

## Bridging the Gap: Analyzing Fresh Fruit Bunch Price Disparities Between Indonesia and Malaysia and Pathways to Enhanced Smallholder Welfare

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**KEYWORDS:** Fresh Fruit Bunch pricing, palm oil smallholders, farmer welfare, price transparency, Indonesia-Malaysia comparison, agricultural policy, value chain distribution, sustainable palm oil, replanting programs, cooperative strengthening

**JEL Classification:** Q13 (Agricultural Markets and Marketing), Q18 (Agricultural Policy), O13 (Agriculture; Natural Resources; Energy; Environment; Other Primary Products), Q01 (Sustainable Development), O53 (Asia including Middle East)

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**Publication Date:** 04 June-2026

**DOI:** [10.55677/GJEFR/01-2026-Vol03E6](https://doi.org/10.55677/GJEFR/01-2026-Vol03E6)

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### ABSTRACT

The persistent disparity in Fresh Fruit Bunch (FFB) prices between Indonesia and Malaysia poses significant implications for smallholder welfare and the sustainability of palm oil production in the world's largest producer. This qualitative literature review examines the magnitude, causal factors, and potential interventions to address the FFB price gap between the two countries. Drawing on recent scholarly literature (2020-2026), industry reports, and policy documents, the study reveals an average price differential of 58.1% favoring Malaysian farmers during 2019-2023, with peak disparities reaching 108.1% during periods of high crude palm oil (CPO) prices. Thematic analysis identifies pricing system differences—specifically, Malaysia's transparent Malaysian Palm Oil Board (MPOB) formula versus Indonesia's complex, regionally fragmented K-index system—as the primary explanatory factor, accounting for approximately 53% of the price gap after controlling for oil extraction rate (OER) differentials. Additional contributing factors include infrastructure deficits, weak farmer bargaining power, variations in quality grading systems, and gaps in policy implementation for replanting programs. The study proposes a multi-tiered intervention framework encompassing pricing transparency reforms, institutional strengthening of farmer cooperatives, infrastructure development, streamlined replanting support, and mechanisms to share certification costs. These evidence-based recommendations aim to narrow the price gap while enhancing economic welfare, productive capacity, and long-term sustainability of Indonesian smallholder palm oil farmers. The findings contribute to the discourse on agricultural price policy in developing countries and provide actionable insights for policymakers seeking to balance industry competitiveness with farmer welfare in commodity value chains.

**Cite the Article:** Judijanto, L. (2026). Bridging the Gap: Analyzing Fresh Fruit Bunch Price Disparities Between Indonesia and Malaysia and Pathways to Enhanced Smallholder Welfare. *Global Journal of Economic and Finance Research*, 3(6), 339–358. <https://doi.org/10.55677/GJEFR/01-2026-Vol03E6>

## 1. INTRODUCTION

### 1.1 Background

Indonesia and Malaysia collectively dominate global palm oil production, accounting for approximately 85% of the world's supply and serving as critical pillars of the global vegetable oil market. As the world's largest producer, Indonesia cultivated 16.38 million hectares of oil palm plantations in 2023, significantly surpassing Malaysia's production capacity. Within this expansive industry, smallholder farmers play an indispensable role, accounting for approximately 40% of Indonesia's total palm oil production area and supporting the livelihoods of over 2.4 million farming households. These independent and plasma scheme farmers operate predominantly on landholdings of less than two hectares, positioning them as crucial stakeholders in both national economic development and rural poverty alleviation strategies [1].

Despite Indonesia's production leadership and the strategic importance of its smallholder sector, a persistent and substantial price differential exists in the compensation received for Fresh Fruit Bunches (FFB)—the primary harvest product sold by farmers to processing mills. Comparative data from 2019-2023 reveal that Indonesian farmers consistently received lower prices than their Malaysian counterparts, with an average differential of 58.1% in favor of Malaysia across the five years. This gap manifested most dramatically in 2021, when Malaysian farmers received FFB prices 108.1% higher than Indonesian farmers during a period of record-high CPO prices, while narrowing to 11.0% during the 2023 market stabilization period. Such disparities translate directly into income inequality, with Indonesian farmers earning approximately IDR 32.8 million per hectare annually compared to IDR 51.8 million for Malaysian farmers under equivalent productivity assumptions [2], [3], [4], [5], [6].

### 1.2 Urgency and Rationale

The FFB price gap carries profound implications across economic, social, and environmental dimensions of sustainable palm oil production. From an economic welfare perspective, income inequality significantly constrains smallholders' purchasing power and living standards. While research indicates that Indonesian palm oil farmers earn approximately five times more than non-palm agricultural producers within the same regions—with average monthly incomes of IDR 3,281,951 documented in Jambi Province—they simultaneously receive 58% less compensation than Malaysian farmers producing the identical commodity. This paradox highlights structural inefficiencies in Indonesia's value chain distribution mechanisms that disadvantage primary producers [7]. The sustainability implications are equally concerning. The majority of Indonesian smallholder plantations have surpassed 25 years of age, well beyond the optimal productive lifespan, resulting in declining yields that threaten both farmer incomes and national production capacity. Replanting these aging plantations requires capital investments of approximately IDR 50-60 million (USD 3,333-4,000) per hectare, yet the government's replanting program achieved only 54.7% of its target by 2022, with just 53,012 hectares replanted in 2023 against an annual target of 180,000 hectares. The persistent price gap directly undermines farmers' financial capacity to self-fund replanting or maintain adequate plantation management practices, creating a cycle of declining productivity [8], [9], [10].

Social welfare dimensions further underscore the urgency of addressing price disparities. Smallholder farmers face multiple vulnerabilities, including limited access to certification (only 35-36% ISPO-certified as of 2024, compared to 86%+ MSPO-certified in Malaysia), inadequate bargaining power against intermediaries and mills, and insufficient institutional support from cooperatives. These challenges are compounded by infrastructure deficits, particularly poor rural road conditions that increase transportation costs and reduce FFB quality during delivery. Without systematic interventions to narrow the price gap, Indonesia risks perpetuating rural poverty, triggering youth migration from agricultural livelihoods, and undermining the long-term sustainability of its most strategically important agricultural export sector [11], [12], [13], [14].

### 1.3 Research Objectives

This study employs a qualitative literature review methodology to achieve three primary objectives. First, it seeks to systematically document and analyze the magnitude of FFB price differentials between Indonesia and Malaysia, using recent data sources to establish the scale and patterns of these disparities. Second, the research examines the causal factors underlying these price gaps through thematic analysis of pricing mechanisms, technical factors, infrastructure conditions, institutional arrangements, and policy environments. Third, drawing on evidence-based policy research and comparative analysis, the study proposes actionable intervention strategies designed to narrow price disparities while enhancing smallholder welfare, productive capacity, and long-term industry sustainability. By integrating economic, institutional, and policy perspectives, this research contributes to scholarly discourse on agricultural pricing policies in developing countries while providing practical guidance for Indonesian policymakers, industry stakeholders, and development organizations committed to equitable and sustainable palm oil production.

## 2. LITERATURE REVIEW

### 2.1 Conceptual Framework of Agricultural Price Determination

Agricultural price formation in commodity markets is a complex intersection of supply and demand dynamics, institutional arrangements, and policy interventions. The economic literature on agricultural pricing policies in developing countries emphasizes that government intervention in price determination serves multiple objectives: stabilizing farmers' incomes amid volatile international markets, ensuring food security through affordable consumer prices, and promoting agricultural development through investment incentives. The International Monetary Fund's analysis of agricultural pricing policies demonstrates that interventions significantly impact economic growth trajectories, with effects varying based on policy design, implementation mechanisms, and market structure characteristics [15], [16], [17].

In the context of perennial tree crops like oil palm, price transmission mechanisms between international commodity markets (CPO and palm kernel prices) and farmgate prices (FFB) are mediated by processing value chains, regulatory frameworks, and contractual arrangements. The palm oil value chain encompasses multiple stages from cultivation through processing, refining, and distribution, with value addition and profit distribution varying substantially across these stages. Research by Chain Reaction Research indicates that fast-moving consumer goods (FMCG) companies and retailers capture approximately 66% of gross profits in the palm oil value chain, while smallholder producers—who contribute roughly 30% of global CPO production—receive disproportionately smaller

shares. This structural imbalance in value capture underscores the importance of pricing mechanisms that ensure equitable distribution of market value to primary producers [18], [19], [20].

## 2.2 FFB Pricing Mechanisms: Indonesia vs Malaysia

The fundamental divergence in FFB pricing systems between Indonesia and Malaysia constitutes a critical determinant of the observed price gap. Malaysia's pricing mechanism, administered by the Malaysian Palm Oil Board (MPOB), operates on a transparent formula that directly links FFB prices to CPO and palm kernel market prices with standardized extraction rate assumptions. Since July 2020, MPOB has calculated daily FFB reference prices based on a standardized 1% Oil Extraction Rate (OER) and published them through accessible channels, including the InfoSawit mobile application, which provides real-time price information to smallholders. This system ensures rapid price transmission—when international CPO prices increase, FFB prices adjust correspondingly within the same trading cycle. The transparency and national consistency of Malaysia's MPOB formula enhance farmer bargaining power by providing clear price benchmarks and reducing information asymmetry between producers and buyers [21], [22], [23], [24], [25].

In contrast, Indonesia employs a K-index system characterized by complexity, regional variation, and limited transparency. The K-index represents the farmer's share of the CPO value after deducting processing and operational costs, but its calculation varies across provinces, districts, and even monthly time periods. Research on K-index implementation in South Kalimantan reveals significant transparency deficits, with farmers often lacking clear information on calculation components, cost deductions, and the rationale for price determinations. This opacity creates power imbalances favoring mills and intermediaries who possess superior information about market conditions and pricing formulas. Additionally, Indonesian farmers face various cost deductions—including transportation fees, weighing charges, and quality penalties—that are inconsistently applied and inadequately disclosed, further reducing their effective price realization [26], [27], [28].

Recent scholarship has proposed alternative pricing formulas for Indonesia that enhance transparency and fairness. Judijanto et al. developed an empirically derived formula based on certain simulated cases:  $PFFB = -2438.7971 + 0.1784 PCPO + 10219.2072 OER$ , which explicitly links FFB prices to CPO prices and extraction rates, with clear parameters. Such transparent formulations align with Malaysia's approach and could significantly improve price predictability and farmer confidence in Indonesia's pricing system. The regulatory framework in Indonesia, outlined in guidelines from the Plantation Fund Management Agency (BPDP), provides provincial-level flexibility in FFB price determination, but this decentralization has led to fragmentation rather than locally optimized pricing [29].

## 2.3 Determinants of FFB Prices

Multiple factors influence FFB price levels beyond the pricing mechanism itself. Global CPO and palm kernel (PK) prices serve as the fundamental price drivers, transmitting international market dynamics to farmgate levels. Malaysia's biodiesel support program, for instance, contributed approximately RM 61.50 per tonne (roughly 16%) to FFB price support through enhanced domestic CPO demand. Indonesia's export levy system and Domestic Market Obligation (DMO) policies similarly influence domestic CPO prices and consequently FFB valuations, though with varying effectiveness in transmitting benefits to farmers [30].

Oil Extraction Rate differences between the two countries represent another frequently cited factor. Malaysian plantations typically achieve OER levels of 21-21.5%, while Indonesian estates average approximately 20%. However, empirical analysis in the attached document shows that OER differentials account for only approximately 5 percentage points of the 58.1% average price gap, leaving 53.1% attributable to systemic and structural factors rather than technical productivity differences. This finding challenges narratives that attribute price disparities primarily to quality or efficiency gaps, directing attention instead toward institutional and policy determinants [31].

Quality grading systems and their implementation constitute an additional price determinant. Malaysia employs standardized FFB grading criteria based on Malaysian Standards (MS) specifications, with systematic quality assessments influencing price adjustments. Research on FFB grading in Indonesian contexts reveals that quality variations can generate price differentials of 300-500 Rupiah per kilogram, yet grading systems are less consistently applied than in Malaysia, creating opportunities for subjective assessments that may disadvantage farmers. Infrastructure quality directly affects FFB condition during transportation, with poor road conditions in many Indonesian production regions leading to bruising, overripening, and quality degradation that reduce both extraction efficiency and price realization [4].

## 2.4 Smallholder Farmer Welfare and Income Dynamics

Understanding the welfare implications of FFB price disparities requires examining smallholder income profiles and economic conditions. Research in Indonesian palm oil regions consistently demonstrates that palm cultivation generates higher incomes than alternative agricultural activities. A 2022 study in Riau Province found that oil palm farmers' average monthly income of IDR 5,730,398 from palm production (85.39% of total household income) far exceeded earnings from other agricultural activities. Similarly, research in Jambi Province documented average monthly household incomes of IDR 3,281,951 among smallholder palm farmers, surpassing provincial minimum wage standards. These findings confirm palm oil's role as an effective poverty alleviation tool and economic development driver in rural Indonesia [32].

However, welfare assessments reveal significant heterogeneity based on land tenure arrangements and market access. Comparative studies of independent versus plasma scheme farmers in Lampung Province indicate that, while majorities of both groups achieve prosperous status according to national welfare indicators, independent farmers are more likely to advance their welfare when they establish direct mill connections and participate in effective cooperative structures. The challenge of bargaining power asymmetry emerges consistently across the welfare literature—smallholders, operating independently or through weak cooperative institutions, possess limited negotiating leverage against mills and intermediaries that control market access and price information [33].

Certification impacts on farmer welfare present mixed evidence. While Roundtable on Sustainable Palm Oil (RSPO) certification has been associated with premium-sharing mechanisms, improved yields, and better household food security in some contexts, certification costs account for 16-39% of smallholders' annual income, creating substantial financial barriers. Indonesian Sustainable Palm Oil (ISPO) certification, mandatory for smallholders by November 2025, aims to provide more accessible certification pathways with government support, yet progress remains limited, with only 35-36% of target smallholders certified as of 2024. Malaysia's achievement of 86%+ MSPO certification coverage reflects more comprehensive institutional support and lower relative cost burdens for farmers [34], [35], [36], [37], [38].

## 2.5 Policy Interventions and Governance

Government policy frameworks significantly shape the enabling environment for smallholder welfare and FFB pricing outcomes. Indonesia's export levy structure on CPO, implemented with progressive rates tied to international price levels, generates revenue for the BPDP fund that finances biodiesel subsidies, replanting programs, and infrastructure development. However, the effectiveness of these interventions in reaching smallholder beneficiaries remains constrained by implementation challenges and bureaucratic complexities [39].

Replanting programs represent a critical policy priority given the aging plantation profile, yet performance has fallen substantially short of targets. The Smallholder Replanting Program (PSR) aimed to replant 500,000 hectares by 2022, but achieved only 54.7% of that goal. In 2023, actual replanting approvals covered merely 53,012 hectares against an annual target of 180,000 hectares. Research on farmers' willingness to replant identifies multiple barriers: capital constraints, lost income during the 3-4-year immature period, complex administrative requirements for land documentation, and inadequate institutional support from cooperatives or extension services. The government increased replanting fund allocations from IDR 30 million per hectare in 2024, yet disbursement procedures and eligibility criteria continue to limit accessibility for independent smallholders [40].

Partnership schemes and cooperative models offer institutional mechanisms to strengthen farmer positions within value chains. The Ministry of Agriculture's Regulation 18/2021 facilitates business partnerships between smallholders and plantation companies, aiming to improve market access, technical support, and input provision. Successful cooperative models, such as documented partnerships in Central Kalimantan and Jambi, demonstrate benefits including guaranteed markets, competitive pricing, access to BPDP financing, technical training, and formalization through the issuance of Plantation Business Licenses (STDB). However, many farmer cooperatives and groups remain inactive or ineffectively managed, limiting their potential to aggregate farmer interests and enhance bargaining power. Ejournal [41].

Sustainability governance frameworks—including the National Action Plan for Sustainable Palm Oil (NAP SPO), ISPO certification requirements, and international sustainability commitments—are increasingly shaping policy directions. Indonesia's push for South-South cooperation on palm oil sustainability standards reflects efforts to establish regionally-appropriate frameworks that balance environmental protection with development needs. The mandatory ISPO certification timeline for smallholders by November 2025 represents an ambitious governance target, though support mechanisms for compliance costs and technical assistance remain inadequately funded [42].

## 2.6 Technology Adoption and Productivity Gaps

Yield differentials between Indonesian and Malaysian smallholder plantations partially reflect differences in technology adoption and agronomic management practices. Research on independent smallholders in Sabah, Malaysia, identifies education levels, farm management practices, weeding frequency, pest control measures, and input costs as significant determinants of FFB yields. Indonesian smallholder productivity studies similarly emphasize the importance of proper fertilization, timely harvesting, and pest management, yet adoption rates of recommended practices remain suboptimal due to capital constraints, limited access to extension services, and inadequate technical knowledge [24].

The technology adoption literature highlights multiple barriers facing Indonesian smallholders: high upfront costs for improved inputs or equipment, inadequate training and demonstration programs, weak institutional support structures, and limited access to agricultural credit on favorable terms. These challenges are compounded for aging farmers with limited formal education, who may be less receptive to technical innovations or less able to implement complex integrated pest management strategies. Addressing productivity gaps thus requires not only technology transfer but also comprehensive capacity building, accessible financing mechanisms, and sustained extension services tailored to smallholder contexts [43].

### 3. METHODOLOGY

#### 3.1 Research Design

This study employs a qualitative literature review approach to synthesize existing knowledge on FFB price disparities between Indonesia and Malaysia and develop evidence-based policy recommendations. Unlike systematic literature reviews, which follow rigid protocols with exhaustive search strategies and meta-analytic synthesis, qualitative literature reviews offer greater flexibility in source selection, thematic exploration, and interpretive analysis, suited to complex policy questions. This methodological choice reflects the study's objectives: to understand multidimensional causal factors, interpret diverse evidence types (academic research, policy documents, industry reports), and generate actionable insights rather than statistical effect-size estimates [44].

The qualitative literature review framework enables integration of theoretical perspectives, empirical findings, and practical policy experiences across disciplinary boundaries. Thematic analysis serves as the primary analytical approach, facilitating the identification of recurring patterns, conceptual categories, and relationships among factors influencing FFB price gaps. This method proves particularly appropriate for synthesizing heterogeneous evidence sources and developing a comprehensive understanding of complex agricultural policy challenges in developing country contexts [45].

#### 3.2 Literature Search Strategy

Literature identification proceeded through multiple search strategies to ensure comprehensive coverage of relevant scholarship. Database searches covered major academic repositories, including Google Scholar, Scopus, and Web of Science, as well as regional journals focused on Southeast Asian agriculture, development economics, and sustainability studies. Search terms combined thematic keywords ("fresh fruit bunch pricing," "palm oil smallholder," "farmer welfare," "FFB price," "oil palm Indonesia Malaysia") with contextual terms ("price transparency," "value chain," "cooperative," "replanting," "certification," "K-index," "MPOB formula").

Inclusion criteria prioritized peer-reviewed journal articles published between 2020 and 2026 to capture recent evidence reflecting current market conditions, policy environments, and sustainability frameworks. Studies focusing on Indonesian and Malaysian palm oil sectors, FFB pricing mechanisms, smallholder welfare, agricultural policy interventions, and value chain dynamics received priority consideration. Government publications from authoritative sources (Indonesia's Central Statistics Agency/BPS, Malaysian Palm Oil Board/MPOB, Ministry of Agriculture), international organization reports (FAO, World Bank, UNDP), and industry association documents (GAPKI, RSPO) supplemented academic literature to provide policy context and recent statistical data. Exclusion criteria eliminated studies focused exclusively on environmental impacts without farmer welfare dimensions, publications predating 2020 unless seminal theoretical contributions, and studies from palm oil regions outside the Indonesia-Malaysia contexts with limited transferability.

#### 3.3 Data Collection and Sources

The final corpus encompasses approximately 120 sources spanning academic journal articles, government statistical reports, policy documents, industry analyses, and technical papers. Academic sources provide theoretical frameworks, empirical findings on pricing mechanisms, welfare analyses, and policy evaluations. Government data sources—particularly BPS Indonesia price statistics and MPOB Malaysia FFB reference prices—enable quantitative documentation of price gaps and temporal trends. Policy documents from Indonesian ministries and Malaysian regulatory agencies illuminate official pricing guidelines, replanting program designs, certification requirements, and sustainability governance frameworks. Industry reports from plantation associations, commodity analysts, and sustainability organizations contribute sectoral perspectives on value chain dynamics, market trends, and implementation challenges.

This multi-source approach ensures triangulation of evidence, enabling verification of key findings across different data types and stakeholder perspectives. The integration of quantitative price data, qualitative policy analysis, and empirical research on farmers' experiences provides a comprehensive foundation for understanding the determinants of the FFB price gap and for developing nuanced policy recommendations.

#### 3.4 Analytical Framework

Thematic analysis proceeded through iterative coding and categorization processes following established qualitative research protocols. Initial coding identified key concepts, factors, and relationships mentioned across literature sources. These codes were subsequently organized into thematic categories representing distinct dimensions of the FFB price gap phenomenon: pricing system characteristics, technical and quality factors, infrastructure conditions, institutional arrangements, policy interventions, and welfare outcomes. Comparative analysis systematically contrasted Indonesian and Malaysian approaches across each thematic dimension, identifying divergences in institutional design, policy implementation, and farmer support mechanisms [46].

Synthesis involved integrating findings across themes to construct comprehensive explanations of price gap causation and identify intervention leverage points. The analytical process remained attentive to methodological quality of source studies, prioritizing findings from rigorously designed empirical research while contextualizing claims from policy documents and industry reports. Validity considerations included cross-verification of key statistical claims across multiple sources, assessment of the temporal relevance of cited evidence, and evaluation of the generalizability of findings from specific regional studies to national-level

conclusions. This systematic yet flexible analytical approach enables both a detailed understanding of specific causal factors and a holistic comprehension of their interactive effects on FFB price disparities and smallholder welfare.

## 4. RESULTS

### 4.1 Magnitude and Patterns of FFB Price Gap

Quantitative evidence unambiguously confirms substantial and persistent FFB price disparities favoring Malaysian farmers across the 2019-2023 observation period. Annual comparisons reveal that Malaysian FFB prices exceeded Indonesian prices by 42.1% in 2019, 65.8% in 2020, 108.1% in 2021, 75.7% in 2022, and 11.0% in 2023, yielding a five-year average differential of 58.1%. The pattern demonstrates remarkable consistency in Malaysian price superiority—not a single year within this period recorded higher Indonesian prices. This systematic disadvantage translates directly into substantial income disparities for smallholder households operating at comparable scales and productivity levels [3], [28], [47], [48], [49].

The temporal dynamics reveal important patterns in how price gaps respond to international market conditions. The 2021 peak differential of 108.1% occurred during a period of record-high CPO prices driven by pandemic-related supply disruptions and accelerating biofuel demand. During this market boom, Malaysian farmers captured significantly greater benefits from elevated commodity prices than their Indonesian counterparts, indicating that Indonesia's pricing system fails to fully transmit international price signals to primary producers. Conversely, the 2023 narrowing to 11.0% during market normalization suggests that Indonesia's pricing mechanisms may provide relatively better protection during price downturns, though farmers still receive lower absolute prices even in this most favorable comparative scenario [50], [51], [52], [53].

Income implications at the household level underscore the welfare significance of these disparities. Assuming average productivity of 20 tonnes per hectare annually—a conservative estimate for mature plantations—Indonesian farmers averaged IDR 32.8 million per hectare per year across the five years, while Malaysian farmers received IDR 51.8 million for equivalent production. For a typical smallholder operating two hectares, this translates to an annual income difference of IDR 38 million (approximately USD 2,500-2,700 at prevailing exchange rates). For larger smallholders with four hectares, the gap reaches IDR 76 million annually. These substantial differences directly constrain Indonesian farmers' capacity for household consumption, children's education, healthcare access, and crucially, reinvestment in plantation maintenance and replanting [54], [55], [56], [57].

### 4.2 Pricing System Differences as Primary Causal Factor

Thematic analysis identifies pricing mechanism divergence as the predominant structural factor explaining FFB price disparities. Malaysia's MPOB formula operates as a transparent, nationally standardized system with several farmer-favorable characteristics. The formula directly links FFB prices to prevailing CPO and palm kernel market prices, ensuring rapid transmission of international commodity price movements to farmgate levels. Since July 2020, MPOB has standardized all reference prices based on a 1% OER, simplifying calculations and eliminating confusion caused by varying extraction rate assumptions. Daily price updates are published on accessible digital platforms, including the InfoSawit mobile application, which enables smallholders to verify current prices before negotiating sales, thereby reducing information asymmetry and enhancing bargaining power [24], [42], [58].

The national consistency of Malaysia's system prevents regional price fragmentation and ensures that smallholders across different states receive comparable compensation for FFB of equivalent quality. This standardization facilitates farmer planning and provides predictable income expectations based on observable international market conditions. Research on Malaysian price discovery mechanisms confirms that the FCPO futures market serves as the primary price discovery center for palm oil globally, with MPOB spot prices adjusting in response to futures market signals, creating an efficient transmission channel from international markets to farmer prices [59].

Indonesia's K-index system presents stark contrasts across multiple dimensions. Rather than a single national formula, K-index calculations vary across provinces, districts, and temporal periods, with monthly recalibrations that lack transparency in their derivation. Research examining K-index implementation in Banjarmasin, South Kalimantan, reveals that determination processes remain opaque to farmers, who typically receive price announcements without accompanying explanations of calculation components, cost assumptions, or adjustment rationales. This information asymmetry concentrates power with mills and intermediaries who possess superior knowledge of pricing parameters and can strategically manipulate negotiations with individual farmers [60].

Additional cost deductions constitute another critical difference between the systems. Indonesian farmers face various charges—transportation fees, weighing costs, quality penalties—that are deducted from quoted FFB prices, yet these deductions are inconsistently applied and inadequately disclosed. The attached document notes that after accounting for these additional costs, farmers' realized prices fall substantially below nominal quotations. In contrast, Malaysian MPOB prices represent clear reference points with standardized delivery terms, reducing opportunities for arbitrary deductions [61].

The explanatory power of differences in pricing systems becomes evident through controlled analysis. The attached empirical examination demonstrates that after normalizing for OER differentials (Malaysia's 21% versus Indonesia's 20% average), the price gap declines from 58.1% to only 53.1%—meaning OER accounts for merely 5 percentage points while pricing system and structural

factors explain the remaining 53.1%. This finding definitively refutes arguments attributing price disparities primarily to technical efficiency gaps, redirecting attention to institutional and policy determinants amenable to reform interventions [3], [62], [63], [64].

#### 4.3 Technical and Quality-Related Factors

While technical factors contribute to price differentials, their explanatory power is considerably more limited than that of pricing system variations. Oil Extraction Rate differences between Indonesian (averaging 20%) and Malaysian (21-21.5%) estates reflect variations in genetic material quality, plantation age profiles, agronomic practices, and processing efficiency. Malaysian plantations benefit from more consistent replanting cycles that maintain younger age profiles with superior OER performance, whereas Indonesia's aging smallholder estate (average 25+ years) increasingly suffers declining extraction efficiency. However, as established above, OER differences explain only approximately 5% of the observed price gap [31], [65], [66], [67].

FFB quality grading systems and their implementation generate additional price variations. Malaysia employs standardized grading criteria based on Malaysian Standards specifications, assessing factors including ripeness, bruising, stalks, unripe bunches, and empty bunches. Systematic quality assessments enable differentiated pricing that rewards superior handling and harvesting practices while penalizing quality deficiencies. Indonesian grading systems exist in principle but are less consistently implemented, with research documenting that grading-related price differentials of 300-500 Rupiah per kilogram occur based on subjective mill assessments rather than standardized protocols. This inconsistency creates uncertainty for farmers regarding expected price realization and reduces incentives for quality-enhancing investments in harvesting and handling infrastructure [68].

The quality dimension interacts significantly with infrastructure conditions. Poor rural road quality in many Indonesian production regions causes substantial FFB degradation during transportation from farms to mills. Extended transport times on rough roads increase bruising, overripening, and loose fruit separation, all of which reduce both extraction efficiency and market value. Malaysian infrastructure investments in plantation region road networks minimize transport-related quality deterioration, enabling farmers to maintain FFB condition and capture full value for their production [69].

#### 4.4 Infrastructure and Logistics Cost Factors

Infrastructure deficits impose tangible cost burdens that directly reduce Indonesian farmers' realized FFB prices. Transportation infrastructure quality poses the most immediate challenge—inadequate road conditions in major palm oil-producing regions of Sumatra and Kalimantan increase transport costs and degrade delivery quality to mills. During rainy seasons, road conditions deteriorate further, sometimes rendering routes impassable and forcing farmers to accept distressed sales at reduced prices or incur extraordinary transport expenses to reach accessible collection points [4].

The logistics cost structure disadvantages Indonesian farmers relative to Malaysian counterparts in multiple ways. Transportation costs are frequently passed directly to farmers through price deductions rather than absorbed by mills, whereas Malaysian pricing systems more commonly include transportation in mill responsibilities. Distance to processing facilities varies substantially across Indonesian regions, with smallholders in remote areas facing significantly higher per-kilogram transport costs that directly reduce their net income. Collection point infrastructure—weighbridges, storage facilities, quality assessment stations—remains underdeveloped in many Indonesian production zones, forcing farmers to transport FFB to distant mill locations rather than aggregating production at intermediate facilities for bulk transport [70].

These infrastructure constraints interact with the fragmented nature of Indonesian smallholder production. Unlike large-scale estate operations that achieve economies of scale in logistics, individual smallholders with 1-2-hectare holdings produce volumes insufficient to negotiate favorable transport arrangements or to justify investment in specialized FFB transport vehicles. Cooperative aggregation could theoretically address this challenge, yet many farmer cooperatives remain inactive or ineffectively managed, failing to provide the collective logistics services that would reduce individual farmers' costs [40].

#### 4.5 Bargaining Power and Market Structure

Structural asymmetries in bargaining power fundamentally disadvantage Indonesian smallholder farmers in price negotiations with mills and intermediaries. Research consistently documents that independent smallholders operating outside formal partnership schemes possess minimal leverage to influence price terms, acceptance of their production, or payment schedules. Mills and intermediaries control essential market access, often representing the only viable buyer within economically feasible transport range for smallholder farmers. This monopsony or oligopsony market structure enables buyers to exercise price-setting power, particularly when dealing with individual farmers who lack alternative marketing channels [71].

Information asymmetry compounds power imbalances. While mills possess comprehensive knowledge of international CPO prices, domestic market conditions, K-index calculation parameters, and processing economics, individual farmers typically have access to only limited price information—often receiving price quotes without justification or transparency into the underlying formulas. This knowledge differential enables strategic behavior by buyers, who can selectively share or withhold information to influence negotiation outcomes in their favor. The opacity of Indonesia's K-index system—contrasting sharply with Malaysia's transparent MPOB reference prices accessible via mobile applications—institutionalizes this information asymmetry [24].

Organizational capacity among Indonesian smallholders remains inadequately developed to counterbalance buyer power. While farmer cooperatives and producer organizations theoretically offer mechanisms for collective action, research reveals that many

cooperatives are inactive, poorly managed, or ineffectively governed. Studies of successful cooperative models—such as Sinar Berkah Cooperative's partnership programs—demonstrate potential benefits, including guaranteed markets, competitive pricing, access to credit facilities, and technical support services. However, these effective cooperatives remain exceptional rather than normative. Weak institutional capacity stems from multiple factors: limited management skills among farmer leaders, inadequate financial resources for professional administration, fragmented membership without a strong collective identity, and insufficient government or NGO support for cooperative capacity building [41].

Malaysia's relatively stronger cooperative infrastructure and organized smallholder groups, often facilitated through government-supported Smallholder Plantation Owner Cooperatives (KPSM) within Smallholder Palm Oil Centers (SPOC), provide more robust institutional platforms for collective action and farmer representation. The contrast highlights that organizational development constitutes a critical complement to pricing transparency reforms—even optimal pricing formulas require effective farmer institutions to monitor implementation and ensure compliance [72].

#### 4.6 Policy Environment and Government Support

Policy frameworks and government support programs significantly influence the enabling environment for FFB pricing and smallholder welfare, though implementation effectiveness varies considerably. Indonesia's export levy system on CPO generates substantial fiscal revenue channeled through BPDP to finance biodiesel subsidies, replanting programs, infrastructure development, and smallholder support initiatives. The progressive levy structure, with rates adjusted based on international CPO prices, theoretically ensures that windfall profits during price booms contribute to sector development. However, questions persist about the efficiency of revenue utilization and the extent to which levy-funded programs effectively reach independent smallholder beneficiaries rather than larger estate operations [30], [65], [73], [74].

The performance of the replanting program illustrates significant implementation gaps between policy intentions and outcomes. Despite recognition that aging plantation profiles (averaging 25+ years for smallholder estates) urgently require replanting to maintain productivity, actual replanting achievements fall dramatically short of targets. The Smallholder Replanting Program set a 500,000-hectare target for 2022, achieving only 54.7% of that. Annual performance remains disappointing, with 2023 replanting approvals covering only 53,012 hectares against a 180,000-hectare target. By 2025, the cumulative replanting requirement will reach 2.4 million hectares, yet current trajectories suggest this goal remains unattainable without a fundamental redesign of the program [9], [10], [75], [76], [77], [78].

Multiple barriers constrain smallholders' uptake of replanting. Capital requirements of IDR 50-60 million per hectare exceed most farmers' savings capacity, particularly when compounded by 3-4 years of lost income during the replanting establishment period before new palms reach productive maturity. While BPDP offers replanting financing that increased from IDR 30 million per hectare in 2024, complex administrative requirements—particularly land documentation and certification prerequisites—exclude many independent smallholders who lack formal land titles or plantation business licenses. Institutional support deficits compound these challenges, with inactive cooperatives failing to facilitate group applications or provide technical assistance during replanting implementation [77], [78], [79], [80], [81].

Certification policy trajectories diverge notably between Indonesia and Malaysia, with implications for farmer support requirements and market access. Malaysia achieved MSPO certification for 86%+ of production through a combination of mandatory requirements, systematic government support, and digital traceability infrastructure via the eMSPO system. Indonesia's ISPO certification, mandatory for smallholders by November 2025, faces more challenging implementation prospects given current smallholder certification rates of 35-36% and limited support mechanisms for compliance costs. Certification expenses account for 16-39% of annual smallholder income, creating substantial financial barriers in the absence of cost-sharing mechanisms or streamlined group certification procedures. The divergence suggests that Malaysia's more comprehensive support infrastructure—encompassing both pricing transparency and certification assistance—creates more enabling conditions for smallholder success [82], [83], [84], [85].

Downstream development policies, while primarily targeting value-added processing rather than FFB pricing directly, shape the broader industry context. Indonesia's downstreaming initiatives expanded palm oil product diversity from 54 types in 2011 to 168 in 2021, with targets of 200 derivatives by 2030 and positioning Indonesia as the global CPO price benchmark setter by 2045. Policy recommendations emerging from downstream strategy discussions emphasize the importance of FFB price stabilization as a prerequisite for sustainable supply chains, suggesting growing recognition that farmer welfare and industry competitiveness are complementary rather than competing objectives [86].

#### 4.7 Value Chain Profit Distribution

Analysis of profit distribution across the palm oil value chain reveals structural imbalances that contextualize FFB pricing challenges. Research by Chain Reaction Research demonstrates that fast-moving consumer goods companies and retailers capture approximately 66% of gross profits in the global palm oil value chain, while smallholder producers—contributing roughly 30% of global CPO production—receive disproportionately smaller profit shares. This value capture asymmetry reflects power dynamics wherein downstream actors with strong brands, diversified supplier options, and direct consumer relationships extract rents, while upstream producers of undifferentiated commodities face competitive pressures that limit profit margins [18], [87], [88], [89], [90].

Within producing countries, profit distribution between estates, mills, refiners, and traders similarly concentrates value downstream from primary production. Indonesian smallholders face particular disadvantages due to the multi-layered intermediary structure common in FFB marketing channels. Many independent farmers sell through agents or collectors who aggregate small volumes for resale to mills, with each intermediary layer extracting margins that reduce farmer price realization. Partnership schemes and direct mill relationships can eliminate intermediary costs, explaining why farmers in effective cooperative partnerships achieve higher welfare outcomes than independent operators [33].

The downstream development emphasis in Indonesian policy—while generating economic value through diversified processing—has not automatically translated into improved terms of trade for farmers. Creating more equitable value chain distribution requires explicit attention to pricing mechanisms, farmer organizations, and power-balancing interventions rather than assuming that overall industry profitability will spontaneously benefit primary producers. Malaysia's relatively stronger farmer price realization suggests that institutional design choices matter substantially for determining how value chain profits are allocated across participants [30], [86], [91], [92].

## 5. DISCUSSION AND ANALYSIS

### 5.1 Synthesis of Causal Factors

The convergent evidence establishes pricing system design as the dominant structural determinant of FFB price disparities between Indonesia and Malaysia. The transparency differential between Malaysia's standardized MPOB formula and Indonesia's opaque, regionally fragmented K-index system creates systematic disadvantages for Indonesian farmers across multiple dimensions. Transparency matters not merely for farmers' understanding of how prices are calculated, but fundamentally shapes bargaining power dynamics. When Malaysian smallholders access daily MPOB reference prices via mobile applications, they enter sales negotiations armed with objective market information that constrains buyers' ability to offer below-market prices. Indonesian farmers lacking equivalent information face inherent disadvantages, dependent on buyer representations about appropriate prices without independent verification capacity [24], [93], [94], [95].

National standardization versus regional fragmentation represents another critical design choice with welfare implications. Malaysia's uniform national pricing framework prevents geographic arbitrage and ensures that smallholders across different states receive comparable compensation for equivalent quality production. Indonesia's provincial and district-level K-index variations create price fragmentation that benefits mills operating across multiple jurisdictions—they can strategically source from regions with lower K-index determinations while farmers lack comparable flexibility to market across administrative boundaries. This jurisdictional arbitrage opportunity for buyers but not sellers systematically disadvantages farmer interests [96].

The direct CPO price linkage in Malaysia's formula, versus the indirect, mediated relationships in Indonesia's K-index, affects price transmission speed and completeness. Malaysia's automatic adjustment mechanisms ensure that when international CPO prices rise, FFB prices increase correspondingly within days, enabling farmers to capture the benefits of the commodity boom. Indonesia's monthly K-index recalculations introduce lags that delay farmer benefit realization, while the discretionary elements in calculation permit selective transmission that favors buyer interests during rising price periods. The asymmetric pattern observed in empirical data—peak price gaps during commodity booms (108.1% in 2021) versus narrower gaps during price normalizations (11.0% in 2023)—directly reflects these differences in transmission mechanisms [97].

Infrastructure deficits compound the disadvantages of the pricing system by imposing tangible cost burdens and quality deterioration, thereby reducing realized prices. Poor rural road conditions, inadequate collection point facilities, and long transport distances impose costs that are disproportionately borne by farmers rather than equitably shared across value chain participants. These infrastructure constraints interact with weak cooperative institutions—effective farmer organizations could aggregate production, negotiate collective transport arrangements, and achieve logistics economies of scale, but inactive or poorly managed cooperatives fail to deliver these services [98].

### 5.2 Welfare Implications for Smallholder Farmers

The 58.1% average price gap translates into profound welfare consequences across multiple dimensions of smallholder livelihoods. Income inequality represents the most immediate impact—Indonesian farmers producing identical quantities of the same commodity receive 58% less compensation than their Malaysian counterparts, creating systematic economic disadvantage despite comparable labor inputs and production efforts. While Indonesian palm oil farmers earn approximately five times more than non-palm agricultural producers in their regions, this national income advantage obscures international comparisons, revealing substantial unrealized potential welfare gains [1].

Reinvestment capacity constraints pose particularly severe long-term consequences. With aging plantation profiles averaging 25+ years and optimal economic lifespans of 20-25 years, Indonesian smallholder estates urgently require replanting to maintain productivity. Replanting costs of IDR 50-60 million per hectare, combined with 3-4 years of foregone income during establishment periods, demand substantial financial resources that lower FFB prices render unattainable for most independent farmers. The resulting cycle of declining yields due to aging palms, reduced incomes from both lower productivity and lower prices, and

insufficient capital for replanting threatens the long-term sustainability of Indonesia's smallholder palm oil sector [9], [76], [78], [81], [99].

Input utilization and agronomic management practices are similarly constrained by income. Optimal fertilization regimes, integrated pest management, proper harvesting techniques, and quality-preserving handling all require investments that financially-stressed farmers may defer or minimize. Technology adoption barriers—already substantial due to knowledge gaps and institutional support deficits—are compounded when low incomes prevent farmers from affording improved genetic material, specialized equipment, or certified inputs even when they possess technical knowledge of best practices [100].

Vulnerability to price volatility and production shocks represents an additional welfare dimension. Lower baseline incomes provide smaller financial buffers to absorb income fluctuations from market price swings or from yield variations caused by weather, pests, or disease. While Malaysia's higher FFB prices create larger safety margins enabling farmer households to maintain consumption during adverse periods, Indonesian farmers' thinner margins force more frequent resort to distressed asset sales, debt accumulation, or consumption reductions that compromise nutritional status and children's education [81].

### 5.3 Sustainability and Long-term Industry Competitiveness

The FFB price gap illuminates a fundamental paradox in Indonesia's palm oil sector: short-term cost competitiveness built on low farmgate prices versus long-term sustainability requirements for farmer welfare and productive reinvestment. Lower FFB prices reduce Indonesian mills' input costs relative to Malaysian competitors, potentially enhancing export competitiveness in price-sensitive markets. However, this cost advantage extracts value from the least economically powerful value chain participants—smallholder farmers—whose constrained incomes undermine sustainability across environmental, social, and economic dimensions [101], [102], [103], [104], [105].

Environmental sustainability suffers when low incomes prevent replanting of aging, low-productivity plantations. Farmers unable to afford in-situ replanting face pressures to establish new plantations through forest conversion—the very land use change that drives deforestation criticisms of palm oil production. Systematic replanting of existing cultivated areas represents the environmentally preferable intensification pathway, yet requires financial resources that current FFB prices inadequately provide. The policy analysis warning that 3.4 million hectares of illegal oil palm already exist in forest areas, with expansion pressures continuing absent improved productivity on existing lands, underscores how pricing failures contribute to environmental challenges [106].

Social sustainability dimensions encompass rural livelihood quality, youth retention in agricultural sectors, and community development prospects. When palm oil farming generates incomes 58% below regional comparators for identical work, younger generations rationally pursue alternative livelihoods through urban migration or other economic sectors. The resulting aging of the farmer population, documented in multiple studies, threatens knowledge transfer, physical capacity for labor-intensive cultivation tasks, and long-term sector viability. Rural community development—schools, healthcare facilities, infrastructure, social services—depends substantially on agricultural income levels that support tax revenues and household expenditures; systematically depressed farm incomes thus constrain broader rural development trajectories [107].

Economic sustainability requires that farming generates returns sufficient to maintain productive asset quality, adopt productivity-enhancing technologies, and attract new generational investment. Certification compliance—increasingly a prerequisite for market access to sustainability-conscious buyers—imposes costs that amount to 16-39% of annual income, which financially stressed farmers cannot absorb. The divergence between Malaysia's 86%+ MSPO certification achievement and Indonesia's 35-36% ISPO coverage partially reflects differences in support infrastructure, but also the reality that economically marginal farmers cannot afford certification costs absent cost-sharing mechanisms [108], [109].

Industry reputation and market access increasingly depend on demonstrable sustainability credentials, particularly in terms of farmer welfare indicators. European market requirements under the EU Deforestation Regulation, sustainability verification demands from multinational buyers, and consumer pressure for ethical sourcing create market access risks for palm oil industries unable to demonstrate adequate farmer compensation and welfare standards. Indonesia's pricing system, which systematically disadvantages smallholders, thus carries strategic risks beyond immediate farmer welfare concerns—it potentially undermines long-term market access and industry positioning in sustainability-oriented value chains [106].

### 5.4 Comparative Policy Analysis: Indonesia vs Malaysia

Systematic comparison of Indonesian and Malaysian approaches across key policy dimensions reveals institutional choices that explain differential outcomes. Pricing policy represents the most fundamental divergence. Malaysia's decision to centralize pricing through MPOB with transparent formulas, standardized parameters, and accessible information dissemination creates enabling conditions for farmer empowerment. Indonesia's decentralized, opaque K-index approach—while perhaps intended to provide provincial flexibility for local conditions—has instead generated fragmentation, information asymmetries, and opportunities for buyer advantage that systematically disadvantage farmers [29], [50], [110], [111].

Support program design and implementation effectiveness differ substantially. Malaysia's replanting support, cooperative development initiatives, and certification assistance operate through relatively streamlined institutional channels with higher farmer accessibility. Indonesia's programs—while well-intentioned and sometimes adequately funded—face implementation barriers,

including bureaucratic complexity, documentation requirements that exclude informal operators, and insufficient institutional capacity at the cooperative or farmer group level to facilitate access. The replanting achievement gap (54.7% of the target in Indonesia versus more successful Malaysian rates) directly reflects these implementation differences [72].

Certification governance pathways illustrate contrasting approaches to mandatory sustainability standards. Malaysia's MSPO implementation combined mandatory requirements with systematic government support, financing assistance, streamlined group certification procedures, and digital infrastructure (eMSPO), thereby reducing compliance burdens. Indonesia's ISPO mandate—equally ambitious in scope—proceeds with more limited support mechanisms, creating risks that the November 2025 smallholder deadline will be missed or poorly enforced absent a substantial intensification of capacity-building and cost-sharing programs [112], [113], [114], [115].

The comparative analysis suggests that Malaysian policy coherence—aligning transparent pricing, comprehensive farmer support, effective certification assistance, and strong cooperative infrastructure—creates synergistic benefits that exceed the effects of individual programs. Indonesia's more fragmented approach, with periodic initiatives in replanting, certification, or cooperative development that proceed without systematic integration, yields more limited results. Policy transfer opportunities exist, but successful adaptation requires attention to institutional capacity preconditions and political economy factors that may differ between contexts [103], [116], [117], [118].

### 5.5 Strategies for Narrowing the Price Gap

Evidence-based analysis supports a multi-tiered intervention framework encompassing immediate transparency reforms, medium-term institutional strengthening, and long-term structural transformations. Short-term interventions (0-2 years) should prioritize enhancing pricing transparency and improving information accessibility. Adopting a standardized national FFB pricing formula with transparent parameters—similar to Malaysia's MPOB approach—would immediately reduce information asymmetries and strengthen farmers' bargaining positions. Publishing daily reference prices through accessible digital platforms, including mobile applications, enables farmers to verify market-appropriate prices before sales negotiations. Eliminating or standardizing non-essential cost deductions (arbitrary transport charges, weighing fees, subjective quality penalties) would reduce opportunities for strategic buyer manipulation and increase farmer price realization [24].

Cooperative strengthening and collective bargaining capacity development constitute critical medium-term priorities (2-5 years). Targeted capacity-building programs focusing on cooperative governance, financial management, market negotiation skills, and service delivery would transform inactive organizations into effective farmer institutions. The Agriterra-Ministry of Cooperatives-RSPO partnership model, emphasizing professional management development and business sustainability, offers promising templates for scaled interventions. Facilitating direct farmer-mill partnerships that bypass multiple intermediaries would reduce value chain leakage and increase farmers' share of the final product value. Developing farmer representation mechanisms within pricing determination processes—whether through cooperative representatives on provincial pricing committees or formal consultation requirements—would introduce farmer voice into currently buyer-dominated systems [119], [120], [121], [122], [123]. Infrastructure investment represents another essential medium-term intervention. Prioritizing rural road improvements in major palm oil-producing regions would reduce transportation costs, minimize quality degradation, and expand farmers' effective market access radius. Developing farmer collection points with weighbridges, storage facilities, and quality-assessment equipment would enable economies of scale and reduce dependence on mill infrastructure. Integrated infrastructure planning that coordinates road development, collection point establishment, and mill location optimization could generate substantial logistics efficiency gains, benefiting farmer incomes [70].

Accelerating the replanting program requires a comprehensive redesign that addresses identified barriers. Streamlining BPDP fund disbursement procedures, simplifying documentation requirements, and providing income support during establishment periods would increase program accessibility and uptake. Expanding financing partnerships with banking institutions to offer favorable loan terms, complementing grant support, would leverage public resources. Developing alternative income-generating activities during replanting periods—intercropping, livestock integration, and off-farm employment facilitation—could reduce the economic stress that currently deters replanting decisions [28], [79].

Sustainability certification support through cost-sharing mechanisms and integrated government services would accelerate ISPO compliance while reducing farmer financial burdens. Subsidizing audit costs, providing free technical assistance for documentation preparation, and streamlining procedures through group certification approaches would lower barriers to entry. Ensuring that certification generates tangible benefits—market access, price premiums, preferential financing—would strengthen farmer incentives beyond compliance pressure alone [124].

Long-term structural transformations (5+ years) encompass comprehensive palm oil governance reforms that integrate sustainability, equity, and competitiveness objectives. Establishing an integrated national palm oil authority analogous to MPOB—coordinating pricing, quality standards, research, extension, market information, and farmer support—could overcome current institutional fragmentation. Mandatory value-chain profit-sharing mechanisms or minimum farmgate price floors linked to CPO prices would formalize farmers' entitlement to reasonable value shares. Regional cooperation and knowledge exchange platforms

with Malaysia, including joint research initiatives, farmer exchange programs, and policy dialogue forums, would facilitate learning and potential harmonization of beneficial practices [29].

## 6. CONCLUSION

### 6.1 Substantive Conclusions

This qualitative literature review confirms the existence of substantial, persistent, and systematic FFB price disparities between Indonesia and Malaysia, with Indonesian smallholder farmers receiving 58.1% lower average prices across the 2019-2023 period despite producing identical commodities under comparable conditions. The price gap exhibits temporal variation—peaking at 108.1% during commodity price booms and narrowing to 11.0% during market normalizations—yet consistently favors Malaysian farmers across all observed periods. This systematic disadvantage translates directly into significant household income inequality, with typical two-hectare Indonesian smallholders earning approximately IDR 38 million less annually than their Malaysian counterparts.

Causal analysis establishes that differences in pricing systems—specifically the transparency, standardization, and farmer-favorable design of Malaysia's MPOB formula versus the opacity, fragmentation, and complexity of Indonesia's K-index system—serve as the primary structural determinant of price disparities. After controlling for oil extraction rate differentials, which account for only 5 percentage points of the gap, pricing system and institutional factors explain the remaining 53.1% differential. This finding decisively refutes explanations attributing price disparities primarily to technical efficiency or productivity gaps, directing policy attention toward institutional reforms amenable to deliberate intervention.

Multiple compounding factors amplify the disadvantages of the pricing system. Infrastructure deficits—particularly poor rural road conditions and inadequate collection point facilities—impose tangible costs and quality deterioration, reducing farmer price realization. Weak bargaining power stemming from monopsony market structures, information asymmetries, and ineffective farmer cooperatives enables buyers to exercise strategic advantage in price negotiations. Policy implementation gaps in replanting programs, certification support, and cooperative capacity-building limit the effectiveness of government interventions aimed at strengthening smallholders' positions.

The welfare implications extend beyond immediate income effects to encompass constraints on reinvestment capacity, barriers to technology adoption, vulnerability to economic shocks, and threats to long-term sustainability. Aging plantation profiles averaging 25+ years require urgent replanting, which low incomes render financially unattainable for most independent farmers, creating a vicious cycle of declining productivity, reduced incomes, and insufficient capital for productive renewal. Certification compliance challenges, youth migration from agricultural livelihoods, and environmental pressures to convert forests rather than intensify them all connect to the fundamental reality of inadequate farmgate compensation.

### 6.2 Policy Recommendations

#### 6.2.1 Immediate Priority: Pricing Transparency Reform

Indonesia should adopt a transparent national FFB pricing formula modeled on Malaysia's MPOB system, establishing clear linkages between international CPO prices and farmgate FFB prices, with standardized extraction-rate assumptions. This reform represents the highest-impact intervention available, directly addressing the primary causal factor identified through this analysis. The pricing formula should be published with full parameter transparency, with calculation methodologies clearly explained, and updates disseminated through accessible digital platforms, including mobile applications that enable farmers to verify current market-appropriate prices.

Eliminating opaque cost deductions and standardizing fee structures would reduce opportunities for strategic manipulation by buyers. Transportation costs, weighing charges, and quality assessments should follow transparent, published guidelines with standardized rate schedules that prevent arbitrary deductions. Establishing independent pricing oversight mechanisms—potentially including farmer cooperative representation, academic monitoring, or civil society observation—would enhance accountability and ensure formula adherence in practice.

#### 6.2.2 Institutional Strengthening

Empowering farmer cooperatives through comprehensive capacity-building programs represents essential institutional infrastructure for sustainable price improvement. Technical assistance in cooperative governance, financial management, business planning, and service delivery would transform inactive organizations into effective member-serving institutions. The Agriterraria-Ministry of Cooperatives partnership model, which emphasizes professional management development and business sustainability, offers promising templates for national-scale expansion.

Facilitating direct farmer-mill partnerships that bypass exploitative intermediaries would increase farmers' share of value in the value chain. Policy support for contract farming arrangements, outgrower schemes, and plasma partnerships should include regulatory safeguards ensuring fair terms, transparent pricing, timely payment, and farmer grievance mechanisms. Strengthening farmer organizations' collective bargaining capacity through training, legal support, and facilitated negotiations would gradually rebalance power dynamics toward more equitable outcomes.

Developing farmer representation in pricing committees at provincial and national levels would introduce producer voice into processes currently dominated by buyer interests. Formal consultation requirements, cooperative representative seats on pricing boards, and public comment periods before K-index adjustments would create institutional channels for farmer input and oversight.

### **6.2.3 Infrastructure and Logistics Improvement**

Prioritizing rural road infrastructure in major palm oil-producing regions should constitute a core development investment strategy. Improved road quality reduces transportation costs, minimizes FFB quality degradation, and expands farmers' effective market access options. Infrastructure planning should coordinate road development with the establishment of collection points to maximize logistics efficiency.

Developing farmer collection points equipped with weighbridges, temporary storage facilities, and quality assessment equipment would enable production aggregation and reduce dependence on mill-controlled infrastructure. These collection points could be managed by cooperatives or farmer groups, providing institutional bases for collective marketing while generating employment for local communities. Integrating infrastructure planning with replanting program location targeting would ensure that improved logistics support reinvigorates plantations.

### **6.2.4 Replanting and Productivity Enhancement**

Streamlining BPDP replanting fund disbursement procedures by simplifying documentation requirements, expediting approval processes, and making application interfaces farmer-friendly would increase program accessibility. Providing income support during the 3-4 year establishment period—potentially through intercropping allowances, livestock integration support, or temporary employment facilitation—would reduce the economic deterrent effect that currently suppresses replanting uptake.

Expanding financing partnerships with banks to offer favorable replanting loans, complementing grant support, would leverage public resources and provide flexible options for diverse farming circumstances. Accelerating administrative processes for land documentation and the issuance of plantation business licenses would remove bureaucratic barriers that currently exclude many independent smallholders from program eligibility.

### **6.2.5 Technology and Knowledge Transfer**

Establishing systematic extension services that deliver best management practice training, pest and disease control guidance, optimal fertilization protocols, and quality-preserving harvest techniques would address knowledge gaps that constrain productivity. Extension services should operate through accessible channels, including farmer field schools, demonstration plots, peer-to-peer learning networks, and digital information platforms.

Facilitating Indonesia-Malaysia knowledge exchange programs—including farmer study tours, technical expert exchanges, research collaboration, and policy dialogue—would enable learning from Malaysia's successful approaches while adapting insights to Indonesian contexts. Developing farmer training centers in key production areas would create permanent institutional infrastructure for capacity building and technology transfer.

Supporting the adoption of quality improvement technologies through subsidized access or cost-sharing mechanisms would help farmers meet grading standards and capture premium prices. Investments in improved genetic material, specialized harvesting equipment, and quality-preserving transport containers require initial capital that financially constrained farmers cannot self-finance absent targeted support programs.

### **6.2.6 Sustainability Certification Support**

Subsidizing ISPO certification costs for independent smallholders through government funding or BPDP resources would remove financial barriers currently preventing compliance. Providing free technical assistance for documentation preparation, internal control system development, and audit readiness would address knowledge and capacity constraints beyond financial costs alone. Integrating government services to reduce farmer compliance expenses—including land titling, environmental compliance verification, and labor documentation—would streamline certification pathways. Group certification approaches that enable cooperative-level certification covering multiple smallholder members would reduce per-farmer costs through economies of scale. Ensuring premium benefits reach certified farmers through market linkages, preferential financing, or direct price incentives would strengthen positive reinforcement for certification investment. Without tangible economic returns, certification remains a compliance burden rather than a value-creating opportunity that farmers voluntarily pursue.

## **6.3 Contribution to Knowledge**

This study contributes to academic and policy discourse across multiple dimensions. It provides comprehensive quantitative documentation of FFB price disparities between Indonesia and Malaysia, using recent data spanning 2019-2023, and establishes empirical foundations for understanding the scale and temporal patterns of price gaps. The systematic decomposition of causal factors through thematic literature synthesis advances analytical understanding beyond anecdotal observations or single-factor explanations, demonstrating the predominant role of pricing system design while recognizing compounding influences from infrastructure, institutions, and policies.

The multi-dimensional policy framework developed through evidence synthesis offers actionable guidance that integrates economic welfare, sustainability, and competitiveness perspectives rather than treating these as competing objectives. By demonstrating that Malaysian approaches achieve both superior farmer welfare outcomes and successful sustainability certification implementation,

the analysis challenges assumptions that farmer interests must be sacrificed for industry competitiveness or environmental goals. The research thus contributes to evolving paradigms recognizing that equitable value chain distribution, environmental sustainability, and economic viability can be mutually reinforcing when supported by appropriate institutional designs and policy frameworks.

#### 6.4 Future Research Directions

Several promising research directions emerge from this analysis. A longitudinal impact assessment of pricing reform interventions would provide empirical evidence on how transparency improvements, standardized formulas, and digital information platforms affect actual farmer price realization, bargaining outcomes, and welfare indicators. Such studies could employ quasi-experimental designs that compare provinces or districts implementing reforms with control regions, generating rigorous evidence on intervention effectiveness.

Quantitative modeling of price transmission mechanisms between international CPO markets, domestic wholesale prices, and farmgate FFB prices would illuminate the specific channels through which pricing system design influences transmission efficiency and completeness. Econometric analysis could estimate transmission elasticities, asymmetric price adjustment patterns, and the magnitude of buyer market power effects, complementing qualitative institutional analysis with precise quantitative parameters.

Farmer perception studies examining smallholder understanding of pricing systems, satisfaction with price transparency, trust in cooperative institutions, and preferences among alternative marketing arrangements would center farmer voice in policy development. Participatory research methodologies that engage farmers as research collaborators rather than merely subjects could generate insights unavailable through expert analysis alone.

A comparative effectiveness evaluation of different cooperative models—examining which organizational structures, governance arrangements, service portfolios, and management approaches yield superior farmer welfare outcomes—would provide evidence-based guidance for institutional development programs. Such research could identify success factors and failure modes, enabling more targeted capacity-building interventions.

Cost-benefit analysis of infrastructure investments, quantifying the economic returns to rural road improvements, collection point development, or logistics system optimization, would support evidence-based prioritization of development expenditures. Integrating spatial analysis of plantation locations, road networks, and mill capacities could identify optimal investment sequences maximizing farmer welfare impacts per rupiah invested.

Climate change adaptation impacts on smallholder productivity, FFB quality, and pricing dynamics represent an emerging research priority. Understanding how temperature increases, rainfall variability, and extreme weather events affect palm oil production systems—and how adaptation investments interact with pricing and welfare outcomes—will become increasingly critical as climate impacts intensify. This research agenda would connect agronomic, economic, and policy dimensions to inform climate-resilient development pathways for Indonesia's smallholder palm oil sector.

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