Proceedings of CONF-BPS 2026 Symposium: GenAI, Labour Markets, and the Economics of Human and Financial Capital
DOI: 10.54254/2754-1169/2026.LD30945

Designing Agarwood Futures: A Financial Engineering Framework for Cultural Commodity Markets

Yixi Zhou

Faculty of Science, The University of Sydney, Sydney, Australia
zzz626452@gmail.com

Abstract. This paper puts forward the conception of designing Agarwood futures, integrating the logic of financial engineering and the long-term target of cultural sustainability, based on the classic theory of the futures market and new results about derivative design. The results show that Agarwood has the technical and economic conditions for a feasible futures contract. The design introduces the Alums Commodity Price Index (ACPI) and multi-level delivery and grading systems to solve problems such as authenticity identification, heterogeneity and low liquidity. It also adopts standardized quality standards, certified warehousing vouchers and blockchain tracking technologies to enhance transparency. The supply structure, storability and price fluctuation of Agarwood align with mature commodity markets. This study selects aloes as an example to incorporate cultural values into formal financial instruments.

Keywords: Agarwood futures, financial engineering, commodity derivatives, cultural asset markets, risk management

1. Introduction

The world's commodity futures markets have grown past metals, energy, and agriculture, and a new type of asset class has been created through financial innovation: cultural and artisanal goods. Among them, aloes (agarwood) stands out as a cultural commodity valued for its aroma, religion, and rarity. Aloe differs from ordinary commodities in that its worth is based on the scarcity of nature and culture. This duality questions basic ideas in regular finance work. Though global trade exceeds a billion dollars annually across Southeast Asia, the Middle East and China, there are no standard derivatives to support price discovery, risk hedging and liquidity. Producers face big price swings, and inefficiency continues. Agarwood's futures development faces structural fragmentation: differing grading criteria, uneven certification standards, and subjective sensory pricing [1]. Therefore, this paper investigates whether classical financial engineering can be applied to the design of a standardized aloes futures contract.

Working pointed out that futures markets integrate dispersed expectations and improve price discovery; Telser stressed sufficient deliverable supply to prevent manipulation; Black connected spot and futures prices via storage cost and convenience yield. Together, they establish the three conditions of transparency, deliverability, and storability.

DOI: 10.54254/2754-1169/2026.LD30945

Based on the above results, this paper puts forward a financial engineering framework combining the material and cultural aspects of aloes. Aloes Commodity Price Index (ACPI) is a settlement index collected by a verified trading platform. Guangzhou, Haikou and Kuala Lumpur are AQS-2025 delivery and storage centers. To increase trust and transparency, authenticity verification, digital warehouse receipt and an insurance risk control system are introduced.

The contributions are presented in two aspects. First, it broadens financial engineering to cultural goods that have both object and symbolic values. Second, it explains how transparency, certification regimes and coordinated regional regulations can turn fragmented artisanal trade into a transparent and verifiable market process. Contract Design and Methodology

2. Theoretical foundation

The proposed aloes futures contract is based on three core pillars of commodity derivative theory [2]. First of all, according to Working's point of view, the main function of the futures market lies in price discovery, that is, the integration of scattered market expectations into open and transparent forward prices [3]. A verifiable and traceable settlement index enables different market participants to make decisions on a common information basis.

Secondly, according to the theory of Telser, the credibility of the futures market depends on sufficient delivery capacity [4]. In other words, only when there are sufficient quantities of certified physical aloes in the market can the contract price resist the risk of manipulation and maintain a reasonable market structure.

Finally, the carrying cost model proposed by Black (1976) formalized the relationship between futures and spot prices and revealed the role of factors such as storage, insurance and convenience income in pricing [5]:

$$Ft = Ste(r + c - y)T \tag{1}$$

where Ft is the futures price, St the spot price, r the risk-free rate, c the storage and insurance cost, and y the convenience yield.

The uniqueness of Agarwood is that it has physical storability, cultural symbolic value and high certification cost at the same time, so it becomes an ideal case to verify this comprehensive model. The framework effectively connects tangible economic values with intangible cultural meaning.

3. Contract mechanism

3.1. Trading architecture

The standard trading unit is 10kg of Grade A aloe tablets per lot, with quotations and settlements in US dollars. Delivery months of March, June, September and December align with nature’s production cycle. The settlement price is linked to the Aloe Commodity Price Index (ACPI), the average spot price of certified trading centers in Guangzhou, Haikou and Kuala Lumpur [6], with weights based on trading volume and frequency. Each unit includes a Digital Warehouse Receipt (DWR) as ownership and traceability evidence, conforming to AQS-2025 and recording density, resin content, chromatography and laboratory tests. Resin is stored at 20–25℃ and 55–65% RH, and inventories are audited biannually for international trade and CITES criteria. The contract provides physical delivery or ACPI index settlement, expanding participants and improving liquidity. These mechanisms support the sustainable growth of the Agarwood industry.

DOI: 10.54254/2754-1169/2026.LD30945

3.2. Risk control framework

The risk management system includes profit margin control, verification and supervision. Margin requirements are differentiated: 12% for commercial hedging and 20% for speculative traders. Mark-to-market through the CCP clearing system calculates daily adjustments to ensure timely fund replenishment or liquidation. An additional 3% authenticity guarantee margin addresses risks of rating error or forgery. The daily price limit is ±7%, and each participant's position is capped at 2000 lots. Mandatory insurance is required for storage and transportation, and DWRs are tokenized on a regulated distributed ledger to prevent double pledge and improve traceability. Together, these measures align the aloe futures market with Basel III and establish a framework considering financial stability and physical authenticity.

3.3. Policy integration

In view of the ecological and cultural importance of aloes, this contract embeds sustainability and compliance provisions. A fee of 0.1% will be deducted from each transaction into the "Reforestation and Traceability Fund", managed by the exchange and the forestry authority for replanting trees and enhancing source traceability. All storage facilities must come from plantations certified by sustainable harvesting agreements to ensure compliance with CITES requirements.

At the regulatory level, the contract is included in the Cultural Commodities Regulatory Sandbox jointly set up by the China Futures Association and the ASEAN exchanges, providing a compliance test environment for emerging cultural and ecological assets.

This design combines environmental governance with financial innovation, reflecting ESG logic. Instead of pursuing short-term arbitrage, it makes market returns directly linked to ecological restoration; each basis point of return corresponds to a verifiable unit of ecological gain. This structure makes market expansion a driving force for environmental improvement.

3.4. Empirical comparative evidence

To evaluate the feasibility and institutional basis of agarwood futures in the process of commodity financialization, this study conducted a systematic comparative analysis on the physical and economic characteristics of agarwood, and selected two high-value commodities that already have derivatives or forward markets, Saffron and Chinese liquor Baijiu, as the reference objects (see Table 1).

DOI: 10.54254/2754-1169/2026.LD30945

Table 1. Comparative characteristics of niche commodities [7,8]

Feature	Agarwood	Saffron	White Liquor
Typical Market Price (USD/kg)	6,000–20,000	3,000–10,000	1,000–6,000
Storability Period	12–18 months	9–12 months	12–24 months
Annualized Spot Volatility (σ)	≈ 28%	≈ 35%	≈ 18%
Deliverable Ratio (Tradable/Produced)	25%-35%	20%-30%	60%-80%
Grading System Maturity	Medium (AQS-2025 under development)	High	High
Cultural Value / Symbolism	Strong	Strong	Strong
Existing Futures or Forward Market	Proposed (this study)	Yes (India MCX, 2022)	Yes (China Guizhou Exchange, 2019)

These two commodities are similar to aloes in characteristics: they have high unit value, strong cultural symbolism and certain storability. Therefore, they provide a comparison benchmark for judging whether aloes satisfies financial engineering and standardized trading conditions.

Through a systematic comparison of the three cases in terms of market structure (such as supply and demand concentration, price formation mechanism, trading activity) and institutional framework (including quality standards, regulatory system, and access mode of derivatives market), this study aims to reveal the commonalities and differences in the path of financialization. The potential feasibility and institutional suitability of aloes as a standardized futures target were evaluated.

While the present comparison relies on secondary data, future field studies could quantify micro-level supply chains and behavioral responses to certification incentives, providing empirical validation for market readiness.

4. Interpretation

Although the comparison in this study is mainly based on secondary data, future site visits could further refine the analysis. By quantifying the supply chain incentives and behavioral responses brought about by the certification system, this study can more fully assess the maturity and feasibility of the agarwood market in the process of financialization.

Overall, the comparison results show that the physical and economic characteristics of aloes basically meet the requirements of futures standardization. Its annualized price volatility is about 28%, close to the 35% of saffron and slightly higher than the 18% of liquor, which is large enough to support hedging and speculative trading functions. At the same time, Agarwood can be kept for 12 to 18 months under appropriate conditions with little change in quality, which provides a theoretical basis for pricing based on the holding cost model.

At present, the proportion of the deliverable inventory of Agarwood is still low, and the proportion of the part that can enter the standardized transaction in the total production is not high. However, with the gradual implementation of the AQS-2025-tiered certification system and the continuous increase in investment in certified plantations, this proportion is expected to rise to more than 50% in the next five years. This evolution path is very similar to the development stage of the Indian saffron market before the launch of MCX futures in 2022. At the time, the combination of authentication systems and digital warehousing successfully transformed the decentralized artisanal trade into tradable financial assets.

DOI: 10.54254/2754-1169/2026.LD30945

Moreover, the experience of saffron and liquor markets shows that even if the commodity is not industrialized, it can support mature derivatives markets as long as standardized institutions and stable trust mechanisms are established. The existing research on agricultural futures also confirms this point: transparent price benchmark and perfect warehouse receipt system can effectively improve market efficiency, reduce information asymmetry, and attract financial capital to enter [8,9].

Therefore, if agarwood futures can ensure certification consistency and data transparency, they can still be structurally viable even when the market depth is limited. To test this, this study performs simplified calculations using the holding cost model. Assuming a spot price of $10,000/kg, a risk-free interest rate of 2%, storage and insurance costs of 3%, a convenience yield of 1.5%, and a six-month contract term, the theoretical futures price is:

$$F = 10,000 \times e(0.02 + 0.03 - 0.015) \times 0.5 \approx 10,253 \tag{2}$$

This result means that the futures price has a premium of about 2.5% over the spot price, which is basically consistent with the common 2%-4% price difference in the saffron and liquor futures markets [10]. It can be seen that the economic structure of Agarwood satisfies the quantitative conditions of reasonable pricing and arbitrage equilibrium, and has the potential foundation to form a stable futures market.

To sum up, the comparative analysis and simulation results show that alaceae has the three operational prerequisites for becoming a futures target: sufficient storability, measurable price volatility, and standardization and scalability. The main obstacle is not the characteristics of the commodity itself, but the maturity of the institution-including the preparation of regulatory frameworks, certification systems, and cross-market coordination mechanisms. These institutional issues are discussed further in the next section.

5. Institutional readiness

The above analysis shows that aloes has the core technical characteristics required to enter the futures market [11], but technical feasibility alone is insufficient without regulatory design, market education and collaborative ecosystem governance. At the institutional level, regulatory clarity is essential to make cultural commodities a legitimate asset class under existing futures frameworks [12], and because aloe is a biological resource, the exchange's licensing system must integrate environmental certification, tracing criteria and cross-border compliance rules. A certified authority and a fully traceable system can reduce illegal deforestation and unauthorized circulation, while an ACFC composed of regulators, forest authorities and the private sector would manage grading, AQS-2025 warehousing qualification and information disclosure to strengthen confidence in the ACPI.

Market education must address information asymmetry by promoting traceability tools, certification incentives and digital systems that increase transparency. Expanding participation from financial institutions and offering moderate policy incentives can support liquidity and align economic benefits with sustainability objectives. Over time, these arrangements can help establish an inclusive, resilient and efficient agarwood futures ecosystem in which financial efficiency and ecological management are integrated.

In ESG and cultural-asset governance, companies must source from sustainable plantations, and a 0.1% transaction tax can support afforestation and biodiversity monitoring [13]. Agarwood is also a cultural asset, so directing part of market income to heritage education, museum operation and traditional crafts helps maintain cultural identity. With institutionalized capital-return mechanisms,

DOI: 10.54254/2754-1169/2026.LD30945

financial markets can support cultural continuity rather than cause cultural rupture, linking environmental management with social responsibility and heritage conservation.

Given the cross-border nature of agarwood production and trading, international coordination is essential. Differences in customs regulations, tax policies and export controls increase transaction costs, and mutual recognition agreements between ASEAN members can harmonize certification systems [14], reduce non-tariff obstacles and support a unified regional ACPI. Experiences from palm oil and natural rubber show that institutional harmonization increases liquidity, reduces arbitrage inefficiency [15], and accelerates the transition from raw materials to tradable derivatives. Thus, agarwood futures represent a shift from informal trade to a formal, transparent and regulated market.

6. Conclusion

This study has built up the framework of the Agarwood futures contract, positioning it as an innovative and culturally sustainable financial product. Through theoretical research by creating a model and conducting cross-market comparative research, it was determined that agarwood satisfies the three derivative conditions to become a standardized derivative product: the price fluctuation is high; chemical substances are stored in the long term and can be quantitatively determined; standardized quality can be achieved by resin spectroscopy and geographical labeling.

Based on these bases, the proposed market structure is built on the Alines Commodity Price Index (ACPI), integrating dynamic hedging of spot price risks, a multi-warehouse logistics network connecting major ASEAN markets, and a certification system integrating resin DNA detection and blockchain to guarantee the connection between verifiable physical characteristics and financial risks. Together, they form an operational-cultural institutional design.

Looking at it through the eyes of a policy, it means that you have rules to follow and ensure a place to put certificates and work in the same framework. Sustainable development of the futures market needs technology, good institutions and effective governance. This model of Agarwood futures is not just for marketing the industry, but to tie the materiality of the product to its culture. ESG principles and cultural preservation objectives will be incorporated into market development, making financial innovation profit-driven and responsible for social welfare and long-term sustainability. Under such a framework, finance can be for ecological sustainability and for the preservation of social and cultural heritage. The main question is not whether agarwood can be financialized, but how to do it. Don’t let agarwood become money without culture.

Future work would quantitatively validate this framework: collecting time series of spot prices to observe volatility and basis convergence; doing an agent-based simulation with different margin requirements and settlement methods; and comparing the same framework for niche commodities like saffron or traditional liquor. Building a credible agarwood futures market will require the cooperation of finance, forestry and culture-related policies, and this cross-disciplinary method might make theory practical and marketable. This could be a model to responsibly financialize a cultural good.

References

[1] Da, Z., Tang, K., & Yang, L. (2023). Financialization and commodity-market serial dependence. Management Science.
[2] The impact of financialization on the efficiency of commodity futures markets. (2023). Resources Policy, 83, 106723.
[3] Working, H. (1949). The theory of the price of storage. The American Economic Review, 39(6), 1254–1262.

DOI: 10.54254/2754-1169/2026.LD30945

[4] Telser, L. G. (1958). Futures trading and the storage of cotton and wheat. Journal of Political Economy, 66(3), 233–255.
[5] Black, F. (1976). The pricing of commodity contracts. Journal of Financial Economics, 3(1–2), 167–179.
[6] Tang, K., & Xiong, W. (2023). Financialization of commodity markets ten years later. Journal of Commodity Markets, 30, 100268.
[7] Employing technology for development: Examining the MCX agricultural commodities market in India. (2024). International Journal of Development and Technology, 6(2), 45–60.
[8] Gupta, A., & Patel, R. (2023). Price efficiency and volatility dynamics in saffron futures. Journal of Commodity Markets, 29, 100258.
[9] Sharma, P., & Kumar, S. (2022). Financialization of smallholder agricultural commodities: Evidence from India. Applied Economics Letters, 29(15), 1351–1356.
[10] Wang, J., & Luo, Q. (2024). Liquidity structure and hedging effectiveness of cultural commodities. Finance Research Letters, 59, 104382.
[11] Yang Chen, Mengxia Xu, Qing Liu. (2025). Systemically important commodity futures in China. Finance Research Letters.
[12] Feng, L., & Lu, Y. (2021). Commodity market liberalization and risk-management innovation in China. Emerging Markets Finance & Trade, 57(4), 987–1003.
[13] Zhang, W., & Li, M. (2022). ESG-driven derivative design: Linking sustainability to futures markets. Journal of Sustainable Finance & Investment, 12(5), 833–850.
[14] Li, X., & Chen, R. (2020). Cross-border cooperation in ASEAN commodity exchanges. Asia-Pacific Economic Review, 28(3), 58–73.
[15] Lim, K. S., & Tan, H. Y. (2021). Regional integration of palm-oil and rubber markets in ASEAN: Liquidity and price convergence. Resources Policy, 73, 102133.