hectares in 2021 accounting for 24.62 % of the geographic area (3). The productivity of Indian forest was lower (1.0 m^3/ha/year) than the global average of 3.0 m^3/ha/year. Per capita availability of forests was 0.06 ha which is lower than the world average of 0.64 ha in 2020. India is ranked second in producing and consuming tropical logs among ITTO member countries next to Indonesia. India cannot meet its demand for wood products with domestic supply (4). India has been trying to supplement domestic timber resources through imports from South East Asian countries. Indian sawmills heavily depend on Myanmar, Malaysian and Indonesian teak logs with a price range from US$225/$m^3$ in January 2017 to US$516/$m^3$ in December 2017 which depends on the quality and transportation cost. With an estimated 26419 km^2 of forest cover, Tamil Nadu made up 20.31 % of the state's total land area. Tamil Nadu has a total forest and tree cover of 30843.23 km^2 or 23.71 % of its geographical area. The percentages of very dense forest, medium dense forest and open forests are 2.76 %, 8.48 % and 9.07 %, respectively (5). In 2021, Tamil Nadu's per capita forest acreage (0.04 ha) was less than the national average (0.06 ha). In 2008, there was a 3.391 MCUM annual increase in growing stock from trees outside of forests (6).

Growing population and urbanization have increased demand for timber in the housing and furniture sectors, but strict forest laws and bureaucratic bottlenecks discourage smallholders (7). Owners of 23220 sawmills run at 40 % capacity because of erratic raw material imports (4). A steady supply of raw materials for wood-based sectors such as plywood, furniture manufacturing, wood processing and building and construction is hampered by low

productivity, low forest cover and strict forest restrictions. One of the greatest impediments to the growth of the furniture industry is the mismatch between increasing demand and limited supply of timber materials. However, the industry continues to struggle with a lack of timber. Against this backdrop, the present study focuses on timber growers and sawmill owners in Tamil Nadu to assess socio-economic conditions, production constraints and market dynamics with the aim of identifying policy measures to strengthen the state's wood-based industry.

A thorough understanding of different timbers available in the market, different seasoning methods adopted and preference of timbers along with the attributed reasons will be understood through this study and generate a good fund of knowledge about the merits of timbers and the perception of wood industrialists over the merits. The findings on their perception would help us to have an understanding of the real value and the market potential for the timber. The study would help to find the marketing channel and the price spread of timbers over the commercial timbers. Based on the identified research gaps, the specific objectives of this study are to:

1. Assess the socio-economic profiles of timber growers and sawmill owner
2. Analyze production and marketing constraints affecting timber supply chain.
3. Evaluate price spread and market efficiency across different marketing channels.

Study area and data collection method

Study area and sampling

The districts of Tirunelveli, Kanniyakumari, Salem, Dindigul and Thanjavur were selected for their distinct agroclimatic zones and concentration of wood-based industries such as sawmills, furniture units and veneer production centres (Fig. 1). A total of 250 timber tree growers (50 per district) were chosen through stratified random sampling based on districts to ensure regional representation. Within each district, respondents were randomly selected from Forest Department and industry records, capturing variation in species cultivation and marketing systems across the study area.

Data collection

Primary data were collected through structured interviews conducted from November 2023-June 2024. The interviews captured information on farm characteristics, species cultivated, harvesting practices, marketing channels, costs and production/ marketing constraints. Respondents were selected using stratified random sampling. Different interview schedules were designed for each respondent category (e.g. farmers, sawmill owners, traders) and pre-tested prior to field administration.

Secondary data on production, consumption, export and import of timber were obtained from the ITTO for the period 2000-2023. Data on forest cover were sourced from the Forest Survey of India's State of Forest Reports (1).

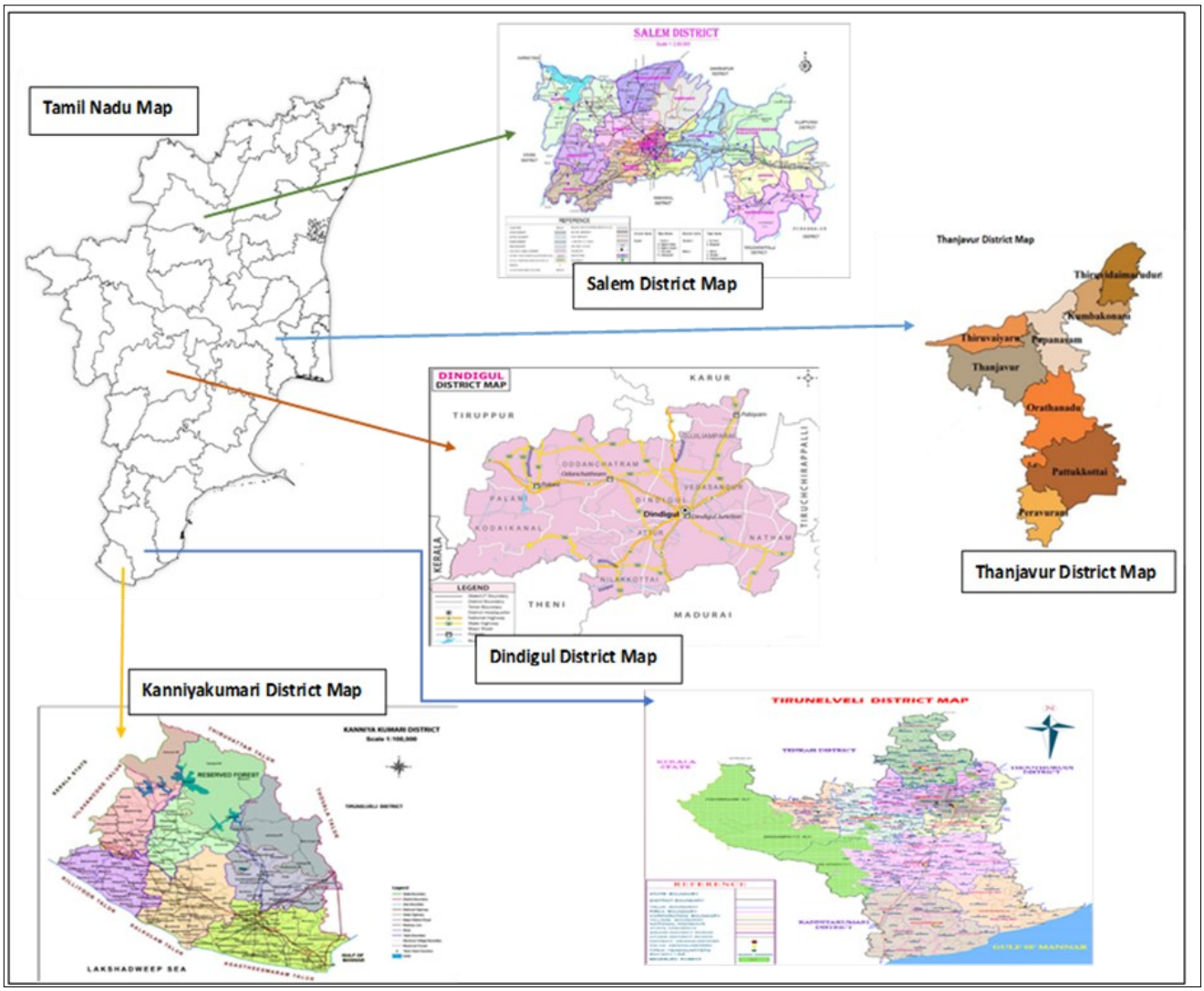

Fig. 1. Study area: District's map.

Analytical Tools and Methodology

Compound Growth Rate (CGR)

CGR was used to measure the annual growth rate of production, consumption, import and export of timbers using the formula $Y_t = ab^t$. The value of CGR is given as follows:

$$CGR\ (r) = [Antilog\ (b) - 1] \times 100 \quad \text{..... (1)}$$

After estimation of the growth rate percentage, the forecast value for the succeeding year is found by using the equation (1). We get

$$Forecasting\ year = Actual\ end\ year \times (1 + CGR)^n \quad \text{..... (2)}$$

The production, consumption, export and import were forecasted based on the compound growth rate for the period of 2030 (8).

Marketing channel and price spread

In the process of marketing timbers, the difference between the price paid by the consumer and that received by the producer for an equivalent quantity was defined as "Price Spread". The farmer's share in the consumer rupee was calculated by equation 3 (9, 10).

where, $$f_s = \left(f_p / c_p\right) \times 100 \quad \text{..... (3)}$$

f_s = Farmer's share in consumer rupee (%)

f_p = Farmer's price

C_p = Consumer's price

Constraint analysis

To identify and rank major production and marketing constraints, Garrett's scoring technique was applied (11). Percent position for each constraint was calculated as (Eq. 4):

$$\text{Percent position} = \frac{(R_{ij} - 0.5)}{N_j} \times 100 \quad \text{..... (4)}$$

R_{ij} = Rank assigned for the i^{th} category by the j^{th} group

N_j = Number of constraints assigned by j^{th} individual

The calculated percent positions were then converted into scores using Garrett's conversion table and mean scores were computed. Constraints were ranked in descending order based on their mean scores.

Results and Discussion

Trends in timber production, import and consumption

The persistent mismatch between high consumption growth (5.20 % Compound Annual Growth Rate (CAGR)) and modest production growth (1.97 % CAGR) explains the widening deficit (Table 1). Both imports and exports grew at CAGRs of 4.75 % and 4.20 %, respectively. These trends are extrapolated to the following expected numbers for 2030: imports (9.75 MCUM), exports (0.14 MCUM), output (94.39 MCUM) and consumption (127.25 MCUM). This emphasizes India's expanding consumption-production mismatch, forcing increased import dependence to meet domestic timber demand.

The wood gap defined as consumption + imports - exports - production−went from a surplus of 22.57 MCUM in 2000 to a deficit of 13.94 MCUM in 2023 (12). This reversal is due to diminishing output growth (1.97 % CAGR) vs strong consumption growth (5.20 % CAGR). According to projections, the deficit would continue to widen, reaching 36.70 MCUM by 2030 (Fig. 2 & Table 2), highlighting India's increasing reliance on timber imports to make up for shortages in its own indigenous supply (13-15).

Table 1. CGR and projected value of timbers

S. No.	Particulars	CGR (%)	Projected value for 2030 (MCUM)
1.	Production	1.97	94.39
2.	Consumption	5.20	127.25
3.	Import	4.75	9.75
4.	Export	4.20	0.14

Source: ITTO (2000-2023).

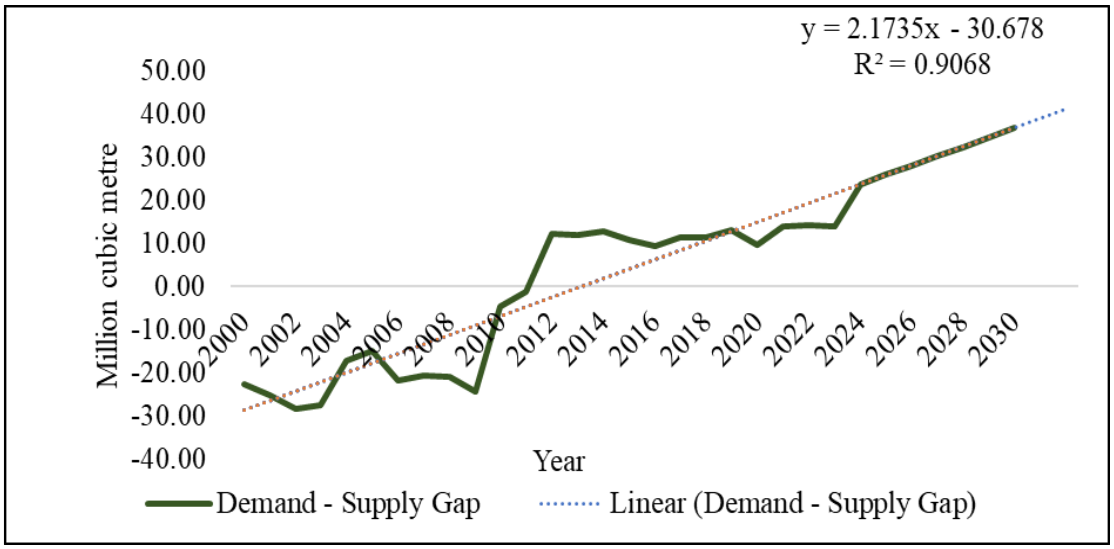

Fig. 2. Trend on demand and supply gap of timber in India (2000-2030).

Source: (13-15) (2000-2023).

Table 2. Key drivers of demand and supply gap of timber in India (2000-2030)

S. No.	Year	Demand - supply gap (MCUM)	Status	Key drivers
1	2000	-22.57	Production surplus	Production (52.94 MCUM) > consumption (27.97 MCUM)
2	2023	+13.94	Consumption deficit	Consumption (89.47 MCUM) > production (82.48 MCUM)
3	2030	+ 36.70*	Widening deficit	Accelerating consumption vs. Stagnant production

Source: ITTO (2000-2023).

Socio-economic conditions of timber growers

Table 3 revealed that socio-economic analysis of 250 timber growers in five districts of Tamil Nadu illustrates obvious demographic trends that have important ramifications for the effectiveness of the value chain (16). The majority of responders (92.4 %) were men, with Dindigul having the highest percentage at 98 %. This suggests that gendered obstacles may still exist and limit household economic diversity. In commercial forestry, the advanced average age of growers (49.91 years), which ranges from 46.6 (Kanniyakumari) to 55.66 (Dindigul), poses questions regarding generational sustainability. These difficulties are exacerbated by notable educational disparities: Overall illiteracy of 29.3 %, which is significantly higher in Dindigul (42 %) and Salem (34 %), is highly correlated with low market awareness (39.6 % overall; 30 % in Kanniyakumari). This knowledge asymmetry, which is consistent with past findings of intermediary-driven price spreads, limits the ability to negotiate prices and maintains trader dependence. The average holdings range from 3.87 acres (Salem) to 13.17 acres (Kanniyakumari), indicating district-specific strategies where smallholders prioritize trees for risk mitigation (as evidenced by 52 % citing loss prevention/income diversification, peaking at 64 % in Dindigul), while larger holders leverage scale for commercial gains. Overall, landholding fragmentation further shapes economic behaviour. The significant reliance on institutional seedling sources (37.2 %) overall, with Tirunelveli accounting for 54 %, both emphasizes the need of government assistance and the fragility of private market ties. Collectively, gender imbalance, ageing producers, low literacy, fragmented holdings and reliance on institutional seedlings create systemic vulnerabilities. These factors strengthen the role of intermediaries and reduce growers' share in final timber values.

Behaviour of timber growers

The behavioural research reveals considerable patterns in market participation techniques across districts (Table 4). Although, 74.8 % of growers harvest and sell directly to sawmills, with Dindigul and Thanjavur having the highest percentages at 86 % and 84 %, respectively, 59.6 % of growers also sell entire plantations to traders, suggesting that multi-channel disposal is common. There are notable differences across the districts: Kanniyakumari depends less on traders (30 %) than Dindigul (78 %), which is probably due to the latter's greater average landholdings (13.17 acres), which allow for direct sales. Crucially, 90.8 % of respondents said they would be very interested in registering plantations on e-portals (the highest percentage is 94 % in Thanjavur and the lowest is 86 % in Salem), indicating that despite currently used analogue methods, digital readiness is widespread. This contrast–high intermediary dependency alongside e-adoption enthusiasm–suggests that traders fill important gaps (e.g. financing, logistics) that producers aspire to replace with digital solutions. E-platforms could challenge trader supremacy, according to the statistics, provided they are made to overcome structural constraints like land fragmentation (avg. 7.49 acres) and literacy (29.3 % illiteracy). Overall, while intermediaries currently dominate timber marketing, growers' strong interest in digital platforms signals an opportunity for policy-driven e-market integration, provided challenges such as land fragmentation and low literacy are addressed.

Major timber species-wise distribution of sample timber growers

According to a species-wise examination of 250 wood farms, the most common species is teak (*Tectona grandis*), which is grown on an average of 3.56 acres by 72.8 % of producer (Table 5). It is commonly planted in block plantations (56.59 %) at 4.75 m spacing for long-term investment (27-year harvest cycle), demonstrating its strong market value and flexibility. The secondary commercial species Red Sanders (19.6 %) and Mahogany (31.6 %) both prefer

Table 3. Socio-economic conditions of timber growers in the sample respondents

Particulars	Categories	Tirunelveli*	Kanniyakumari*	Thanjavur*	*Dindigul*	Salem*	Overall**
Gender	Male	46 (92.00)	45 (90.00)	48 (96.00)	49 (98.00)	43 (86.00)	231 (92.40)
Age Group	Average age (years)	49.84	46.6	50.8	55.66	46.64	49.91
Educational Status	Illiterate	14 (28.00)	10 (20.00)	12 (24.00)	21 (42.00)	17 (34.00)	74 (29.30)
Land area	Average (acre)	09.9	13.17	4.91	5.60	3.87	07.49
Reason for growing tree plantation	Prevent agricultural losses and increase the source of income	25 (50.00)	25 (50.00)	30 (60.00)	32 (64.00)	18 (36.00)	130 (52.00)
Seedling source	Govt. & NGOs, Forest department	27 (54.00)	15 (30.00)	17 (34.00)	18 (36300)	16 (32.00)	93 (37.20)
Market awareness	Aware	24 (48.00)	15 (30.00)	22 (44.00)	18 (36.00)	20 (40.00)	99 (39.60)

* District sample respondents (50 respondents), ** Overall respondents (250 respondents).

Source: Field survey (Nov 2023-Jun 2024).

Table 4. Behaviour of timber growers in the sample respondents

Particulars	Tirunelveli*	Kanniyakumari*	Thanjavur*	Dindigul*	Salem*	Overall**
Sell entire plantations to traders	33 (66.00)	15 (30.00)	34 (68.00)	39 (78.00)	28 (56.00)	149 (59.60)
Harvest and sell to sawmills directly	35 (70.00)	30 (60.00)	42 (84.00)	43 (86.00)	37 (74.00)	187 (74.80)
Interested in registering plantations on e-portals	46 (92.00)	45 (90.00)	47 (94.00)	46 (92.00)	43 (86.00)	227 (90.80)

Note: * District sample respondents (50 respondents), ** Overall respondents (250 respondents).

Source: Field survey (2024-2025).

Table 5. Major timber species-wise distribution of sample growers

S. No.	Tree species	Timber growers**	Average planting area (acre)	Block plantation/ (2)	Border plantation/ (2)	Year of planting (average)	Spacing (m)	Height (m)	Diameter (cm)	Year of harvest
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Teak	182 (72.80)	3.56	103 (56.59)	79 (43.41)	2017	4.75	6.56	24.72	2044
2	Mahogany	79 (31.60)	4.02	52 (65.82)	27 (34.18)	2022	6.7	1.39	7.1	2043
3	Red sanders	49 (19.60)	1.07	49 (100.00)	0 (0.00)	2021	5.5	2.74	10.85	2049
4	Vembu	23 (9.20)	0.75	11 (47.83)	22 (95.65)	2011	4.8	10	39.6	2030
5	vengai	12 (4.80)	2.66	03 (25.00)	09 (75.00)	2021	8.33	1.56	7.33	2030
6	Malai vembu	16 (6.40)	0.5	11 (68.75)	05 (31.25)	2022	8	2	6	2030
7	poovarasu	08 (3.20)	0.5	08 (100.00)	0 (0.00)	2024	0.7	1.5	7	2035
8	Savukku	10 (4.00)	2.5	10 (100.00)	0 (0.00)	2023	7.25	1.25	2.75	2032
9	Kumil	18 (7.20)	0.5	04 (22.22)	14 (77.78)	2005	2.5	8	55	2045

Note: ** Overall respondents (250 respondents).

Source: Field survey.

block systems (65.82 % and 100 %, respectively), while Red Sanders matures for long rotation period (28 years). Notably, species that are suited to smallholders, such as Kumil (7.2 %), Vengai (4.8 %) and Vembu (9.2 %), flourish in border plantations (>75 % adoption), taking advantage of marginal land with shorter rotations (19-25 years). Notable physiological differences were observed: Kumil achieves impressive diameter growth (55cm) despite limited spacing (2.5m), but Poovarasu and Savukku, though minimally adopted (3.2 %–4.0 %), exhibit rapid early growth in constrained settings. Planting patterns substantially correlate with landholding economics: smallholders (<5 acres) prioritise border species for faster returns, whereas bigger holders prioritise high-value block species like teak. Thus, timber species choice is closely tied to landholding size, with smallholders favouring fast-growing border species for short-term returns, while larger holders invest in high-value block plantations such as teak and mahogany.

Marketing channels and price spread

Two principal marketing channels for timber were identified (Table 6 & 7). Channel I consists of Farmer → Agent → Sawmill → Retailer → Consumer, while Channel II bypasses the agent, involving Farmer → Sawmill → Retailer → Consumer. Price spread analysis indicates that the presence of agents in Channel I reduces farmers' share, while Channel II provides relatively higher returns to grower

This streamlined channel I, which involves only three intermediates, is more efficient (Table 6) (10, 17). The price spread of ₹440/cft shows that transaction expenses, middleman markups and operational profits account for a smaller share of the final consumer price. This arrangement implies advantages such as fewer handling, faster throughput and perhaps higher returns for farmers (assuming comparable farmgate prices) or lower prices for consumers when compared to Channel II. In contrast, this channel II has five intermediaries, including an Agent on the farm and a Wholesaler between the Sawmill and the Retailer. This added complexity results in a much higher price spread of ₹570/cft, indicating an additional burden of ₹130/cft compared to Channel I. Each additional middleman involves new costs, logistics, profit margins and potential inefficiencies, all of which contribute to an increase in the final consumer cost.

Farmers received 43.14 % and 49.57 % of consumer price under Channels I and II (Table 7). Sawmill conversion cost averaged ₹85/cft, marketing cost ₹60/cft and sawmill margin ₹145/cft. The wholesaler's margin accounts for 81 % (₹105/₹130) of Channel II's increased cost, indicating fragmentation as a major inefficiency driver in timber markets.

Table 6. Marketing channel of timber flow

Channel	Flow	Price spread (₹ /cft)
I	Farmer→Sawmill→Retailer→Consumer	440
II	Farmer→Agent→Sawmill→Wholesaler→Retailer→Consumer	570

Source: Field survey.

Table 7. Price spread for timbers (Minor timber)

Component	Channel I (₹ /cft)	Channel II (₹ /cft)
Net price to farmer	580	580
Sawmill conversion cost	85	85
Sawmill margin	145	145
Wholesaler margin	-	105
Retailer margin	84	75
Price paid by the consumer	1020	1150
Price Spread	440	570

Source: Field survey.

Table 8. Constraints in growing tree plantation of the sample respondents

S. No.	Particulars	Tirunelveli*	Kanniyakumari*	Thanjavur*	*Dindigul*	Salem*	Overall**
1	Water problem	I (59.17)	II (54.1)	I (60.11)	I (59.51)	I (63.46)	I 59.04
2	Weed, Pest & diseases problem	III (51.47)	I (54.5)	III (52.22)	III (50.06)	IV (49.84)	II 51.53
3	Natural calamities	VI (41.60)	VI (42.8)	VI (36)	VI (43)	III (50.46)	VI 43.05
4	Labour insufficient	II (52.47)	V (43.7)	V (36.67)	IV (46.75)	VI (41.30)	V 44.09
5	Don't know the cultural practices	IV (51.04)	III (49)	IV (42.11)	V (46.37)	V (43.38)	IV 46.18
6	Fence, electricity, electric motor problems	V (47.39)	IV (44.2)	II (53.44)	II (51.24)	II (52.46)	III 49.67

Note: * - District sample respondents (50 respondents), ** - Overall respondents (250 respondents), () -the brackets value represents in Garrett score.

Problem and constraints facing of timber growers

Constraints in growing tree plantation

Table 8 revealed that overall, water scarcity is the biggest obstacle to timber cultivation (59.04 %) and it ranks first in four districts (Tirunelveli: 59.17 %, Thanjavur: 60.11 %, Dindigul: 59.51 %, Salem: 63.46 %). The management of pests and diseases (51.53 %) is the second most important issue, with Kanniyakumari (54.5 %) having the highest percentage, where it overtakes water issues. Although they rank third overall, infrastructure deficiencies (fencing/electricity: 49.67 %) are the secondary restriction in three districts (Thanjavur: 53.44 %, Dindigul: 51.24 % and Salem: 52.46 %), which represent systemic weaknesses in asset protection and rural electrification. The district-specific severity of labour shortages (44.09 %) varies with regional migration patterns, with Tirunelveli having the greatest rate (52.47 %, rank 2) and Salem having the lowest rate (41.30 %, rank 6). Crucially, climate vulnerabilities (natural calamities: 43.05 %) and deficiencies in technical understanding (cultural practices: 46.18 %) increase the hazards of production; Salem reports much worse calamity impacts (50.46 %, rank 3). These limitations combined represent three systemic flaws: firstly, inability to adapt to climate change (water/calamities), secondly, shortfalls in extension services (pest/knowledge gaps) and thirdly neglect of rural infrastructure. Overall, timber cultivation faces interlinked ecological, institutional and infrastructural barriers, which collectively undermine long-term sustainability.

Constraints in the marketing of timber

The most critical constraint identified was drying issues (Garrett score 64.71), reflecting deficiencies in post-harvest infrastructure

Table 9. Constraints in the marketing of timber of the sample respondents

S. No.	Particulars	Tirunelveli*	Kanniyakumari*	Thanjavur*	Dindigul*	Salem*	Overall**
1	Difficult in the drying process	I (64.47)	I (62.3)	I (65.05)	I (66.41)	I (65.30)	I (64.71)
2	Transportation	IV (47.26)	V (46.8)	V (44.72)	V (44.17)	VI (40.69)	VI (44.73)
3	Separation of grade	II (57.86)	III (54)	II (55.16)	IV (61.62)	II (58.61)	II (57.45)
4	Brokerage/commission agents' intervention and fees are too high	III (55.91)	II (61.6)	III (52.33)	II (51.13)	IV (5084)	III (54.37)
5	Market distance	VII (40.78)	IV (47.3)	VI (42.38)	VI (41.86)	VII (40.53)	V (42.57)
6	Marketing Infrastructure	IV (45)	VI (45.1)	IV (49.16)	III (46.55)	III (51.07)	IV (47.38)
7	Others	VI (42.04)	VII (36.7)	VII (22)	VII (41.22)	V (45.92)	VII (37.58)

Note: * - District-wise sample respondents (50 respondents), ** - Overall respondents (250 respondents), () - the brackets value represents in Garrett score.

(Table 9) (18). This is closely followed by grading problems (57.45 %) and excessive broking fees (54.37 %), corroborating previous results of intermediary-driven inefficiency. District-level trends reveal important weaknesses: Kanniyakumari is most likely to experience broker exploitation (61.6), while Dindigul has severe grading problems (61.62). Infrastructure gaps rank fourth overall (47.38) but are the third most severe barrier in Salem (51.07) and Dindigul (46.55), which correlates with limited mechanization found during field visits. Despite regional topography variances, transportation scores lowest (44.73), which is surprising and suggests that this conventional barrier has been somewhat lessened by increased road connectivity. These results suggest that inefficiencies in post-harvest processing and grading, coupled with broker dominance, reduce farmer profitability far more than transport constraints. Overall, marketing inefficiencies particularly in drying, grading and broker control mirror the structural weaknesses observed in cultivation, reinforcing the need for institutional reforms and improved infrastructure development.

Conclusion and Recommendation

This study analyzed the timber value chain in Tamil Nadu and critical issues were found in filling the growing demand-supply gap. India's wood consumption (5.20 % CGR) significantly exceeds growth in production (1.97 % CGR), with the shortage estimated to be 36.70 MCUM by 2030. Tamil Nadu's minor wood growers were mostly male (92.4 %), aging (avg. 49.91 years) and sometimes having limited education (29.3 % illiterate) were operating fragmented plots (avg. 7.49 acres). Reliance on institutionally based seedlings (37.2 %) and extremely low market understanding (39.6 %) hamper value chain agency among growers. These socioeconomic circumstances, along with earlier evidence showing dysfunctional marketing channels, suggest that growers' weak market position allows intermediaries to take advantage of excessive margins.

The timber sector of Tamil Nadu is dominated by teak (72.8 % adoption), although considerable diversification has emerged through niche species adapted to specific geographical conditions. The majority of farmers practice block plantations for premium species such as teak, mahogany and red sanders, with rotation periods exceeding 25 years. Some smallholders adopt border planting systems that integrate timber species like vembu and kumil with agricultural crops, enabling efficient land use and supplementary income. A smaller group follows species–site matching practices, as reflected in the superior growth of kumil, which attains a diameter of about 55 cm even under dense planting conditions. This segmentation, in which large holders seek capital-intensive teak while smallholders employ risk-mitigating border species, is perfectly aligned with socioeconomic reality. Despite willingness to sell directly, intermediaries dominate, depressing farmer margins, fragmented channels reduce farmer's share to 43 % -50 % of consumer price.

Major constraints are bottlenecks in production (water deficiency: 59.04 % Garret score, pests/diseases: 51.53 %) and marketing inefficiencies (difficulty in drying: 64.71 %, broker commissions: 54.37 % and difficulty with grading: 57.45 %). Sawmills are operating only at a 40 % rate due to unreliable supply, exacerbated by administrative bottlenecks and market penetration weaknesses (39.6 %). Of crucial significance, there is good digital preparation among producers (90.8 % interest in e-portals). These constraints interact in an unanticipated way: poor drying demands distressed sales to brokers, but weak grading methods allow for arbitrary price reductions.

Key initiatives are required to enable small-scale forestry growers. First, digital access should be streamlined through single-window e-portal clearance systems and mobile-friendly integration. Second, co-operative marketing organizations and farmer-sawmill contracts must be promoted to strengthen market linkages. Third, input availability can be increased by supplying subsidized high-value saplings and establishing community nurseries through public –private partnerships. In addition, rethinking GST slabs to reduce operational expenses and incentivize rural value addition would support tax reforms. Logistics can also be optimized by improving road connectivity to mills and providing subsidies for rural transport. Collectively, these actions will improve viability, enhance market access and reduce production burdens. Taken together, these measures can strengthen timber farming, empower smallholders and decrease India's growing reliance on timber imports.

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Authors' contributions

RR participated in the research activities, establishment, survey, statistical data analysis and the writing of the research article. SVR, KB, AV, RD and DD edited and reviewed the research article. Every author reviewed and endorsed the final manuscript.

Compliance with ethical standards

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