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Growth Prospects and Economics of Geographical Indication-Tagged Pineapple Cultivation in Vazhakulam, Kerala: An Analysis of Cost Structure, Market Volatility and Value Chain Constraints

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Abstract

Vazhakulam in Ernakulam district, Kerala, popularly termed the "Pineapple City," functions as Asia's largest pineapple market, handling nearly 80% of the state's pineapple trade and contributing over 10% of India's total production. Despite the premium positioning conferred by the Geographical Indication (GI) tag awarded to the Vazhakulam Mauritius variety in 2009, the sector faces acute economic instability, evidenced by an 80% decline in active farmers between 2021 and 2024 and extreme farm-gate price volatility. This study undertakes a descriptive-analytical examination of the growth trajectory and economics of pineapple cultivation in Vazhakulam using secondary data spanning 2021-22 to 2025-26. The analysis covers cost structure, price behaviour, varietal transition from Mauritius to MD2, export performance, value-addition potential, and marketing-channel preferences across farmer categories, tested using a chi-square test of independence. Results indicate that escalating planting-material costs, an 88–90% dependence on leased land, an under-developed processing base (below 15% of output against a 90% global benchmark), and acute export dependence on Gulf markets are the principal drivers of instability, compounded by a statistically significant association between farm size and marketing-channel choice ($\chi^2 = 25.87$, $df = 4$, $p < 0.05$). The study concludes that integrated interventions in price stabilisation, planting-material subsidy, processing infrastructure and tenurial security are necessary to sustain the GI brand and reverse farmer attrition.

Keywords: *Pineapple Economics, Geographical Indication, Vazhakulam, Value Chain, Price Volatility, MD2 Variety, Bromelain.*

Introduction

Pineapple (Ananas comosus) is among the most economically significant horticultural crops of Kerala, and Vazhakulam in Ernakulam district has emerged as the epicentre of its cultivation, trade and processing. Recognised as "Asia's largest pineapple market," Vazhakulam accounts for nearly 80% of Kerala's pineapple trade and over 10% of national production, with an annual market turnover exceeding ₹250 crore that sustains more than 5,000 farmers cultivating 12,000–13,000 hectares and supports the livelihoods of over four lakh people through cultivation, trading, transport and processing.

Commercial cultivation expanded from the 1980s, favoured by Vazhakulam's agro-climatic endowments — mean temperatures of 25–32°C, relative humidity above 75%, and well-drained laterite soils. These conditions produce the GI-tagged "Vazhakulam Pineapple," registered in 2009, distinguished by high total soluble solids (14–16° Brix), low acidity and residue-free cultivation. Kerala produces 3.25–

3.5 lakh tonnes annually, with Ernakulam contributing over half of state output. Cultivation economics have nonetheless become increasingly volatile: farm-gate prices that held near ₹58/kg for 12–18 months collapsed to ₹16–17/kg in 2026 amid demand contraction in North Indian markets, while the 2026 Middle East crisis — triggered by the closure of the Strait of Hormuz — halted Gulf-bound shipments that normally absorb 80% of exports, driving daily export volumes from 150 tonnes to zero.

Three structural shifts are widely regarded as pivotal to the sector's future: varietal upgradation from the short-shelf-life Mauritius variety to the globally dominant MD2 cultivar; strengthening of post-harvest and export infrastructure; and expansion of value addition, currently below 15% of output against a global processing average of 90%. Institutional actors — the Pineapple Research Station (PRS) Vazhakkulam, the Vazhakulam Agro and Fruit Processing Company (VAFPC), APEDA, NABARD, the Kerala Pineapple Mission, and private processors such as Manna Pineapples and Pineco Foods — provide a comparatively robust but fragmented support ecosystem. Given the scale of the market, the severity of recent price and export shocks, and the fragmentation of existing evidence, a consolidated economic analysis of the Vazhakulam pineapple value chain is warranted.

Accordingly, this study examines (i) the cost of cultivation and profitability of Mauritius and MD2 pineapple in Vazhakulam; (ii) the structure of marketing channels and the price spread received by farmers; (iii) the major constraints confronting farmers; and (iv) measures for improving farmer income and long-term sectoral growth.

Review of Literature

Studies on cultivation economics report that the cost of producing Mauritius pineapple in Vazhakulam ranges between ₹20–₹35 per kg, rising to ₹35/kg when temperatures exceed 33°C, and that inorganic fertiliser application yields the highest benefit-cost ratio (3.82) among tested nutrient regimes (Pineapple Research Station Vazhakkulam, 2024). Sectoral status assessments document that 88–90% of Ernakulam pineapple farmers cultivate on leased land, with rent constituting nearly a fifth of total cost, alongside pronounced farmer attrition (NABARD, 2023).

On market behaviour, trade-association data document farm-gate prices falling from a stable ₹58/kg to ₹16–17/kg in 2026 amid demand contraction in northern markets (All Kerala Pineapple Merchants Association, 2024), while news reports corroborate the collapse of Gulf-bound shipments following the Strait of Hormuz closure and confirm that the producer's share of the consumer rupee is only around 55% (Times of India, 2026; APEDA, 2024). Varietal studies report that MD2 offers 92% higher fruit weight and 67% longer shelf life than Mauritius and dominates roughly three-quarters of global fresh pineapple trade, though its adoption in Kerala remains constrained by the high cost of tissue-culture planting material and limited multiplication capacity at PRS (The Economic Times, 2024).

On processing and nutraceutical potential, a project report prepared with CSIR-NIIST establishes the technical feasibility of Bromelain extraction from pineapple waste at VAFPC, though working-capital constraints have delayed commercialisation (CSIR-NIIST, 2022). International nutrition research confirms pineapple's immunomodulatory, anti-inflammatory and antioxidant properties, and school-feeding trials associate canned pineapple consumption with measurable improvements in nutritional and health status among children (Hossain, 2016; Sripakdee et al., 2015).

Collectively, this literature addresses cost structures, price volatility, varietal economics and processing potential largely in isolation. No study has integrated cultivation economics, marketing-channel efficiency, and statistically tested constraint patterns for Vazhakulam in the aftermath of the 2026 price crash and export disruption. The present study addresses this gap by combining time-series secondary data across these dimensions and applying a chi-square test to examine the association between farm size and marketing channel choice — an analytical linkage largely absent from earlier sector reports.

Materials and Methods

- **Research Design**

The study adopts a descriptive-analytical design based exclusively on secondary data to ensure objectivity and reliance on authenticated sources. The quantitative component analyses time-series data on area, production, productivity, cost of cultivation, farm-gate prices, price spread, export volumes and benefit-cost ratios for 2021-22 to 2025-26, with particular focus on 2023-24 to 2025-26 to capture the effects of the 2026 Middle East export crisis, monsoon-linked price crashes, and MD2 adoption. The

qualitative component interprets structural constraints and institutional interventions from documented reports and case studies.

- **Sources of Data**

No primary field survey was conducted. Data were compiled from institutional and government publications (PRS Vazhakkulam/KAU, NABARD, APEDA, Kerala State Planning Board, DASD, VAFPC, CSIR-NIIST, PMFME-MoFPI); market and industry sources (Merchants Association bulletins, Manna Pineapples and Pineco Foods profiles); news reports (Times of India, The Economic Times, The Hindu Business Line, Mathrubhumi); and peer-reviewed journals (Hossain, 2016; Sripakdee et al., 2015).

- **Sampling, Reliability and Validity**

As the study relies solely on documentary secondary data, "sampling" refers to the purposive selection of source documents rather than respondents. Sources were selected on three criteria: authenticity (government, university or registered institutional origin), relevance (data specific to Vazhakulam rather than aggregated state-level figures), and recency (publication up to June 2026). Reliability was ensured by restricting data primarily to official institutional sources, with news media used only to corroborate discrete events such as export disruptions or price crashes. Content validity was established by cross-verifying each key statistic — production, price, cost, export volume — across at least three independent sources; where figures diverged, the most recent government publication was adopted.

- **Analytical Framework**

Cost-return analysis follows the standard Cost A1/A2, Cost B and Cost C concepts to derive gross returns, net returns and benefit-cost (B:C) ratios. Price behaviour is summarised using the coefficient of variation (CV). A chi-square (χ^2) test of independence, with expected frequencies computed as E_{ij} = (row total × column total)/grand total, is applied to examine whether farmer category (small, medium, large) is associated with preferred marketing channel (direct export, local traders, processing units), at the 5% level of significance with degrees of freedom $(r-1)(c-1)$.

Results and Discussion

- **Farmer Participation and Attrition**

Farmer participation in Vazhakulam pineapple cultivation has contracted sharply. Of the 5,000-plus farmers dependent on the crop in 2021, only around 1,000 (20%) remained active by 2024, representing roughly 80% attrition, with small farmers exiting at a higher rate (60%) than large farmers (50%). Average landholding stands at about 3.6 hectares, and roughly 90% of cultivated area is on leased land, indicating that tenurial insecurity compounds the effect of price volatility in driving exit from the sector.

Table 1: Farmer Participation, 2021 and 2024

Category	Value	Share of 2021 base
Total dependent farmers, 2021	5,000+	100%
Farmers currently active, 2024	1,000	20%
Farmers who exited, 2021–2024	4,000	80%
Small farmers who exited	—	60%
Large farmers who exited	—	50%
Average landholding	3.6 ha	—

Source: All Kerala Pineapple Merchants Association (2024); NABARD, Status of Pineapple Sector in Kerala (2023).

- **Area, Production and Yield Trends**

Reported area under cultivation shows extreme inter-source volatility (CV of approximately 42%), ranging from roughly 20,000 to 57,000 acres across estimates for 2023–2025, reflecting both genuine contraction and inconsistent agency reporting. Production recovered at an estimated 11% CAGR after a flood-related trough in 2019-20, reaching approximately 5.4–5.5 lakh tonnes by 2023-25; lower production volatility (CV of about 24%) suggests yield gains have partly buffered area contraction. Even so, Kerala's average productivity of roughly 15 tonnes/hectare remains only about a quarter of the 58 tonnes/hectare potential demonstrated at PRS Vazhakkulam, and well below Karnataka's nearly 66 tonnes/hectare, indicating recent output growth has been driven by area rather than productivity.

Table 2: Cost of Cultivation of Mauritius Pineapple per Hectare

Cost component	Amount (₹)	Share (%)
Seedlings/suckers	1,72,784	47.58
Human labour	83,527	23.00
Manure and fertilisers	50,884	14.01
Machine labour	43,061	11.86
Other costs	13,022	3.59
Total	3,63,278	100.00

Source: Pineapple Research Station Vazhakkulam, Kerala Agricultural University, Annual Report and Economic Analysis of Mauritius Pineapple Cultivation (2024).

- **Cost Structure and Profitability**

Table 2 shows that planting material (seedlings/suckers) alone accounts for 47.6% of total cultivation cost per hectare (₹1,72,784 of ₹3,63,278), making it the single largest entry barrier for new and re-entering farmers; the high cross-farm variability in cost (CV of roughly 84%) reflects differing dependence on purchased versus farm-retained planting material. At prevailing 2026 farm-gate prices of ₹16–17/kg, cultivation at an estimated cost of about ₹6.25 lakh/hectare against gross revenue of roughly ₹4.99 lakh/hectare implies a net loss of approximately ₹1.26 lakh/hectare, with the government support price of ₹15/kg remaining 40% below the estimated cost of production. This cost-price mismatch is the proximate economic driver of the farmer attrition documented in Section 4.1.

- **Price Volatility and Marketing Margins**

Farm-gate prices fluctuated between approximately ₹5/kg and ₹65/kg over 2024–2026, yielding a CV of about 51%, among the highest reported for any Indian horticultural commodity. Two shocks compounded this volatility: monsoon-related demand contraction in Delhi and Mumbai, which produced roughly 40% price declines in earlier seasons, and the 2026 Strait of Hormuz closure, which halted Gulf-bound exports (normally 150 tonnes/day, 80% of total exports) entirely. Intermediary margins remain substantial: traders reportedly charge 8–10% commission, and the producer's share of the consumer rupee is estimated at only about 55%, with farm-gate realisations of ₹15–20/kg against retail prices of ₹80–120/kg.

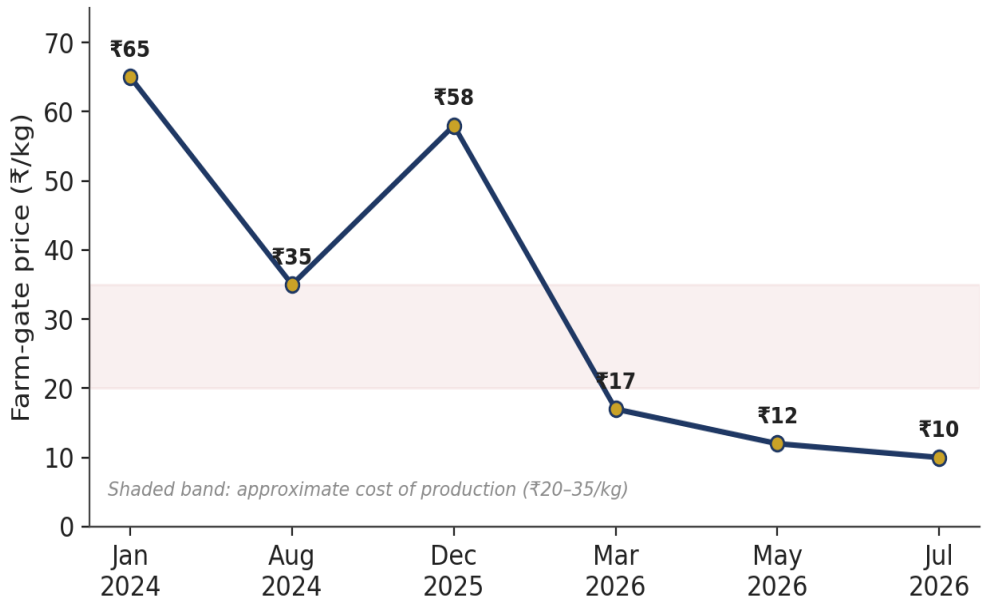

Figure 3: Farm-Gate Price Movement, January 2024 – July 2026

Source: All Kerala Pineapple Merchants Association, daily price bulletins (2024–2026); Mathrubhumi Daily (2024, 2025, 2026); The Hindu Business Line (2026).

- **Varietal Transition: Mauritius to MD2**

Field trials indicate MD2 offers approximately 92% higher fruit weight and 67% longer shelf life (about 17 days versus 10 for Mauritius), with higher plant density per acre and lower processing loss, consistent with its dominance of roughly three-quarters of global fresh pineapple trade. However, of an estimated 30,000 MD2 suckers planted, only about 13,000 (65%) survived, and tissue-culture planting material (₹40/piece, implying an initial investment of roughly ₹1.2 lakh/acre) remains prohibitive for smallholders. Estimated B:C ratios of approximately 1.44 for MD2 against 1.10 for Mauritius suggest superior long-run profitability, but adoption remains below one-fifth of trial plantings, constrained by planting-material cost and PRS Vazhakkulam's limited multiplication capacity.

Table 3: India's Pineapple Export Performance, 2022–2024

Year	Volume (kg)	Value (US$)	Unit value (US$/kg)
2022	68,93,726	43,54,399	0.63
2023	73,96,729	43,58,321	0.59
2024	90,61,350	59,41,840	0.66

Source: APEDA, Agri Exchange Export-Import Data Bank (2024).

- **Export Performance and Global Competitiveness**

As shown in Table 3, India's pineapple export volume grew by about 22.5% and value by 36.3% in 2024, with the Maldives, Nepal and the UAE together accounting for over 60% of export value. Despite this growth, India's global export share remains marginal at approximately 0.2% of world trade value, against Costa Rica's roughly 50% share built on large-scale MD2 cultivation. The 2026 Gulf-market disruption, which alone absorbed 80% of Kerala's exports, thus exposed a structural over-concentration of the export base in a small number of destinations, underscoring the need for market diversification alongside the varietal transition discussed above.

- **Value Addition and Processing Potential**

Less than 15% of Vazhakulam's pineapple output is processed, against a global benchmark of roughly 90%, resulting in an estimated 25,000 tonnes of post-harvest wastage during glut periods. VAFPC, with 51% government and 30% farmer equity, has commercialised limited product lines (the "JIVE" fruit drink and fruit pulp) but continues to face working-capital constraints that delay two DPR-ready initiatives prepared with CSIR-NIIST — Bromelain extraction for nutraceutical and pharmaceutical use, and leaf-based biodegradable cutlery. Nutritional analysis indicates that pineapple provides substantial Vitamin C (about 80% of RDI per 100g) and manganese (109% of RDI), together with Bromelain, a proteolytic enzyme documented in the pharmacological literature to have anti-inflammatory, antimicrobial and wound-healing properties, reinforcing the commercial rationale for expanding processing capacity beyond fresh-fruit trade.

Table 4: Nutritional and Bioactive Profile of Pineapple (per 100 g, indicative)

Parameter	Value	Associated benefit
Energy	50 kcal	Low-calorie fruit
Vitamin C	47.8 mg (≈80% RDI)	Immunity, antioxidant, collagen synthesis
Manganese	≈109% RDI	Bone health, metabolism
Bromelain	2–40 mg	Anti-inflammatory, wound healing, immunity
Dietary fibre	1.4 g	Digestive health

Source: Hossain (2016), International Journal of Nutrition and Food Sciences; Sripakdee et al. (2015), Journal of Medicinal Food.

Table 5: Chi-Square Test: Farmer Category and Marketing Channel Preference

Farmer category	Direct export (O/E)	Local traders (O/E)	Processing units (O/E)	Total
Small (<2 acres)	5 / 13.45	25 / 16.36	10 / 10.18	40
Medium (2–5 acres)	12 / 13.45	15 / 16.36	13 / 10.18	40
Large (>5 acres)	20 / 10.09	5 / 12.27	5 / 7.64	30
Total	37	45	28	110

Source: Computed by the author from marketing-channel distribution data reported in Chapter 4 of the underlying project report (2024–2026).

- **Association between Farmer Category and Marketing Channel**

To examine whether channel choice is systematically related to farm size, a chi-square test of independence was applied to observed and expected frequencies of marketing-channel preference across small, medium and large farmer categories (Table 5). The null hypothesis (H_0) stated that farmer category is independent of marketing channel preference; the alternative hypothesis (H_1) stated that the two variables are associated. The calculated chi-square statistic ($\chi 2 = \sum(O-E)^2/E$) was 25.87 against a critical value of 9.488 at 4 degrees of freedom and $\alpha = 0.05$. Since the calculated value exceeds the critical value, H_0 is rejected: farmer category is significantly associated with marketing channel preference.

Large farmers accessed direct export channels at 66.7% of their transactions, more than double the 33.6% expected under independence, while small farmers relied on local traders for 62.5% of sales against an expected 40.9%, and medium farmers showed the highest relative use of processing units. This pattern indicates that landholding size and associated resource capacity — rather than crop quality or GI certification alone — determine farmers' ability to bypass intermediaries and capture higher-value marketing channels, reinforcing the income disparity implicit in the cost and price findings above.

Conclusion

This study establishes that Vazhakulam retains the distinctiveness conferred by its GI-tagged, residue-free Mauritius variety, yet the underlying economics of cultivation remain acutely unstable. Extreme price volatility (CV of approximately 51%), a cost-price mismatch producing losses of roughly ₹1.26 lakh per hectare at prevailing prices, an 80–90% dependence on leased land, and an underdeveloped processing base collectively explain the roughly 80% contraction in active farmer participation since 2021. The 2026 Middle East export crisis further demonstrated the structural fragility created by over-concentration in Gulf markets. The statistically significant association between farm size and marketing-channel access ($\chi^2 = 25.87$, $p < 0.05$) indicates that market information and resource asymmetries, rather than crop quality, disproportionately constrain smallholders. While MD2 offers demonstrably superior yield, shelf life and benefit-cost characteristics relative to Mauritius, its adoption remains limited by planting-material cost and multiplication capacity. Without coordinated intervention in price stabilisation, tenurial security, planting-material subsidy and processing-infrastructure expansion, the erosion of Vazhakulam's farmer base is likely to continue despite the sector's export and nutraceutical potential.

Policy Recommendations

Based on the findings, the study recommends: (i) revising the minimum support price closer to actual production cost plus a reasonable margin, supported by an Operation Greens-style procurement mechanism during gluts; (ii) subsidising MD2 tissue-culture material and expanding multiplication capacity at PRS Vazhakkulam; (iii) tenurial reforms granting leased-land cultivators medium-term security to enable long-term investment; (iv) expanding APEDA pack-house and cold-chain capacity to match peak-season arrivals; (v) providing working capital to VAFPC to operationalise DPR-ready Bromelain-extraction initiatives with CSIR-NIIST; (vi) supporting FPO-based collective marketing and PMFME-linked micro-processing units; and (vii) diversifying export markets beyond the Gulf region to reduce geopolitical exposure. Collectively, these measures would help translate Vazhakulam's GI status and agro-climatic advantages into stable, equitable farmer incomes.

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