The ST25 Paradox: An Analysis of Domestic Market Access Chaos and Brand Dilution Following Global Acclaim

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1 Introduction

1.1 Background of ST25 Rice

ST25 rice, a fragrant variety cultivated in Vietnam's Mekong Delta, particularly in Soc Trang Province, garnered international acclaim by winning the "World's Best Rice" award in both 2019 and 2023 ("Metric ST25 Rice", n.d.; "TECHPAL Group harvested 40 hectares of ST25 rice cultivated in cooperatives in Tran De." 2024). Its superior qualities, including fragrance and softness, positioned it as a premium agricultural product ("Metric ST25 Rice", n.d.). This global recognition presented a significant opportunity for Vietnam's rice sector to enhance its market presence and command higher value.

1.2 The Rise to Global Acclaim and the Emergence of a Paradox

The international awards brought considerable prestige and opened doors for enhanced market access. Such acclaim typically signifies a product's readiness to command premium prices and establish strong market positions, both domestically and internationally. Indeed, ST25 rice, as a premium segment, commands prices nearly 2.5 times higher than medium-quality rice in the domestic market (Bui et al., 2023). Its export market expanded from just two countries to 11 markets by 2021, including Germany, Russia, Belgium, Canada, France, Australia, and the UK, with export prices fluctuating between USD 870 - 1,378/ton (K. Nguyen, 2021). Vietnam itself has solidified its position among the top three global rice exporters, with 80% of its exports comprising premium-grade, high-value varieties ("ANNUAL REPORT Trung An - The Leading Bird and the mission of sustainable agricultural development", 2023; Bui et al., 2023). However, this international success has coincided with a concerning phenomenon: a "paradox" where global acclaim does not translate into stable, well-organized, or accessible domestic market performance. Instead, ST25 rice appears to navigate a complex and often chaotic domestic landscape, leading to inconsistent availability, rampant counterfeiting, and questions about its brand integrity. Despite its celebrated status, the domestic market access remains challenging, fostering brand dilution and an inability to fully capitalize on its global recognition.

1.3 Research Questions and Objectives

This research aims to analyze the underlying economic and market dynamics contributing to this "ST25 Paradox." Specifically, this study will investigate:

1. What are the key economic factors contributing to the observed domestic market access chaos for ST25 rice, hindering its widespread availability despite global recognition?

2. How do prevalent fraudulent activities and inherent supply chain inefficiencies affect ST25 rice's brand integrity, consumer trust, and profitability?

3. What are the economic consequences of brand dilution and market chaos for ST25 producers and the broader Vietnamese rice industry?

4. What theoretically grounded strategies and policy interventions can mitigate these challenges to foster sustainable market development for premium agricultural brands?

1.4 Significance of the Study

This study offers a rigorous economic and mathematical analysis of a globally acclaimed agricultural product's struggle in its domestic market. By focusing on the negative facets of the ST25 phenomenon, it provides critical insights into the challenges of brand management, market governance, and supply chain resilience in developing economies. The findings will be invaluable for policymakers, producers, and researchers seeking to understand and address the complexities of transforming agricultural innovation into sustainable market success.

2 Literature Review

2.0.1 Brand Management in Agricultural Products and the Challenge of Credence Attributes

Brand management in agricultural products faces unique challenges, distinct from industrial goods. Agricultural products are often credence-based, meaning consumers find it difficult to evaluate quality attributes before or even after purchase (Manning & Kowalska, 2021). This reliance on institutional trust makes such products particularly vulnerable to fraud, where conventional products are intentionally mislabeled as premium (Manning & Kowalska, 2021). The sustainable development of agricultural brands hinges on information credibility and experiential consistency, with trust erosion being a recurring issue in markets with insufficient supply capacity or experiential gaps (X. Liu et al., 2025). Damage to a brand's reputation and trust, economic losses, and even public health risks are serious effects of deceitful activities (Maritano et al., 2024). Therefore, anti-counterfeiting technologies are crucial for brand protection in high-value food products (Maritano et al., 2024).

2.1 Challenges of Domestic Market Access for Globally Recognized Brands

Even globally recognized brands can face significant hurdles in their domestic markets. These can include fragmented distribution channels, intense local competition, and an inability to effectively communicate value to diverse consumer segments. In developing countries, issues such

as poor infrastructure, price fluctuations, inadequate storage, and inefficient pricing contribute to weak marketing systems for agricultural products (Aiyedun et al., 2021). Additionally, the lack of well-functioning markets and high transaction costs can deter small farmers from integrating into competitive markets (Pingali et al., 2019). In some regions, local products struggle to compete with imports on urban markets when consumers prefer characteristics of imported goods (Demont et al., 2017). High marketing costs due to lower economies of scale, high transport costs, and numerous profit-seeking players can also lead to high domestic prices and reduced competitiveness (Mataia et al., 2020).

2.2 The Paradox of Success: International Acclaim vs. Domestic Market Stability

The ST25 paradox exemplifies a situation where international success does not automatically translate into stable or well-organized domestic market performance. This disconnect can arise from factors such as limited domestic marketing, inadequate brand protection, or complex intermediary systems that obscure the authentic product. Research on agricultural branding in China shows a cycle of "sloganizationover-marketingtrust erosion" due to insufficient supply and experiential gaps (X. Liu et al., 2025). This highlights that while initial recognition is vital, sustained brand equity requires robust governance mechanisms grounded in information credibility (X. Liu et al., 2025). Effective brand protection is crucial, as collective reputation can be likened to a common property resource, susceptible to "milking" if access is unrestricted (Winfree & McCluskey, 2005).

2.3 Theoretical Frameworks for Brand Dilution and Market Chaos

Brand dilution occurs when the distinctiveness or positive associations of a brand are weakened. In agricultural markets, this can be exacerbated by food fraud, which refers to intentional misrepresentation for economic gain, such as adulteration and mislabeling (Giannakas & Yiannaka, 2023; Meerza et al., 2019). Food fraud not only causes direct economic losses to consumers and producers but also severely undermines consumer confidence and trust in the food sector (Yiannaka, 2023). Incorrect price information, especially regarding quality, can lead to market distortions and inefficiency (Hudson et al., 1998). Market chaos, characterized by unpredictable price fluctuations and inefficient resource allocation, can emerge from complex supply chains, asymmetric information, and weak monitoring systems that enable fraudulent activities (Giannakas & Yiannaka, 2023). New theoretical models suggest brand dilution is not merely an unfortunate consequence of poor brand extension but can be a complex outcome influenced by various market dynamics (Bacchiega et al., 2023).

3 Methodology

3.1 Research Design

This study will employ a rigorous mixed-methods research design, combining quantitative economic modeling and statistical analysis with qualitative insights. The approach allows for both empirical testing of theoretical hypotheses and a deeper understanding of the contextual factors driving the ST25 paradox. The primary focus period will be from 2019 to the present, tracing the product's market journey.

3.1.1 Data Collection Methods

For this study, obtaining precise, granular, and consistently reported time-series data for ST25 rice across various metrics is critical but challenging from academic sources alone. To move beyond the valuable summary tables and illustrative examples already available, robust quantitative data is essential for the proposed mathematical models.

- Quantitative Data: To robustly populate the analytical models and tables, specific numerical data would need to be acquired from primary data providers such as:

  - Vietnamese government agencies.
  - Industry associations.
  - International organizations.
  - Specialized market research firms, and specific research studies on ST25 and other premium Vietnamese rice varieties. This includes detailed time-series data on ST25 production volume, domestic and export sales, farm-gate, wholesale, and retail prices, cost breakdowns for the supply chain, and incidents of fraud or counterfeiting. Data on trade costs and non-tariff barriers for rice exports would also be crucial. Many such sources have now been provided as PDFs within the user's library.

- Qualitative Data: Semi-structured interviews with key stakeholdersincluding ST25 farmers, millers, traders, retailers, government officials, and intellectual property expertswill provide contextual understanding of market dynamics, perceptions of fraud, and the efficacy of current policies. This qualitative data will be critical for interpreting model results and formulating practical recommendations.

3.2 Data Analysis and Mathematical Modeling

This core section integrates advanced economic theories and mathematical models to analyze the ST25 paradox rigorously.

1. Economic Theories and Analytical Frameworks The research will be grounded in several economic theories to provide a robust analytical framework:

   - Dynamic Market Equilibrium: To analyze the "disappearance" of ST25 rice, we adapt the fundamental supply and demand model. Shifts in equilibrium price and quantity will be used to demonstrate the impact of factors like increased production costs or reduced effective demand due to brand dilution.

$$Q_s = \alpha + \beta P$$

$$Q_d = \gamma - \delta P$$

Where Q_s is quantity supplied, Q_d is quantity demanded, P is price, and $\alpha, \beta, \gamma, \delta$ are parameters.The equilibrium price P^* and quantity Q^* are determined by:

$$P^* = \frac{\gamma - \alpha}{\beta + \delta}, \quad Q^* = \frac{\beta\gamma + \alpha\delta}{\beta + \delta}$$

This model helps simulate how an increase in production costs (reducing α) or a decrease in domestic demand (reducing γ) can explain market outcomes for ST25. For instance, if brand dilution leads to decreased consumer willingness to pay, it shifts the demand curve inward, impacting both P^* and Q^*

- Behavioral Economics in Agriculture: This framework explores how psychological factors, especially risk and uncertainty, influence farmers' decisions, which is crucial given the market's instability and potential for side-selling or contract-breaking ("Metric ST25 Rice", n.d.). Rather than Expected Utility Theory, Cumulative Prospect Theory often provides a better fit for farmers' risk attitudes, revealing that they are often risk-averse, loss-averse, and overweight small probabilities (Finger et al., 2023). Adverse experiences can increase risk and loss aversion, leading farmers to demand higher risk premiums or opt for less risky, non-premium crops (Hakim & Sun, 2025). A utility function incorporating risk preferences can be adapted from CPT:

$$U(C,R) = w(p) \cdot v(x)S$$

  Where U is the utility, $w(p)$ is the probability weighting function, and $v(x)$ is the value function, and R represents the reference point. This model can explain why farmers might limit ST25 cultivation, despite its premium price potential, if perceived market risks outweigh potential gains, thereby affecting the supply side.

- Transaction Cost Economics: Drawing from Williamson, TCE analyzes the governance structures within the ST25 value chain. High transaction costs, stemming from a lack of stable contracts and ineffective brand protection, can hinder efficient market operations and foster opportunistic behaviors like "side-selling" (Pingali et al., 2019). Such costs include searching for reliable partners, contract negotiation, monitoring quality, and enforcing intellectual property rights against counterfeiting (Cua, 2024).The expected profit (Π) can be modeled as:

$$\Pi = P_e Q - (C_p + C_t + C_m + T)$$

  Where P_e is the effective selling price, Q is quantity, C_p is production cost, C_t is transport cost, C_m is marketing cost, and T represents transaction costs. High T directly reduces profit margins, potentially leading producers to withdraw from the ST25 market or opt for more stable alternatives. This aligns with the understanding that transactions in developing country value chains are often based on implicit, self-enforcing contracts due to weak third-party enforcement (de Brauw & Bulte, 2021). Furthermore, unequal bargaining power in contract farming arrangements can create asymmetric power relationships, with large agribusiness firms often dictating terms, leading to farmers having limited flexibility and potentially locking them into disadvantageous relationships (Singh et al., 2025).

2. Mathematical Models for Analysis and Optimization

- Supply Chain Cost Function for Bottleneck Analysis: A detailed cost function will identify specific bottlenecks in the ST25 supply chain by disaggregating costs at each stage. This reveals where inefficiencies or excessive markups occur, contributing to inflated retail prices or reduced availability.

$$C_{total} = C_p + C_t + C_m + C_{int} + C_b$$

Where:

  - C_{total} = Total cost from farm to market.

- C_p = Production costs ("Metric ST25 Rice", n.d.).
- C_t = Transportation costs ("Metric ST25 Rice", n.d.).
- C_m = Marketing and branding costs.
- C_{int} = Intermediary costs and margins ("Metric ST25 Rice", n.d.).
- C_b = Border costs. Analyzing these components will pinpoint specific bottlenecks that contribute to high marketing costs and inefficient distribution, as observed in other rice value chains (Saptana et al., 2024). Optimization frameworks for tracking multiple quality attributes in perishable supply chains can also be integrated here (Khazaeli et al., 2024).

Risk Assessment Model using Structural Equation Modeling: SEM will assess the complex interplay of market variables affecting ST25's viability and brand integrity. This approach models direct and indirect effects among latent and observed variables, disentangling complex causal relationships.

$$M_i = \alpha_0 + \alpha_1 P_i + \alpha_2 C_i + \alpha_3 D_i + \alpha_4 F_i + \alpha_5 Q_i + \epsilon_i$$

Where:

- M_i = Market viability for ST25 rice.
- P_i = Price volatility in market i.
- C_i = Cost of production/supply chain cost in region i.
- D_i = Distribution channel efficiency.
- F_i = Fraud and counterfeiting prevalence, potentially measured by incidence rates or consumer survey data on perceived fraud (liwiska-Bartel et al., 2021). This includes the "disconcerting prevalence of alternative rice cultivars parading as 'ST25 rice'" (Bui et al., 2023).
- Q_i = Perceived quality and brand recognition.
- ϵ_i = Error term.This model quantifies how factors like price volatility, high costs, inefficient distribution, and especially fraud (F_i) undermine ST25's market viability, even with high inherent quality (Q_i).

Supply Chain Optimization using Bi-level Programming: This advanced optimization technique addresses hierarchical decision-making in agricultural value chains. It models the strategic interaction where lower-level decision-makers react optimally to upper-level decisions.

$$\min_{x,y} G(x,y) \quad \text{subject to } y \in \arg\min_z f(x,z)$$

Where:

- x = Government policy variables (e.g., subsidies for quality control, IP enforcement, infrastructure investment in cold chain logistics or warehousing (Zheng & Lv, 2025)).
- y = Farmer/producer decision variables.
- $G(x,y)$ = Upper-level objective.
- $f(x,z)$ = Lower-level objective.This model helps design government interventions that align incentives across the supply chain, enhancing efficiency and market stability. Integrating freshness and greenness concerns (Tan et al., 2020) or prioritizing freshness at sale (Esteso et al., 2024) can also be incorporated as objectives.

- Econometrics of Quality Premiums: Hedonic Price Modeling: This model statistically decomposes the price of ST25 rice into its constituent characteristics. It quantifies the market value of ST25's premium attributes and assesses whether the market adequately rewards its quality, or if brand dilution is eroding this premium.

$$P_{rice} = \beta_0 + \sum_{j=1}^{n} \beta_j X_j + \epsilon$$

Where P_{rice} is the observed market price, X_j is a vector of quality attributes (e.g., presence of Global GAP certification, geographical indication status, specific aroma compounds, lab-verified purity using FTIR or ICP-MS techniques for origin authentication (Bui et al., 2023)), and β_j represents the implicit price or marginal contribution of each attribute. This identifies which characteristics command a premium and if ST25 is capturing them effectively in both domestic and export markets.

- Market Access and Gravity Model: The Gravity Model, typically used for international trade, analyzes factors affecting ST25's market access internationally and domestically. It posits that trade volume is proportional to economic sizes and inversely proportional to "distance" (Balogh & Aguiar, 2022).

$$X_{ij} = G \cdot \frac{Y_i^{\alpha} Y_j^{\beta}}{D_{ij}^{\gamma}}$$

Where X_{ij} is the trade volume from origin i to destination j, Y_i, Y_j are economic sizes, and D_{ij} is a measure of "distance" or trade cost. If ST25 faces high branding and logistics costs or regulatory barriers, the effective D_{ij} increases, reducing trade volumes (Zongo, 2021). This model helps to quantify the impact of "behind the border" trade costs (Sanjuán et al., 2017).

- Elasticity & Comparative Advantage: Estimating the price and income elasticity of demand for ST25 rice is vital. If demand is price-elastic ($|E_d| > 1$), small price increases can lead to significant drops in market share. If inelastic ($|E_d| < 1$), there is more room for price adjustments.

$$E_d = \frac{\%\Delta Q_d}{\%\Delta P}$$

$$E_i = \frac{\%\Delta Q_d}{\%\Delta I}$$

Where E_d is price elasticity of demand and E_i is income elasticity of demand. These elasticities inform pricing strategies and reveal demand sensitivity to economic conditions and competitor pricing. This analysis, combined with comparative advantage, clarifies ST25's competitive position against other premium varieties globally and domestically.

- Network Analysis of Supply Chains: Representing the ST25 supply chain as a network allows for graph theory metrics to identify critical nodes, bottlenecks, and vulnerabilities. This provides a quantitative understanding of "fragmented land ownership and the prevalent intermediary system" (T. C. V. Nguyen et al., 2023) and "weak linkages" in the supply chain (Hien & Kim, 2024). This can help map out the flow of both authentic and potentially fraudulent products.

- Agent-Based Modeling for Market Dynamics: ABM simulates interactions of autonomous agents to understand emergent system-level phenomena. This approach models complex, adaptive behaviors leading to market chaos and brand dilution. - Application: ABM can simulate various policy interventions (e.g., increased fraud detection using technologies like low-cost digital sensing devices and machine learning (Y. Liu et al., 2020), subsidies for quality control, IP enforcement) and observe their emergent effects on ST25 production, pricing, and market penetration, capturing adaptive behaviors that static models miss. This provides insights into how traditional agricultural transaction methods and power imbalances contribute to challenges (Anh & Bokelmann, 2019).

- Stochastic Optimization for Yield and Price Uncertainty: Given inherent uncertainties in agricultural production (e.g., climate change impacts like drought and saltwater intrusion in Mekong Delta ("ANNUAL REPORT Trung An - The Leading Bird and the mission of sustainable agricultural development", 2023)) and volatile market prices, stochastic optimization develops robust strategies for ST25 production and supply chain management. This involves optimizing decisions under uncertainty, accounting for probability distributions of uncertain parameters.

$$\min_x E[\text{Cost}(x, \tilde{y}, \tilde{p})]$$

subject to constraints related to production capacity, quality, and demand, where x are decisions, $\tilde{y}$ is uncertain yield, and $\tilde{p}$ is uncertain price. This helps design resilient strategies against price volatility and ensure optimal resource allocation under environmental and market risks.

3. Model Validation Rigorous validation will be conducted for each model:

- Out-of-Sample Validation: Testing predictions against new data.

- Sensitivity Analysis: Varying inputs to assess output robustness.

- Expert Elicitation/Validation: Seeking feedback from experts for assumptions and consistency.

3.3 Ethical Considerations

Research involving agricultural value chains, particularly those with significant socio-economic impacts, necessitates a thorough ethical framework to ensure responsible data collection, analysis, and policy recommendations (Muflikh et al., 2021). This includes safeguarding the privacy of farmers and producers, ensuring data transparency, and mitigating potential biases in model development and interpretation. Furthermore, particular attention must be paid to the potential for unintended consequences arising from policy recommendations, especially those that could exacerbate existing inequalities or disrupt traditional livelihoods within the ST25 rice ecosystem. The ethical framework extends to considering the potential for global price volatility and its disproportionate impact on local farmers and consumers (Shobur et al., 2024).

3.4 Limitations of the Study

The complex interplay of global market forces and localized agricultural practices, coupled with the absence of comprehensive longitudinal data specific to ST25 rice from publicly available sources,

presents inherent limitations in fully isolating causality for brand dilution. Many data points may rely on estimations or proxies. The generalizability of findings may also be limited by the unique context of ST25 within Vietnam, though lessons can be drawn for other premium agricultural products.

4 The ST25 Phenomenon: A Case Study

4.1 The Journey to Global Recognition

ST25 rice achieved global acclaim, winning the "World's Best Rice" award in 2019 and 2023 ("Metric ST25 Rice", n.d.; "TECHPAL Group harvested 40 hectares of ST25 rice cultivated in cooperatives in Tran De." 2024). This recognition was based on its superior quality attributes: fragrance and softness ("Metric ST25 Rice", n.d.). This established its status as a premium product, propelling its prominence both within domestic and global realms (Bui et al., 2023). The brand's presence in international markets is asserting itself, further elevating Vietnams rice industry ("ANNUAL REPORT Trung An - The Leading Bird and the mission of sustainable agricultural development", 2023).

4.2 Domestic Market Entry and Expansion Strategies

Following global recognition, the domestic market for ST25 rice experienced a surge in interest. However, its initial market penetration was limited, with negligible export volumes in 2018-2019 ("Metric ST25 Rice", n.d.). While export markets expanded to 11 countries by 2021 (K. Nguyen, 2021), this suggests that domestic market entry and expansion strategies were either nascent or ineffective in translating global renown into widespread availability and consumer trust locally. Efforts are underway to diversify export markets and develop specific certifications like "Green Vietnamese Rice with Low Emissions" ("Vietnam focuses on exporting high-quality rice", 2025).

4.3 Stakeholder Perceptions and Responses

Stakeholder perceptions are diverse. While the "World's Best Rice" title brings potential for higher returns, farmers face market instability ("Metric ST25 Rice", n.d.). Contract farming provides stability, guaranteed prices, and secure market access for farmers ("Metric ST25 Rice", n.d.; Ngoc, 2019; Singh et al., 2025). However, challenges like farmers potentially "side-selling" if spot prices are higher, and contract-breaking, remain major issues ("Metric ST25 Rice", n.d.). Consumers, initially drawn by the brand, frequently encounter inconsistent availability or perceived high prices, often encountering counterfeit products, leading to erosion of trust (Kokthi et al., 2022; X. Liu et al., 2025; Manning & Kowalska, 2021; Meerza et al., 2019). Mr. Ho Quang Cua, the developer of ST25, has continuously expressed frustration over the widespread counterfeiting that intensifies every time the rice receives global accolades (Cua, 2024).

4.4 Market Dynamics and Competitive Landscape

The Vietnamese rice market is competitive. ST25 commands a significantly higher estimated retail price compared to mass-market varieties like OM 5451 and other fragrant varieties such as Jasmine 85 ("Metric ST25 Rice", n.d.). This makes ST25 a premium segment, commanding prices nearly 2.5 times higher than medium-quality rice (Bui et al., 2023). Despite this price premium, its export

volumes were initially negligible, only growing to ~3,102 tons in the first nine months of 2021, primarily to the US (K. Nguyen, 2021). This indicates that its premium quality has not yet fully translated into broad market penetration, especially when compared to ST24 rice exports, which saw significant volumes to China at lower prices (K. Nguyen, 2021). Vietnam has capitalized on global supply shortages, such as India's export restrictions, using flexible government policies and free trade agreements to expand its export markets ("ANNUAL REPORT Trung An - The Leading Bird and the mission of sustainable agricultural development", 2023). High-quality fragrant rice varieties like ST24 and ST25 together account for 19% of total rice export volume, fetching an average export price of $640-700 USD/tonne in markets like the EU, US, China, and Japan ("High-quality rice gradually dominates exports", 2025). In some European markets, ST25 can command up to 1,250 USD/tonne, while in China, it is around 700-800 USD/tonne ("Vietnam focuses on exporting high-quality rice", 2025). The following tables summarize key market data and supply chain dynamics, integrating information from various sources including the author's analysis.

Table 1: Comparison of Key Metrics for ST25 Rice vs Other Vietnamese Varieties

Metric	ST25 Rice	GM5451 Rice	Jasmine 85 Rice	Other Premium Rice
Avg farm-gate price (VND/kg)	≈ 5600(Proxy)	$\approx 4500 - 4900$ (Est)	$\approx 5000 - 5400$ (Est)	(Varies)
Avg retail price (VND/kg)	35000-45000	$\approx 18000 - 22000$ (Est)	$\approx 22000 - 27000$ (Est)	(ST24): 28000-34000
Primary Growing Regions	Soc Trang Province; Mekong Delta	Mekong Delta (An giang, Dong Thap)	Mekong Delta (Widely grown)	Soc Trang (ST24), Various
Target Market Segment	Premium Domestic (gourmet, gift); Niche Export (US, EU)	Mass Market (Domestic); Volume Export	Fragrant Export (Asia); Domestic	Premium/ Niche
Key Quality Attributes	World's Best (2019, 2023), fragrant, soft	High-yeild, soft	Fragrant, soft, high-yeild	High-quality, fragrant

Table 2: Vietnamese Rice Supply Chain

Supply Chain Stage	Average Cost per kilogram (VND)	Percentage of Final Price (%)	Key Activities
Farm gate	≈ 5600 (Proxy)	14 (Est)	Cultivation, harvesting
Transportation to mill	≈ 800 (Est)	2 (Est)	Collection of wet paddy
Milling/Processing	≈ 11000 (Est)	27.5 (Est)	Drying, milling, branding and packaging
Storage (if applicable)	≈ 1200 (Est)	3 (Est)	Warehousing of finished goods
Wholesale/Trader margin	≈ 8400 (Est)	21 (Est)	Distribution, marketing, costs
Transportation to retailer	≈ 1000 (Est)	2.5 (Est)	Logistics to retail points
Total cost/price	≈ 12000 (Est)	30 (Est)	Shelf space, final sale

Table 3: Comparison of Contract vs. Non-Contract Rice Farmers

Feature	Contract Farmers	Non-Contract Farmers	Key Impact
Access to Inputs	Guranteed, often higher quality/lower cost	Self-financed, variable quality/price	Contract farming improves input quality
Yield (Tonnes/Ha)	Similar in short-term	Similar in short-term	Insignificant impact on yeild in short-term
Income/Revenue Stability	High stability; guranteed contract price	Low stability; exposed to volatile spot prices	Contract farming provides stability
Market Access	Guaranteed; linked to enterprise/cooperative	Relies on local traders	Provides secure market access
Technical Adoption	Higher: receive support on skills/ technology	Lower: Relies on self or public extension	Contracts as a vehicle for technology
Risk sharing	Enterprises share prices and market risks	Farmers bear all prices and market risks	A key benefit of the contract model
Potential Challenges	Farmers may "side-sell" if spot rices are higher	Price volatility	Contract-breaking is a major challenge
Participation Rate	93.4k hectares (2021)	Majority of farmers	Participation in formal linkage models can fluctuate

5 Analysis of Domestic Market Access Chaos

5.1 Factors Contributing to Market Instability

The domestic market for ST25 rice appears unstable despite its premium attributes. The significantly higher estimated retail price of ST25 (35,000 - 45,000 VND/kg) compared to other popular varieties ("Metric ST25 Rice", n.d.), coupled with substantial intermediary margins (Wholesale/Trader 21%, Retailer 30%) ("Metric ST25 Rice", n.d.), suggests a value chain where costs are heavily borne by the consumer. This can limit broader market access and contribute to its perceived "disappearance" from common retail channels. The low export volumes of ST25 relative to Vietnam's total rice exports (e.g., ~3,102 tons in first 9 months of 2021 compared to 6.2 million tons total exports) ("Metric ST25 Rice", n.d.; K. Nguyen, 2021) also highlight a mismatch between its quality and market penetration. Furthermore, challenges like climate change, drought, and saltwater intrusion in the Mekong Delta directly impact productivity, adding another layer of instability to the supply side ("ANNUAL REPORT Trung An - The Leading Bird and the mission of sustainable agricultural development", 2023). Even when comparing model fields employing biosafety methods for ST25 cultivation, the yield was not significantly higher than traditional methods, and selling prices were similar, implying higher input costs for potentially marginal profit gains ("Production of ST25 rice in the direction of biosafety", 2024).

5.2 Supply Chain Disruptions and Their Impact

The cost breakdown of the ST25 supply chain indicates significant inefficiencies. Milling/processing accounts for an estimated 27.5% of the final price, while retail margin adds another 30% ("Metric ST25 Rice", n.d.). Such high percentages for intermediaries can inflate consumer prices and reduce the incentive for farmers to invest in premium cultivation if their share of the final price is

Table 4: Time-Series Data (2018-2025)

Year	Global Rice Index(FAO All Rice)	Vietnam's Total Rice Export Volume (Tonnes)	Average Export Price of Vietnamese Rice (USD/tonne)	ST25 Rice Export Volume (Tonnes)	Key Global Events Affecting Rice Market
2018	$\approx$ 99 (Est)	$\approx$ 6.1 million (Est)	$\approx$ 450 (Est)	Negligible	US-China trade tensions
2019	$\approx$ 100 (Est)	$\approx$ 6.3 million (Est)	$\approx$ 440 (Est)	Negligible	ST25 wins "World's Best Rice" (Nov 2019)
2020	$\approx$ 111 (Est)	$\approx$ 6.1 million (Est)	$\approx$ 496 (Est)	<3000	COVID-19 pandemic; supply chain shocks
2021	$\approx$ 115 (Est)	$\approx$ 6.2 million (Est)	$\approx$ 503 (Est)	$\approx$ 3102 (Est)	Global freight crisis (ST25 exports up 14.7 times)
2022	$\approx$ 119 (Est)	$\approx$ 7.1 million (Est)	$\approx$ 515 (Est)	$\approx$ 8667 (Est)	Russia-Ukraine war; food security concerns
2023	$\approx$ 138 (Est)	8.13 million	575-597	16900	India's export ban; ST25 wins again
2024	$\approx$ 133 (Est)	9.04 million	$\approx 600 - 627$ (Est)	$\approx$ 25000 (Proj)	Continued market tightness from India's ban
2025	100.9 (Sept)	7.9 million (Forecast)	390-500 (Mid-year)	$\approx$ 35000 (Proj)	Prices fropping 24.2% from 2024 highs

disproportionately low (14% farm-gate) ("Metric ST25 Rice", n.d.). Inefficient supply chains, often found in premium agricultural markets, contribute to high marketing costs and hinder competitiveness (Mataia et al., 2020; Saptana et al., 2024). The ability to effectively track multiple quality attributes through the supply chain is critical for perishable products like rice, and lack thereof can lead to significant losses and reduced profitability (Khazaeli et al., 2024; Lejarza & Bâldea, 2021). Optimal logistics, including cold chain management and intelligent scheduling, are crucial for fresh agricultural products to reduce loss and improve responsiveness (Zheng & Lv, 2025).

5.3   Regulatory Environment and Policy Influence

The regulatory environment, particularly regarding intellectual property and contract enforcement, is crucial for market stability. The Transaction Cost Economics framework suggests that high transaction costs, arising from weak contracts and brand protection, deter reliable market engagement and foster opportunistic behaviors (Pingali et al., 2019). The observation that contract farmers might "side-sell" if spot prices are higher, and that contract-breaking is a major challenge ("Metric ST25 Rice", n.d.), indicates a need for stronger contractual governance. Unequal bargaining power between large agribusiness firms and small farmers can lead to contract terms unfavorable to producers, trapping them in dependent relationships (Singh et al., 2025). Effective regulation is essential to reduce food fraud, which is often enabled by asymmetric information and weak enforcement (Giannakas & Yiannaka, 2023). The absence of documented instances of ST25 rice adulteration within Vietnam is noted, but there is "a disconcerting prevalence of alternative rice cultivars parading as 'ST25 rice'" (Bui et al., 2023). This highlights the difficulty in legal enforcement when mimicry rather than direct adulteration is the primary form of fraud.

5.4   Consumer Behavior and Market Fragmentation

In a fragmented market, consumer trust is vital. If consumers cannot reliably distinguish authentic ST25 from counterfeits or substitutes, their willingness to pay a premium diminishes (X. Liu et al., 2025; Manning & Kowalska, 2021; Meerza et al., 2019). The widespread appearance of counterfeit ST25 rice, affecting labels, packaging, and even the rice itself, actively reduces the brand's reputation in both domestic and export markets (Cua, 2024). This challenge of counterfeiting has been noted since 2020, becoming "out of control" and making it difficult for consumers to discern genuine products (Cua, 2024). Differentiating authentic ST25 from spurious counterparts is a "quagmire of uncertainty" for customers, requiring expert discernment (Bui et al., 2023). This erosion of trust, coupled with the high price range of ST25 ("Metric ST25 Rice", n.d.), positions it as a niche product and contributes to market fragmentation if broader strategies for trust and availability are not implemented. Consumer willingness to pay for perceived quality and uniqueness needs to be continually reinforced, but this is undermined by widespread fraud (Long & Quyet, 2023).

6   Brand Dilution and Its Implications

6.1   Indicators of Brand Dilution

Brand dilution for ST25 is evident in the discrepancy between its global recognition and its limited, chaotic domestic market penetration. Despite being named "World's Best Rice" in 2019, its export volumes were negligible that year ("Metric ST25 Rice", n.d.). This suggests that the brand's equity

was not effectively translated into market share. The widespread and "out of control" counterfeiting of ST25 rice, including labels, packaging, and the rice itself, directly contributes to dilution by eroding the brand's unique value proposition and causing "suffering to the real owners" (Cua, 2024). This problem has "existed for a long time," making it difficult for consumers to distinguish genuine products (Cua, 2024). The "disconcerting prevalence of alternative rice cultivars parading as 'ST25 rice'" further exacerbates this dilution by confusing consumers and commoditizing the premium brand (Bui et al., 2023). This erosion of trust, coupled with the high price range of ST25, positions it as a niche product and contributes to market fragmentation if broader strategies for trust and availability are not implemented. This situation aligns with the concept of collective reputation, where unrestricted access to a brand's reputation (e.g., through counterfeiting) can lead to a "milking" of its rents and a decline in quality perception (Winfree & McCluskey, 2005).

6.2 Impact on Consumer Trust and Loyalty

When a premium brand like ST25 is subject to inconsistent quality or widespread counterfeiting, consumer trust is severely undermined (Kokthi et al., 2022; Yiannaka, 2023). Consumers who pay for perceived quality but receive an inferior product experience economic loss and lose confidence, impacting their future purchasing decisions and loyalty. This undermines the brand's long-term viability. The fact that the authenticity of ST25 is being challenged, leading to the need for advanced analytical tools to detect fraud (Aznan et al., 2022; Y. Liu et al., 2020; liwiska-Bartel et al., 2021), signifies a serious breach of consumer trust.

6.3 Economic Consequences for Producers and the Industry

Brand dilution has significant economic repercussions. For ST25 producers, it can lead to lower effective prices, reduced demand, and disincentives to maintain high-quality standards. The challenges associated with food fraud, such as mislabeling, have asymmetric welfare effects across consumers and producers (Meerza et al., 2019). The high marketing costs associated with premium agricultural products, including the need for robust anti-counterfeiting measures, further reduce profitability if the brand value is not protected (Maritano et al., 2024). For the industry, it damages the reputation of Vietnamese premium rice, potentially affecting future export opportunities and overall competitiveness, even as the ST25 brand helps elevate the position of the Vietnamese rice industry internationally ("ANNUAL REPORT Trung An - The Leading Bird and the mission of sustainable agricultural development", 2023). The relatively low participation rate in formal contract farming for ST25 ("Metric ST25 Rice", n.d.) may also reflect farmers' apprehension regarding market stability and the potential for exploitation or fraud.

6.4 Reputational Damage and Long-term Sustainability

The paradox of global acclaim alongside domestic market chaos and brand dilution poses a severe reputational risk. If ST25 cannot establish a stable and trustworthy presence in its domestic market, it undermines the credibility of its "World's Best Rice" title. This can affect the long-term sustainability of the brand and broader efforts to promote Vietnam's agricultural products on the global stage. Building a good reputation for an agricultural product brand requires commitment to customers and environmental friendliness (Prokopenko et al., 2023). The erosion of brand equity, even for a globally recognized product, can lead to a decline in its long-term success (Long & Quyet, 2023).

7 Discussion

7.1 Reconciling Global Acclaim with Domestic Challenges

The ST25 paradox clearly illustrates a critical gap between international recognition and effective domestic market integration. Achieving "World's Best Rice" status affirms product quality but does not automatically resolve underlying issues of market access chaos, supply chain inefficiencies, lack of robust brand protection, and behavioral aspects of producers and consumers. The limited export volumes of ST25 years after its initial award ("Metric ST25 Rice", n.d.) underscore the persistent nature of this disconnect. Reconciling this paradox requires a multi-faceted approach that addresses economic, regulatory, and behavioral dimensions, leveraging the insights from advanced modeling techniques. The adoption of biosafety production models, as seen in Binh Thuan, represents a strategic shift towards high quality and safety, aiming to build a brand and increase farmer income by targeting high-end markets ("Production of ST25 rice in the direction of biosafety", 2024).

7.2 Lessons Learned from the ST25 Paradox

The ST25 case offers vital lessons for premium agricultural product development:

1. Robust Brand Protection is Paramount: Global recognition must be immediately followed by stringent domestic and international brand protection mechanisms to combat counterfeiting and misuse. Effective anti-counterfeiting strategies, utilizing both legal frameworks and technological solutions like rapid digital sensing devices and machine learning for fraud detection, are crucial for high-value food products (Aznan et al., 2022). The difficulty in differentiating authentic ST25 from "alternative rice cultivars parading as 'ST25 rice'" highlights the need for advanced authentication strategies like chemometric analysis with FTIR and ICP-MS (Bui et al., 2023).

2. Integrated and Transparent Supply Chains are Essential: Premium products demand tightly integrated, transparent, and efficient supply chains that minimize transaction costs and ensure product authenticity from farm to consumer (Ahmed et al., 2025). Supply chain optimization models can help design systems that prioritize quality, freshness, and profitability, while identifying and mitigating bottlenecks (Bolívar et al., 2025).

3. Farmer Incentives and Support are Critical: Stable contracts, fair pricing, and robust risk-sharing mechanisms (as highlighted by the contract farming analysis (Singh et al., 2025)) are crucial to incentivize consistent production of high-quality output. Addressing the unequal bargaining power in contract farming arrangements is necessary to ensure farmers benefit equitably and reduce reliance on intermediaries (Singh et al., 2025). The importance of pertinent contract attributes, such as adjusted price, partial payments before harvesting, and input provision by contractors, is also crucial for successful CFAs (Tuyn et al., 2022).

4. Strategic Domestic Market Development: A dedicated strategy for domestic market penetration, distinct from export strategies, is needed to build local consumer trust and loyalty, thereby preventing the erosion of brand value (X. Liu et al., 2025). This includes educating consumers and establishing clear channels for verified authentic products.

7.3 Implications for Brand Management and Agricultural Policy

For brand management, the ST25 paradox underscores the need for a holistic strategy that encompasses intellectual property protection, supply chain governance, and targeted domestic marketing, in addition to international promotion. For agricultural policy, it highlights the necessity for stronger regulatory enforcement against fraud, active support for farmer-agribusiness linkages through effective and equitable contract farming models ("Metric ST25 Rice", n.d.; Ngoc, 2019), and investment in infrastructure that reduces logistics costs and improves market access for premium products (Deng et al., 2019; Ma et al., 2024). Furthermore, policies that leverage free trade agreements and capitalize on global supply dynamics, as Vietnam has successfully done ("ANNUAL REPORT Trung An - The Leading Bird and the mission of sustainable agricultural development", 2023), should be complemented by internal market stability measures, such as promoting biosafety production for increased competitiveness and brand building ("Production of ST25 rice in the direction of biosafety", 2024). The shift from quantity to quality in rice production, where food security goals have been met, provides a strong impetus for such policies ("Production of ST25 rice in the direction of biosafety", 2024).

7.4 Future Research Directions

Future research could further explore:

1. Empirical estimation of the parameters for the proposed mathematical models using comprehensive, granular ST25 market data, especially for supply and demand elasticities, and specific cost components.

2. In-depth comparative analyses of brand protection strategies and their effectiveness in similar premium agricultural product contexts across Southeast Asia, considering various types of fraud.

3. The role of digital technologies, such as blockchain and advanced sensing devices, in enhancing traceability, combating food fraud, and improving supply chain efficiency in complex agricultural supply chains.

4. Detailed case studies of successful domestic market development strategies for high-value agricultural products, specifically analyzing how they overcame challenges similar to the ST25 paradox.

5. Quantitative analysis of farmer risk preferences using prospect theory to inform targeted policy interventions that promote adoption of premium varieties and contract farming, considering factors like income volatility reduction (Singh et al., 2025).

8 Conclusion

8.1 Summary of Findings

This paper has introduced and analyzed the "ST25 Paradox," characterized by the incongruity between ST25 rice's global acclaim and the significant domestic market chaos and brand dilution it faces. Our economic and mathematical frameworks identify key contributing factors, including inefficient and opaque supply chains with high intermediary costs, pervasive food fraud, and

a regulatory environment that struggles to enforce brand protection and contractual agreements effectively (Bui et al., 2023; Cua, 2024). The analysis underscores how these factors disrupt market equilibrium, influence farmer behavior, and erode brand equity, leading to the product's paradoxical "disappearance" from its own domestic market despite its world-class quality. The role of contract farming in providing stability for farmers, contrasted with its inherent challenges like side-selling and unequal bargaining power, has been highlighted as a critical area for intervention ("Metric ST25 Rice", n.d.; Singh et al., 2025).

8.2 Policy Recommendations

1. Strengthen Intellectual Property Enforcement: Implement and rigorously enforce anti-counterfeiting laws, ensure swift action against fraudulent producers, and provide accessible legal and administrative mechanisms for brand owners to protect ST25's authenticity. This is critical for credence-based products (Cua, 2024).

2. Promote Integrated and Transparent Value Chains: Policy should support the development of short, transparent value chains that foster direct linkages between producers and consumers, reducing opportunities for fraud and excessive intermediary markups. Effective, equitable contract farming models, offering guaranteed prices, technical support, and risk-sharing, can mitigate side-selling and stabilize supply (Singh et al., 2025). Contract attributes regarding payment terms and input provision should be carefully considered (Tuyn et al., 2022).

3. Invest in Quality Infrastructure and Technology: Improve logistics, storage, and processing infrastructure to reduce supply chain costs and enhance the efficiency of distribution, ultimately making authentic ST25 more accessible and affordable (Zheng & Lv, 2025). Simultaneously, invest in research and deployment of advanced anti-fraud technologies, such as low-cost digital sensing devices, machine learning, FTIR, and ICP-MS, to rapidly detect counterfeits and authenticate origin (Y. Liu et al., 2020). Promote biosafety production models for sustainable competitiveness ("Production of ST25 rice in the direction of biosafety", 2024).

4. Develop Robust Market Information Systems: Implement platforms that provide transparent price and quality information across the value chain, reducing information asymmetry for both farmers and consumers and supporting fair trade practices.

8.3 Strategic Recommendations for Brand Holders

1. Prioritize Domestic Brand Education and Protection: Launch targeted domestic campaigns to educate consumers on authentic ST25, its unique qualities, and verified points of purchase. Simultaneously, invest in advanced anti-counterfeiting technologies and legal efforts to protect the brand vigorously (Cua, 2024).

2. Implement Robust Traceability Systems: Adopt technologies like QR codes or blockchain to ensure end-to-end traceability, allowing consumers to verify product authenticity from farm to table.

3. Foster Direct Relationships and Farmer Support: Develop direct and equitable relationships with farmers through well-structured contract farming, providing technical assistance, quality inputs, and stable pricing. This builds trust and ensures a consistent supply of authentic premium product.

4. Strategic Market Segmentation with Integrity: Continue to leverage ST25's premium status in niche domestic and international markets while systematically addressing the challenges required for broader market penetration, always prioritizing brand integrity over rapid expansion without control.By rigorously applying these economic and mathematical frameworks, and by strategically implementing the suggested recommendations, Vietnam can transform the ST25 Paradox into a model of sustainable success for its premium agricultural products, both domestically and on the global stage.

*Note: The reference "Metric ST25 Rice" is my own document that I collected the raw datas on many official government reports then analysed to create tables (1,2,3 and 4)

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