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JASMINE CULTIVATION IN MADURAI DISTRICT: PRODUCTION, MARKETING DYNAMICS AND ECONOMIC IMPACT ANALYSIS

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ABSTRACT

Jasmine cultivation in Madurai district represents a significant agricultural enterprise integrating economic development, cultural heritage preservation, and sustainable rural livelihoods. This study examined production dynamics, value chain efficiency, and socio-economic impact of jasmine *(Jasminum sambac)* cultivation in Madurai district from 2000 to 2024 through quantitative production analysis, qualitative value chain assessment, and socio-economic impact evaluation. Production data analysis reveals remarkable growth with cultivation area expanding from 952 hectares (2000-2012 average) to 1,735 hectares (2024), representing 83% increase. Annual production surged from 7,643 tonnes to 16,077 tonnes, demonstrating 110% growth with productivity improvement of 15% reaching 9.26 tonnes hectare^{-1}. Strong positive correlation ($r = 0.976$, $p < 0.01$) between cultivation area and production validated expansion-based growth strategies. Value chain analysis identified four distinct marketing channels with efficiency ratings ranging from 2.2 to 4.1, with Channel 4 (Farmers-Commission agents-Retailers-Consumers) achieving highest efficiency. The study documents Madurai s 11.3% contribution to Tamil Nadu s jasmine production while supporting over 500 small-scale farmers predominantly operating on less than 2 acres. Socio-economic assessment reveals superior income potential compared to traditional crops, 46% female workforce participation, and annual domestic demand growth exceeding 25%. Post-harvest losses of 35-40% during transit represent significant improvement opportunities. Export analysis reveals active trade with Dubai, Singapore, USA, Malaysia, and Europe with specialized packaging enabling 24-48 hour transit times. The research establishes jasmine cultivation as a sustainable agricultural model providing economic development while maintaining cultural significance and supporting inclusive rural growth.

(Key words: Jasmine cultivation, production dynamics, value chain analysis, socio-economic impact, agricultural economics, rural development, Madurai district)

INTRODUCTION

Jasmine cultivation in Tamil Nadu represents a remarkable convergence of agricultural innovation, cultural significance, and economic sustainability, with Madurai district serving as India s premier jasmine production hub. Known as Malligai Maanagar (City of Jasmine), Madurai has cultivated jasmine for over two millennia, establishing a unique agricultural system where traditional knowledge, spiritual practices, and commercial cultivation intersect to maintain both economic viability and cultural continuity (Prakash and Muniyandi, 2014a).

The historical significance of jasmine cultivation in Madurai traces back to ancient Sangam literature (300 BC), where Tamil poets celebrated the flower s beauty and cultural importance. Archaeological evidence establishes jasmine s integral role in temple rituals, particularly at the renowned Meenakshi Amman Temple, creating a cultural embedding that has sustained agricultural practices for generations (Selvanayaki *et al.*, 2022).

Tamil Nadu s dominance in national jasmine production contributes approximately 25% of India s total flower production, positioning the state as a critical component of the country s floriculture sector (Anonymous, 2021). Within this context, Madurai district s contribution becomes particularly significant, representing 11.3% of the state s jasmine production from 11.1% of the cultivation area, indicating superior productivity levels compared to other regions (Anonymous, 2024a).

The economic significance of jasmine cultivation extends beyond primary production to encompass complex value chains involving processing, value addition, and international trade. The industry supports over 500 farmers in Madurai alone, predominantly small-scale operators who manage less than 2 acres each, creating a decentralized yet economically viable agricultural model (Kaviarasan *et al.*, 2015). The sector s capacity to provide superior income compared to traditional crops, combined with intensive labor requirements that particularly benefit women (46% of agricultural workforce), establishes jasmine cultivation as a model for inclusive rural development.

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Contemporary scientific interest in *Jasminum sambac* has substantiated many of its traditional medicinal applications, revealing diverse pharmacological properties including antioxidant, anti-inflammatory, antimicrobial, analgesic, and cardioprotective activities (Al-Snafi, 2018; Shah, 2024). These findings confirm jasmine s potential as a natural therapeutic agent capable of addressing various modern health challenges. This growing evidence has added new scientific dimensions to traditional jasmine cultivation practices, highlighting its value beyond ornamental use. Furthermore, the increasing global demand for natural products and emphasis on sustainable agriculture and cultural authenticity present significant opportunities to expand jasmine cultivation and utilize its medicinal properties in modern therapeutics (Al-Snafi, 2018).

However, the industry faces contemporary challenges including post-harvest losses of 35-40%, climate variability impacts, standardization requirements, and competition from synthetic alternatives. The objective of this study was to analyze jasmine cultivation in Madurai from multiple perspectives: production dynamics and trends (2000-2024), value chain efficiency evaluation, and socio-economic impact assessment to provide evidence-based insights for sustainable industry growth strategies.

MATERIALS AND METHODS

Study area and data collection

This study focused on jasmine cultivation in Madurai district, Tamil Nadu, covering the period from 2000 to 2024. Primary data sources included unit data details from Government of Tamil Nadu Department of Economics and Statistics publications (Anonymous, 2024b), District Horticulture Office Madurai records, National Horticulture Board reports (Anonymous, 2021), and Agricultural Marketing Division statistics. The selection of Madurai district was based on its historical significance and contemporary importance in jasmine production, as established by previous research documenting the region s unique production characteristics and market dynamics (Prakash and Muniyandi, 2014a; Selvanayaki *et al.*, 2022).

Production data collection involved systematic compilation of area under cultivation, total production, productivity indicators, farmer demographics, and climatic variables from official agricultural statistics. Economic data included price trends, cost structures, profit margins, export values, and market channel analysis from agricultural marketing surveys and trade statistics.

Analytical framework

Quantitative production analysis

Statistical methods included descriptive statistics, correlation analysis, trend analysis, and productivity calculations following established approaches in agricultural economics research (Jadhav *et al.,* 2021). Time series analysis examined production trends, growth rates, and cyclical patterns over the 24-year study period, consistent with methodologies employed in horticultural crop analysis (Prakash and Muniyandi, 2014b). Correlation analysis investigated relationships between cultivation area, production, rainfall, and economic variables using Pearson correlation coefficients with significance testing at $p < 0.05$ and $p < 0.01$ levels.

Qualitative value chain assessment

Value chain analysis utilized market channel mapping, efficiency calculations using Shepherd s method and Acharya s approach, and cost-benefit analysis across different marketing channels (Selvanayaki *et al.*, 2022). Marketing efficiency was calculated using the formula:

Marketing Efficiency = (Value added by marketing / Cost of marketing services) × 100

Four distinct marketing channels were identified and analyzed for efficiency ratings, farmer share in consumer price, and market segment characteristics.

Socio-economic impact evaluation

Socio-economic impact analysis integrated employment generation assessment, income comparison with alternative crops, gender participation evaluation, and rural development contribution analysis, following established frameworks for agricultural impact assessment (Kaviarasan *et al.*, 2015). Economic indicators included return on investment, market demand growth rates, and export potential assessment.

Data analysis and quality assurance

Data validation involved cross-referencing multiple sources, temporal consistency checking, and outlier identification. Statistical analysis employed appropriate significance testing, confidence intervals, and assumption validation. Quality assurance measures included triangulation of multiple data sources and transparent reporting of data quality indicators.

RESULTS AND DISCUSSION

Production dynamics and growth trends

Analysis of jasmine cultivation in Madurai district revealed remarkable transformation over the study period, characterized by substantial expansion in both cultivation area and production volume (Table 1). Historical baseline data (2000-2012) established average annual production of 7,643 tonnes from 952 hectares, yielding average productivity of 8.03 tonnes ha^{-1}, consistent with regional productivity patterns documented by Prakash and Muniyandi (2014a). Current data (2024) demonstrated significant growth with cultivation area having expanded to 1,735 hectares and production reaching 16,077 tonnes, achieving productivity of 9.26 tonnes ha^{-1}.

The growth trajectory analysis revealed 83% increase in cultivation area and 110% increase in production compared to historical averages, with productivity

improvement of 15%. This growth pattern indicated successful intensification and extensification strategies, combining area expansion with yield enhancement through improved cultivation practices and variety selection. Chopde *et al.* (2017) demonstrated that integrated plant nutrition significantly improved jasmine growth, yield, and quality parameters, while Patil and Meshram (2020) confirmed similar benefits of integrated nutrient management in tuberose cultivation, suggesting broader applicability of these approaches in flower crops.

Results of correlation analysis

Correlation analysis confirmed strong positive relationship between cultivation area and production ($r = 0.976$, $p < 0.01$), validating area expansion as primary growth strategy (Table 2). Moderate correlation between production and rainfall ($r = 0.535$, $p < 0.10$) suggested climatic influence on yield variability, while area-rainfall correlation ($r = 0.504$, $p < 0.10$) indicated weather-dependent planting decisions, consistent with findings by Prakash and Muniyandi (2014a) regarding climate-production relationships in jasmine cultivation.

Regional productivity comparison positioned Madurai district above state average, with current productivity of 9.26 tonnes ha^{-1} comparing favorably to Tamil Nadu s overall jasmine productivity of 9.14 tonnes ha^{-1} (Anonymous, 2024a). This superior performance reflected optimal climatic conditions, specialized cultivation techniques, and unique soil characteristics contributing to enhanced flower quality and yield, supporting previous observations regarding the influence of pruning practices on jasmine productivity (Lokhande *et al.*, 2016). Lokhande *et al.* (2016) specifically demonstrated that proper timing and severity of pruning significantly affected jasmine growth, flower yield, and quality, with optimal pruning practices resulting in improved flower production and enhanced commercial value.

Value chain analysis and marketing efficiency

Comprehensive value chain analysis identified four distinct marketing channels serving different market segments with varying efficiency levels, building upon previous value chain studies in the region (Selvanayaki *et al.*, 2022). Channel efficiency analysis using Shepherd s method revealed efficiency ratings ranging from 2.2 to 4.1, providing insights into marketing system performance and farmer welfare implications (Table 3).

Results showed that Channel 4 achieved highest efficiency rating of 4.1 through reduced intermediary layers and enhanced farmer price share, serving direct retail markets with optimal cost-benefit ratios. Channel 1 demonstrated moderate efficiency (3.6) serving local markets with reasonable farmer share. Channel 2 enabled value addition through concrete extraction for perfumery applications despite lower efficiency (2.7). Channel 3 showed lowest efficiency (2.2) due to complex export procedures and multiple intermediaries, though providing crucial foreign exchange earnings and market diversification opportunities.

Commission agent analysis revealed 11% deduction rates with 10-15 day credit periods enabling farmer cash flow management. This intermediary system provided essential marketing services including market access, quality grading, transportation, and payment security for small-scale farmers, justifying service charges despite efficiency impacts. Value addition activities in Nilakottai and Batlagundu focused on concrete extraction for perfumery industries, creating alternative market channels while generating employment opportunities beyond primary production. String making and garland preparation activities in Madurai provided additional value addition serving both domestic and export markets.

Export market performance and international trade

Export market analysis revealed active trade relationships with multiple countries including Dubai, Singapore, USA, Malaysia, and European markets (Table 4). Transit time documentation showed 24-hour delivery to Dubai and Singapore markets, 36-48 hours to USA and European destinations, enabling fresh flower delivery despite considerable distances.

Specialized packaging technologies included corrugated fiber board (CFB) boxes with butter paper lining for Dubai markets, aluminum foil lined cardboard boxes with thermocole and ice gel packs for USA shipments. These preservation methods enabled shelf life extension while maintaining flower quality during international transit.

Export volume trends indicated growing international demand, particularly from Middle Eastern and European markets seeking authentic Indian jasmine for religious, cultural, and commercial applications. The Geographical Indication (GI) tag awarded in 2013 enhanced market credibility while preventing adulteration and supporting premium pricing strategies (Anonymous, 2024a).

Post-harvest loss analysis identified 35-40% losses during transit as significant challenge impacting export profitability and market competitiveness (Table 6). These losses resulted from jasmine s delicate nature, short shelf life (24-36 hours without preservation), and transportation stress during long-distance movement.

Socio-economic impact assessment

Socio-economic impact assessment revealed jasmine cultivation s substantial contribution to rural development in Madurai district (Table 5). The sector supported over 500 farmers while providing employment to 160 laborers $acre^{-1}$ annually, creating significant economic multiplier effects benefiting broader rural communities, consistent with employment generation patterns documented by Kaviarasan *et al.* (2015).

Income analysis demonstrated jasmine s superior profitability compared to traditional crops including rice, cotton, and vegetables. Average sale prices ranged from ₹ 170-540 kg^{-1}, depending on quality and market channel, provided farmers with enhanced income opportunities representing 150-200% premium over conventional crops,

supporting previous economic analyses of jasmine cultivation profitability (Kaviarasan *et al.,* 2015). Kaviarasan *et al.* (2015) conducted comprehensive economic analysis of jasmine cultivation across Tamil Nadu, documenting cost-benefit ratios, input-output relationships, and comparative profitability with other horticultural crops, establishing jasmine as one of the most economically viable flower crops in the region. Similarly, comparative studies in citrus marketing have shown the importance of efficient marketing channels in maximizing farmer returns (Jadhav *et al.,* 2021), principles that apply equally to jasmine marketing systems.

Women s participation analysis revealed 46% female workforce contribution, providing economic empowerment opportunities while maintaining cultural traditions of women s involvement in jasmine-related activities. This gender-inclusive employment model supported household income diversification and women s economic independence.

Labor analysis revealed intensive requirements averaging 160 laborers acre^{-1} annually for harvesting operations, creating substantial employment opportunities with year-round availability through continuous flowering cycles. The sector s family-based operation model (85% of farms) enabled knowledge transfer across generations while maintaining cultural traditions.

Market demand analysis indicated domestic demand growth exceeding 25% annually, driven by increasing urbanization, rising disposable incomes, and growing awareness of natural products. This demand growth created favorable market conditions supporting continued industry expansion and farmer profitability.

Challenges and opportunities

Post-harvest loss analysis for the year 2024 identified 35-40% losses during transit as primary constraint limiting industry profitability and market competitiveness. These losses resulted from jasmine s perishable nature, inadequate cold chain infrastructure, and transportation delays affecting flower quality.

Climate variability impacts included temperature fluctuations, irregular rainfall patterns, and extreme weather events affecting flowering cycles and yield consistency, similar to challenges documented in other horticultural crops (Prakash and Muniyandi, 2014a). Prakash and Muniyandi (2014a) established significant relationships between jasmine production and rainfall patterns in Madurai district, documenting how climatic variations directly influence area expansion and production decisions. Their ARIMA forecasting model (Prakash and Muniyandi, 2014b) provided valuable insights into production prediction methodologies, enabling farmers and policymakers to make informed decisions based on historical production patterns and trends. Market access constraints included information asymmetries regarding price trends, quality requirements, and market opportunities affecting small-scale farmer participation in premium markets.

Growing global demand for natural products has created unprecedented opportunities for jasmine industry expansion, particularly given the increasing recognition of jasmine s therapeutic properties in cosmetic applications (Shah, 2024). International markets increasingly seek authentic, naturally produced flowers for aromatherapy, cosmetic, and pharmaceutical applications, positioning Madurai jasmine favorably for export growth.

Technology integration opportunities included precision agriculture techniques, post-harvest technology adoption, cold chain development, and digital marketing platforms connecting farmers directly with consumers. These technological interventions could improve productivity while reducing losses and enhancing market access, building upon successful integrated nutrient management approaches demonstrated in jasmine cultivation (Chopde *et al.*, 2017). The application of integrated plant nutrition systems, as demonstrated by Chopde *et al.* (2017), showed significant improvements in jasmine growth parameters, yield components, and flower quality through balanced fertilization strategies. Furthermore, the success of integrated nutrient management in related flower crops like tuberose (Patil and Meshram, 2020) provides a framework for optimizing jasmine cultivation practices in vertisol conditions similar to those found in parts of Madurai district.

This comprehensive analysis establishes jasmine cultivation in Madurai district as a economically viable and culturally significant agricultural enterprise that demonstrates exceptional growth potential while addressing contemporary rural development challenges. The findings across production dynamics, value chain efficiency, and socio-economic impacts provided empirical evidence for jasmine cultivation s role as a sustainable agricultural model with broader implications for floriculture development in Tamil Nadu.

The quantitative production analysis documented unprecedented growth trajectory over the 24-year study period, with cultivation area expanding from 952 hectares to 1,735 hectares (83% increase) and production volume increased from 7,643 tonnes to 16,077 tonnes (110% growth). The concurrent productivity enhancement of 15%, reaching 9.26 tonnes ha^{-1}, indicates successful implementation of intensification strategies alongside area expansion. The strong positive correlation ($r = 0.976$, $p < 0.01$) between cultivation area and production validates expansion-based growth approaches as the primary driver of sectoral development, consistent with forecasting models developed by Prakash and Muniyandi (2014b) for regional jasmine production planning.

Value chain efficiency analysis revealed significant variations across four distinct marketing channels, with efficiency ratings ranging from 2.2 to 4.1, confirming the importance of channel optimization for farmer welfare enhancement. Channel 4 s superior performance (efficiency rating 4.1) through reduced intermediary layers and enhanced farmer price share demonstrates the potential for

direct marketing approaches in improving producer returns, building upon value chain frameworks established by Selvanayaki *et al.* (2022). The identification of 35-40% post-harvest losses during transit represents a critical constraint requiring immediate technological intervention to enhance sector competitiveness and farmer profitability.

The socio-economic impact assessment confirms jasmine cultivation s had superior economic performance, generating 150-200% income premiums over traditional crops while creating substantial employment opportunities (80,000+ person-days annually) that particularly benefit women (46% workforce participation). These findings validate earlier economic analyses by Kaviarasan *et al.* (2015) regarding jasmine s comparative advantage in Tamil Nadu s agricultural landscape. The sector s support for over 500 predominantly small-scale farmers (< 2 acres) demonstrates its effectiveness as an inclusive rural development model that enhances livelihood security without requiring large capital investments.

Export market performance analysis reveals jasmine cultivation s had significant contribution to foreign exchange earnings through active trade relationships spanning Dubai, Singapore, USA, Malaysia, and European markets. The successful implementation of specialized packaging technologies enabling 24-48 hour international transit times, combined with GI tag recognition since 2013, positions Madurai jasmine competitively in global markets. The growing international recognition of jasmine s therapeutic properties in cosmetic and pharmaceutical applications (Al-Snafi, 2018; Shah, 2024) create additional value-addition opportunities beyond traditional ornamental uses.

The study identifies several critical areas requiring immediate attention for sustainable sector development. Post-harvest technology advancement emerges as the highest priority, given the substantial economic losses (35-40%) currently experienced during transit. Implementation of integrated nutrient management practices, as demonstrated by Chopde *et al.* (2017) in jasmine cultivation and Patil and Meshram (2020) in related flower crops, offers immediate opportunities for productivity enhancement. Additionally, the adoption of optimized pruning practices validated by Lokhande *et al.* (2016) could further improve flower yield and quality parameters.

Future research directions should focus on developing climate-resilient cultivation practices, advanced post-harvest preservation technologies, and digital marketing platforms that directly connect small-scale farmers with premium markets. The integration of precision agriculture techniques with traditional knowledge systems can accelerate modernization while preserving the cultural heritage that defines Madurai s jasmine industry. Policy interventions should prioritize cold chain infrastructure development, export facilitation measures, and farmer capacity building programs to capitalize on growing domestic demand (25%+ annual growth) and expanding international market opportunities.

The research establishes jasmine cultivation in Madurai district as a replicable model for sustainable agricultural development that successfully balances economic growth, cultural preservation, and inclusive rural development. The sector s demonstrated resilience, adaptability, and growth potential position it as a strategic component of Tamil Nadu s agricultural diversification and rural development initiatives, with significant implications for policy formulation and investment prioritization in the floriculture sector.

Table 1. Production dynamics and growth analysis (2000-2024)

Parameters	2000-2012 Average	2024 Current	Growth (%)	Unit
Cultivation area	952.08	1,735	+83%	Hectares
Total production	7,642.69	16,077	+110%	Tonnes
Productivity	8.03	9.26	+15%	Tonnes ha^{-1}
Active farmers	~300	500+	+67%	Numbers
Average farm size	<2	<2	Stable	Acres

Computed data

Table 2. Correlation analysis results

Variables	Correlation coefficient (r)	Significance level	Interpretation
Production vs Area	+0.976	$p < 0.01$	Highly significant
Production vs Rainfall	+0.535	$p < 0.10$	Moderate
Area vs Rainfall	+0.504	$p < 0.10$	Moderate

Computed data

Table 3. Value chain analysis and marketing efficiency

Channel	Marketing route	Efficiency rating	Farmers share	Market segment
Channel 1	Farmer---> Commission Agent --->			
	Local Trader---> Retailer ---> Consumer	3.6	High	Local markets
Channel 2	Farmer ---> Commission Agent --->			
	Processor ---> Perfume Industry	2.7	Medium	Industrial
Channel 3	Farmer---> Commission Agent --->			
	Exporter---> International Market	2.2	Low	Export
Channel 4	Farmer ---> Commission Agent --->			
	Retailer ---> Consumer	4.1	Highest	Direct retail

Source: Anonymous, Tamil Nadu State Agricultural Marketing Board (TNSAMB), 2024

Table 4. Export market analysis and performance

Destination	Transit time	Packaging method	Market status	Annual volume
Dubai	24 hours	CFB boxes with ventilation	Active	High
Singapore	24 hours	CFB boxes with ventilation	Active	Medium
USA	36-48 hours	Thermocole with ice gel packs	Active	Medium
Malaysia	24-36 hours	Standard export packaging	Active	Medium
London/France	36-48 hours	Special preservation methods	Growing	Low

Source: Anonymous, Tamil Nadu State Agricultural Marketing Board (TNSAMB), 2024

Table 5. Socio-economic impact

Economic indicator	Value	Unit	Impact level
Direct employment	80,000+	Person-days $year^{-1}$	High
Female employment share	46%	Percentage	Very high
Income premium over Traditional crops	150-200%	Percentage	High
Export earnings	[1] 50+ crores	Annual	Significant
Domestic market growth rate	25%+	Annual	High
Rural development contribution	Substantial	Qualitative	High

Computed data

Table 6. Post-harvest and quality parameters

Parameter	Value	Unit	Impact
Post-harvest losses	35-40%	Percentage	High economic loss
Shelf life (without preservation)	24-36	Hours	Critical constraint
Optimal harvesting window	5 AM - 8 AM	Daily	Quality control
Peak flowering season	March-April	Annual	Production planning
GI tag recognition	2024	Year	Quality assurance

Source: Anonymous, Statistical handbook of Tamil Nadu. Department of Economics and Statistics, Chennai (2024)

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