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Integrating Quality Function Deployment and Analytic Hierarchy Process to Analyze Third-Party Fresh Fruit Bunch Supplier Needs: A Case Study of Torgamba Palm Oil Mill, PTPN IV Regional 1, Indonesia

Hendra Kesuma[1], Yustiar Gunawan[2]

[1]Master of Industrial Engineering Study Program, Faculty of Applied Science and Technology, Institut Sains dan Teknologi Nasional (ISTN), Jakarta, Indonesia,
[2]PT Perkebunan Nusantara IV Regional 1, Medan, Indonesia.

Corresponding Author: Hendra Kesuma

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ABSTRACT

Fresh fruit bunch (FFB) availability is the primary determinant of processing continuity and production stability at palm oil mills whose own-estate supply falls short of installed milling capacity. At Torgamba Palm Oil Mill (PKS Torgamba), operated by PT Perkebunan Nusantara IV (PTPN IV) Regional 1, own-estate FFB covered only around 80% of the 900–1,000 ton/day processing capacity between 2020 and 2025, leaving a persistent daily shortfall of 300–400 tons that is met by third-party FFB suppliers operating under transactional, non-binding arrangements amid competition from roughly twelve neighboring mills. Despite the strategic role of these suppliers, prior studies integrating Quality Function Deployment (QFD) and the Analytic Hierarchy Process (AHP) have concentrated on new-product or service design for end customers or on one-off supplier-selection decisions, leaving supplier-partnership retention in agro industrial raw-material chains largely unexplored. This study identifies third-party FFB supplier needs, weights them using AHP, and translates the results into prioritized company actions through a first-level House of Quality (HoQ). Voice-of-customer analysis, conducted with ten internal experts and validated with third-party suppliers and their affiliated smallholders, yielded four criteria (financial, operational, relational, technical) and eight sub-criteria. AHP weighting (Consistency Ratio = 0.0225) identified the financial aspect as dominant (57.4%), with payment timeliness as the single highest-weighted sub-criterion (42.5%). Integration with QFD produced eight ranked technical responses, led by a twice-weekly Weekly Payment System (technical importance = 3.825; 28.0% share), FFB reference pricing (20.5%), and quality-criteria socialization (15.0%). The study further operationalizes the top-ranked recommendation into a proportional lot-sizing scheme for payment administration staffing, bridging strategic QFD-AHP prioritization with workforce-level implementation – a linkage rarely made explicit in the QFD-AHP literature.

Keywords: third-party FFB suppliers; Analytic Hierarchy Process; Quality

Function Deployment; House of Quality; supplier partnership sustainability; lot sizing

1. INTRODUCTION

Oil palm is one of the most economically significant plantation commodities in Indonesia, producing crude palm oil (CPO) that is used across the food, pharmaceutical, cosmetic, and oleochemical industries, as well as in cooking oil and biodiesel production. According to Statistics Indonesia (BPS, 2023), Indonesia's total oil palm plantation area reached 16,833,985 hectares in 2023. This comprised 577,937 hectares of state-owned plantations, 8,614,259 hectares of private plantations, and 6,736,516 hectares of smallholder plantations, accounting for approximately 40.02% of the national total. An additional 905,273 hectares were classified as land area with unconfirmed data. This ownership structure indicates that a substantial proportion of national fresh fruit bunch (FFB) production originates from plantations outside the direct ownership of individual palm oil mills, making third-party raw material sourcing an important structural feature of the Indonesian palm oil industry.

Torgamba Palm Oil Mill (PKS Torgamba) is one of fourteen mills operated by PT Perkebunan Nusantara IV (PTPN IV) Regional 1. Built in 1982 and inaugurated on 8 July 1983, the mill is located in Torgamba Village, Torgamba Sub-district, South Labuhan Batu Regency, North Sumatra Province, with an installed processing capacity of 50 tons of FFB per hour, or up to 1,000 tons per day. Table 1 summarizes FFB throughput from own estates and third-party suppliers for 2020–2025.

Table 1. FFB Processed at Torgamba Palm Oil Mill, 2020–2025 (kg)

Year	Own Estate	Third-Party	Total
2020	190,251,320	7,172,700	197,424,020
2021	182,951,440	42,568,430	225,519,870
2022	197,508,650	44,503,740	242,012,390
2023	196,641,290	50,685,310	247,326,600
2024	181,191,060	53,701,810	234,892,870
2025	163,043,740	76,810,270	239,854,010

Source: PKS Torgamba Processing and Technical Report, 2020–2025.

Over the six-year period, own-estate FFB has supplied an average of 80.14% of total throughput, with third-party FFB contributing the remaining 19.86%. Own-estate deliveries typically reach only 600–700 tons per day, against a milling capacity of 900–1,000 tons per day, leaving a structural shortfall of 300–400 tons per day that the mill fills by purchasing FFB from third-party suppliers – locally referred to as “Pihak III”, distinguished from individual smallholders (“Pihak I”) and small field-level collecting agents (“Pihak II”) – operating in South Labuhan Batu and Rokan Hilir Regencies. Five third-party suppliers (UD. Jilenka, UD. AMS Jaya, CV. Almira Hasil Bumi, Koperasi HKTI, and CV. Poros Jaya) have supplied the mill, of which three currently deliver on a regular basis and constitute the object of this study.

FFB procurement from third-party suppliers in this region is complicated by competition from roughly eight mills within a 50-kilometer radius in South Labuhan Batu and four mills in Rokan Hilir - twelve competing buyers in total - alongside price volatility, inconsistent FFB quality standards, and suppliers' perceptions of unfair treatment. The relationship between PKS Torgamba and its third-party suppliers has so far been reactive and purely transactional, without a binding, mutually beneficial, long-term partnership structure. Consequently, supplier loyalty remains fragile: uncertainty over payment timing, limited price transparency, unsatisfactory FFB receiving service, the absence of

routine communication, and the lack of a binding long-term partnership agreement all elevate the risk that suppliers redirect deliveries to competing mills, jeopardizing PKS Torgamba's raw-material stability, milling efficiency, and profitability.

Quality Function Deployment (QFD) is well established as a structured method for translating customer needs into technical specifications, while the Analytic Hierarchy Process (AHP) provides an objective, ratio-scale mechanism for weighting those needs through pairwise comparison – addressing a well-documented weakness of QFD's own absolute-scale importance ratings [2]–[4]. Integrating AHP with QFD can improve the prioritization of customer requirements by providing a more systematic approach to determining their relative importance [5]. The integration of AHP and QFD has therefore been applied across a wide range of domains. Table 2 summarizes ten representative prior studies identified in the course of this research.

Table 2. Representative Prior Studies Integrating AHP and QFD

Study	Domain / Object	Integration Method	Relation to the Present Gap
[6]	Automotive customer needs	QFD–Fuzzy AHP–AHP	End-customer product design, not raw-material supplier partnership
[7]	Logistics, healthcare, electronics product design	PCA–AHP–QFD	Feature/product design decision-making, single-transaction focus
[8]	Rice raw-material supplier selection	AHP–TOPSIS	Generic procurement criteria only (price, quality, delivery); no relational/partnership dimension
[9]	Bridge structural system selection	QFD–AHP	Engineering design selection, one-off decision
[10]	Hospital services (patients)	QFD–Fuzzy AHP	End-customer (patient) service design
[11]	Maritime supply chain resilience	AHP–QFD–DEMATEL	Resilience strategy, not supplier-need prioritization
[12]	Cassava grater design	AHP–QFD–TRIZ	End-product design for equipment users
[13]	Gear concept selection	Fuzzy QFD–Fuzzy AHP–tacit knowledge	Mechanical component design
[14]	Swine livestock housing design	Kano–AHP–QFD	Facility design for animal welfare, not raw-material supplier retention
[15]	Smart medical device for the elderly	AHP–QFD–Kansei Engineering	Consumer product design

Across these ten studies, spanning automotive, logistics, healthcare, electronics, rice-supplier selection, bridge engineering, maritime resilience, cassava-processing equipment, mechanical design, livestock housing, and medical devices, AHP-QFD integration has been applied almost exclusively to (a) new product or service design aimed at end customers, or (b) discrete, one-off supplier-selection decisions evaluated against generic procurement attributes such as price, quality, delivery, and capacity. None of the identified studies apply the integration to characterize the needs of an already-engaged raw-material supplier base for the purpose of building a continuing partnership, and none situate the analysis within a palm-oil or FFB agroindustrial supply chain, which is distinguished by daily perishable-commodity transactions, multi-tier smallholder linkages, and intense multi-mill competition for the same raw-material catchment area. Furthermore, none of the reviewed AHP-QFD studies extends its resulting technical priority beyond the level of a strategic recommendation into a concrete operational or workforce design. This combination of gaps – a supplier-retention (rather than product-design) application, an agroindustrial FFB supply-chain setting, and an explicit

relational/sustainability weighting dimension – defines the research gap addressed by this study.

This study offers three points of novelty relative to the literature summarized above. First, to the authors' knowledge, it is the first application of a single-phase House of Quality QFD-AHP integration to the needs of an existing third-party raw-material supplier in the palm oil agroindustry, explicitly incorporating a relational and long-term partnership sustainability dimension as one of four weighted criteria alongside financial, operational, and technical dimensions – a structure absent from prior AHP-QFD supplier-selection studies such as [8], which weight only transactional procurement attributes. Second, the study operationalizes the top-ranked QFD-AHP technical response – a twice-weekly payment cycle – into a proportional lot-sizing scheme for payment-administration workload, drawing on classical workload-variability theory [16], [17]. This explicitly connects strategic QFD-AHP output to line-level human-resource and process design, a linkage that is largely absent from the reviewed literature, which typically stops at the strategic-recommendation stage. Third, the study provides the first documented AHP-QFD supplier-needs profile for a PTPN IV Regional 1 palm oil mill, offering a replicable decision-support template that other state-owned mills facing similar third-party FFB dependency can adapt.

Building on the problem context above, this study aims to: (1) identify the criteria and sub-criteria that constitute third-party FFB suppliers' needs at PKS Torgamba, PTPN IV Regional 1; (2) determine the priority weight of each need using the Analytic Hierarchy Process; and (3) formulate strategic recommendations that PKS Torgamba can implement to build a sustainable partnership with third-party FFB suppliers based on the integration of AHP and QFD.

2. MATERIALS & METHODS

2.1 Research Design

This study employs a quantitative-descriptive design with a qualitative component at the front end, aimed at identifying and analyzing the needs of third-party FFB suppliers and translating them into prioritized company actions. The study is a case study conducted at PKS Torgamba, PTPN IV Regional 1, integrating QFD – used to translate supplier needs (voice of customer) into the company's technical response – with AHP, used to determine the priority weight of each supplier need in a systematic and structured manner.

2.2 Data Collection

Primary data were obtained directly from third-party FFB suppliers and PKS Torgamba management through in-depth interviews, focus group discussions (FGD), and an AHP pairwise-comparison questionnaire. Secondary data were obtained from company documents, FFB supply reports, FFB-receiving evaluation and monitoring records, and relevant journals and textbooks on QFD and AHP. The criteria and sub-criteria hierarchy was developed jointly by the researcher and a panel of ten internal experts at PTPN IV Regional 1 (Table 3), consistent with the principle that AHP hierarchies are best developed through literature review together with a smaller, technically competent expert panel before the pairwise-weighting stage is opened to a wider respondent group [18]–[20]. The AHP pairwise-comparison questionnaire was subsequently administered to the third-party suppliers' owners and their affiliated smallholder farmers to obtain the priority weighting of the criteria and sub-criteria.

Table 3. Profile of Expert Respondents, PTPN IV Regional 1

No.	Position	n	Tenure
1	Head of Technical and Processing Division	1	26 years
2	Head of FFB Purchasing Sub-Division	1	26 years
3	Head of Processing Sub-Division	1	14 years
4	Head of Technical & Investment Sub-Division	1	20 years
5	PKS Torgamba Manager	1	26 years
6	PKS Torgamba Chief Engineer	1	14 years
7	FFB Purchasing Assistant	1	9 years
8	Processing Assistant	1	14 years
9	Technical & Investment Assistant	1	11 years
10	Quality Assurance Assistant	1	3 years

2.3 Data Analysis

Data analysis integrates AHP and QFD in three stages. First, voice-of-customer analysis: interview and FGD results were analyzed to identify suppliers' main needs, structured into a hierarchy of criteria and sub-criteria. Second, AHP analysis: (a) constructing the hierarchy of supplier needs; (b) building the pairwise-comparison matrix using Saaty's 1–9 verbal-to-numerical scale; (c) computing priority weights through matrix normalization (column-sum, cell-normalization, row-averaging); and (d) testing consistency using the Consistency Ratio (CR = CI/RI), with CR < 0.10 as the acceptable threshold [21]. Third, QFD analysis through construction of a first-level House of Quality (HoQ): the WHATs (customer needs) populated with AHP global weights; the HOWs (technical responses) derived from interviews with PKS Torgamba management; the relationship matrix scored on a 9-3-1-0 scale (strong, moderate, weak, none); the roof (technical correlation) analyzing positive, negative, or neutral correlation among HOWs; and the technical priority calculation $PT(Hj) = \Sigma[Wi_Global(Ki) \times Relationship(Ki, Hj)]$, which directly integrates the AHP output into QFD's technical prioritization.

2.4 Research Stages

The research proceeded through five stages: (1) preparation – literature review, preliminary observation, and instrument development; (2) voice-of-customer identification – in-depth interviews, brainstorming, and FGD with experts, followed by a first-stage questionnaire to structure the criteria/sub-criteria hierarchy; (3) AHP data collection and analysis – a second-stage pairwise-comparison questionnaire distributed to suppliers and their affiliated farmers, processed to obtain priority weights with CR < 0.10 validation; (4) House of Quality construction – populating WHATs with AHP weights, defining HOWs from management interviews, scoring the relationship matrix, analyzing the roof correlation, and computing technical priorities; and (5) conclusion and recommendation – drawing conclusions and formulating strategic recommendations from the AHP-QFD results.

2.5 Scope and Limitations

This study is limited to PKS Torgamba, PTPN IV Regional 1, and to its three regularly active third-party FFB suppliers. Only a first-level HoQ is constructed – translating supplier needs directly into company action priorities – without extending into subsequent QFD phases (e.g., part deployment or process planning). Supplier-need variables are restricted to financial, operational, relational, and technical aspects relevant to the partnership relationship.

3. RESULT

3.1 Identification of Third-Party FFB Supplier Needs (Voice of Customer)

Discussions with the ten-member expert panel (Table 3) yielded four criteria and eight sub-criteria describing third-party FFB supplier needs, summarized in Table 4.

Table 4. Criteria and Sub-Criteria of Third-Party FFB Supplier Needs

Criterion	Sub-Criteria
Financial (K1)	Payment timeliness (K1.1); Competitive FFB price (K1.2)
Operational (K2)	Speed of mill receiving service (K2.1); Clarity of FFB quality-acceptance criteria (K2.2)
Relational (K3)	Communication with mill management (K3.1); Long-term partnership trust (K3.2)
Technical (K4)	Quality-improvement extension services (K4.1); Access to price and market information (K4.2)

Although the discussion round initially surfaced eighteen candidate sub-criteria across financial, operational, relational, and technical dimensions, the expert panel and researcher subsequently consolidated them into two representative sub-criteria per criterion (eight in total) to keep the pairwise-comparison matrix at a size that preserves respondent judgment consistency, since consistency becomes progressively harder to maintain as matrix size grows. The identification of supplier needs follows the voice-of-the-customer principle, which emphasizes systematically capturing and translating stakeholder requirements into actionable priorities [22].

This consolidation follows the same principle applied by [19], whose AHP-based tourism-attractiveness study likewise relied on a smaller, technically competent panel to define the hierarchy before opening the pairwise weighting to a wider and more heterogeneous respondent group; in that study, even though the majority of weighting-stage respondents (56.25%) held only secondary education, all pairwise matrices satisfied the CR < 0.10 consistency requirement – confirming that the validity of AHP weighting depends on the quality of the elicitation process rather than respondents' formal education level.

3.2 AHP Weighting of Main Criteria

The pairwise-comparison matrix for the four main criteria, elicited from the respondent panel using Saaty's 1–9 scale, is presented in Table 5.

Table 5. Pairwise Comparison Matrix of Main Criteria

Criterion	K1 Financial	K2 Operational	K3 Relational	K4 Technical
K1 Financial	1	3	5	7
K2 Operational	1/3	1	3	5
K3 Relational	1/5	1/3	1	3
K4 Technical	1/7	1/5	1/3	1

Normalizing the matrix (column-sum, cell normalization, row-averaging) yields the priority weight of each criterion, summarized together with the consistency test in Table 6.

Table 6. Normalized Weights and Consistency Test of Main Criteria

Criterion	Weight (Wi)	Share (%)	λmax	CI	RI	CR
K1 Financial	0.5740	57.4%				
K2 Operational	0.2490	24.9%	4.0608	0.0203	0.90	0.0225
K3 Relational	0.1236	12.4%				
K4 Technical	0.0534	5.3%				

With CR = 0.0225, well below the 0.10 threshold [21], the pairwise judgments are consistent and the resulting weights are valid for further use. The Financial criterion dominates with 57.4% of the total priority, followed by Operational (24.9%), Relational (12.4%), and Technical (5.3%). This distribution is unsurprising given that third-party suppliers typically operate as medium-scale enterprises facing considerable short-term cash-flow pressure from their own payment obligations to affiliated smallholder farmers.

3.3 Sub-Criteria Weighting and Global Priority

Local weights were computed within each criterion group using the same pairwise-comparison procedure, and global weights were obtained by multiplying each sub-criterion's local weight by its parent criterion's weight. Table 7 presents the consolidated ranking.

Table 7. Local and Global Weights of Supplier-Need Sub-Criteria (WHATs)

Code	Sub-Criterion	Wi Criterion	Wi Local	Wi Global	Rank
K1.1	Payment timeliness	0.574	0.740	0.425	1
K2.2	Clarity of FFB quality-acceptance criteria	0.249	0.740	0.184	2
K1.2	Competitive FFB price	0.574	0.260	0.149	3
K3.1	Communication with mill management	0.124	0.639	0.079	4
K2.1	Speed of mill receiving service	0.249	0.260	0.065	5
K3.2	Long-term partnership trust	0.124	0.361	0.045	6
K4.1	Quality-improvement extension services	0.053	0.740	0.040	7
K4.2	Access to price and market information	0.053	0.260	0.014	8

Payment timeliness (K1.1, global weight 0.425) and clarity of FFB quality-acceptance criteria (K2.2, global weight 0.184) together account for approximately 61% of total supplier priority, indicating that sustained, organized improvement on these two fronts would disproportionately affect supplier satisfaction and, by extension, FFB supply stability.

3.4 House of Quality Construction

Following the AHP stage, eight technical responses (HOWs) were defined through interviews with PKS Torgamba's management team (mill manager, chief engineer, administration assistant, and quality-assurance assistant), each designed to be clear, implementable, and directly linked to at least one supplier need. Table 8 summarizes the eight technical responses.

Table 8. Technical Responses (HOWs) in the QFD Framework

Code	Technical Response	Current Condition	Target
H1	Weekly Payment System (twice-weekly, scheduled payment)	Payment often exceeds one week due to absence of a dedicated processing clerk	Payment within 3 days of FFB handover
H2	Socialization of transparent, standardized FFB quality-acceptance criteria	Sorting procedures never formally socialized to suppliers	Documented criteria, socialized to all suppliers, refreshed every 6 months
H3	FFB reference pricing based on CPO/kernel market price and processing cost	Daily pricing set without reference to market price	Daily price update, published via announcement board and WhatsApp group
H4	Monthly communication and coordination forum	No routine coordination forum ever held	Minimum 1 meeting/month with distributed minutes
H5	FFB Receiving Station (SPB) optimization and digital queueing	Sorting yard very narrow; capacity approx. 1,500 tons	Waiting time < 3 hours/vehicle; integrated digital queue
H6	Long-term partnership agreement	Contract renewed every 3 months	Signed agreement for all active suppliers; annual review
H7	Technical extension and training on harvesting and FFB quality	Never conducted	Minimum 2x/year; standardized module
H8	Real-time FFB price and market information platform	No digital platform exists	Automatic daily price update system

The relationship between each WHAT and HOW was scored on the standard QFD 9-3-1-0 scale (strong-moderate-weak-none) in a joint session involving management and the research team, summarized in Table 9.

Table 9. WHATs–HOWs Relationship Matrix

Sub-Criterion (WHATs)	Wi Global	H1	H2	H3	H4	H5	H6	H7	H8
K1.1 Payment timeliness	0.425	9		3	1				
K2.2 Quality-criteria clarity	0.184		9		1	3		1	
K1.2 Competitive price	0.149			9			3		3
K3.1 Communication with management	0.079		1		9		3	1	
K2.1 Receiving service speed	0.065		3			9			
K3.2 Long-term partnership trust	0.045			3	3		9		1
K4.1 Quality extension services	0.040		3					9	
K4.2 Price/market information access	0.014			3			1		9

3.5 Technical Priority and Strategic Action Ranking

The technical priority (PT) of each HOW was computed as PT(Hj) = Σ [Wi_Global (Ki) × Relationship (Ki, Hj)], directly integrating AHP output into QFD's technical prioritization. Results are presented in Table 10.

Table 10. Technical Priority and Ranking of Strategic Actions

Code	Technical Response	Calculation	PT Value	Share (%)	Rank
H1	Weekly Payment System	(0.425×9)	3.825	28.02%	1
H3	FFB reference pricing	(0.425×3) +(0.149×9) +(0.045×3) +(0.014×3)	2.793	20.46%	2
H2	Quality-criteria socialization	(0.184×9) +(0.079×1) +(0.065×3) +(0.040×3) +(0.014×3)	2.050	15.02%	3
H4	Communication forum	(0.425×1) +(0.184×1) +(0.079×9) +(0.045×3)	1.455	10.66%	4
H5	SPB optimization	(0.184×3) +(0.065×9)	1.137	8.33%	5
H6	Partnership agreement	(0.149×3) +(0.079×3) +(0.045×9) +(0.014×1)	1.103	8.08%	6
H7	Technical extension	(0.184×1) +(0.079×1) +(0.045×1) +(0.040×9)	0.668	4.89%	7
H8	Price information platform	(0.149×3) +(0.045×1) +(0.014×9)	0.618	4.53%	8

The Weekly Payment System (H1) ranks first with a technical importance of 3.825 (28.0% of total priority), driven by its strong relationship (value 9) with the highest-weighted supplier need, payment timeliness (K1.1, 0.425). FFB reference pricing (H3, 20.5%) and quality-criteria socialization (H2, 15.0%) rank second and third respectively. Together, these top three responses account for approximately 63% of total technical priority, indicating that concentrating initial management attention and resources on these three programs would address the majority of suppliers' weighted needs. The roof (technical correlation) matrix of the HoQ showed only positive (moderate "+" or strong "++") correlations among the eight HOWs, with no negative or conflicting relationships – meaning the eight technical responses are mutually reinforcing and can be pursued concurrently without resource conflict.

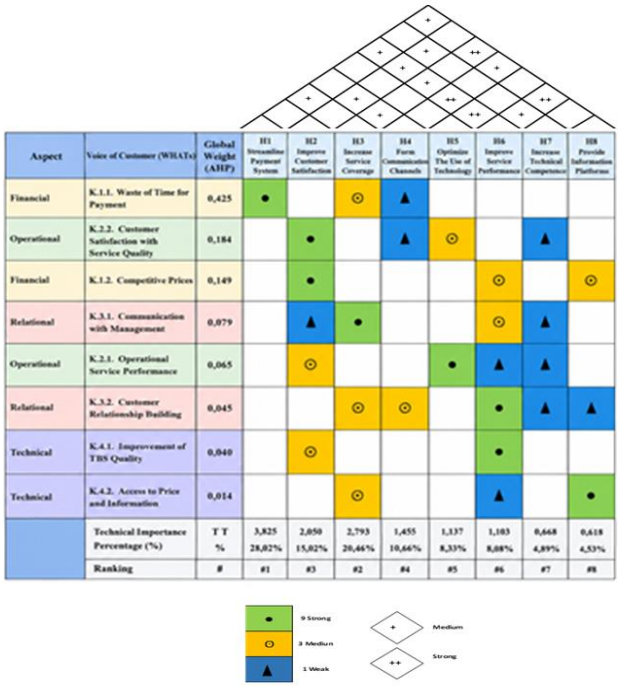

Figure 1. *House Of Quality* (HoQ) Integrating QFD -AHP in POM Torgamba

DISCUSSION

The dominance of the financial criterion (57.4%) and, within it, payment timeliness (42.5% of total priority) is consistent with the structural characteristics of third-party FFB suppliers, who are typically medium-scale enterprises operating under considerable short-term cash-flow pressure created by their own payment obligations to affiliated smallholder farmers. In a competitive catchment area served by roughly twelve mills, any delay in payment by PKS Torgamba creates a tangible risk that suppliers redirect FFB deliveries to competing mills, directly threatening raw-material stability.

Methodologically, these results corroborate [6] observation that using AHP to weight customer needs within a QFD framework produces technical priorities that are more discriminating, precise, and scientifically defensible than priorities derived from ordinary absolute-scale weighting. This is consistent with [2] argument that only a ratio scale, such as that produced by AHP, allows QFD importance ratings to be interpreted meaningfully and used in subsequent optimization. The absence of negative correlations in the roof matrix further echoes Bernal, Lambert, and colleagues' "quality lever" principle (cited in the underlying thesis as Bernal et al., 2009), whereby programs introduced early and preventively at the planning stage yield a larger customer-satisfaction impact than reactive measures introduced after problems have already surfaced.

Based on the technical-importance ranking, a three-horizon implementation roadmap was constructed following the technology-roadmapping framework of [23], summarized in Table 11.

Table 11. Three-Horizon Strategic Implementation Roadmap

Horizon	Timeframe	Technical Responses
Short-term (quick win)	0–6 months	H1 Weekly Payment System; H3 FFB reference pricing; H2 quality-criteria socialization; H4 communication forum
Medium-term	6–18 months	H5 SPB optimization & digital queueing; H6 partnership agreement; H7 technical extension & training
Long-term	18–24 months	H8 real-time price/market information platform

The first four responses are classified as short-term "quick wins" because they can be implemented rapidly with manageable complexity and risk, generating early credibility and momentum before the organization proceeds to more resource-intensive stages. The next three responses require coordination with other internal divisions (procedural optimization, partnership agreements, training programs) and are therefore grouped as medium-term. The lowest-ranked response, the real-time information platform, requires substantial capital investment and external collaboration (e.g., with a telecommunications provider) and is accordingly classified as long-term.

4. Managerial Implications

Beyond its methodological contribution, this study yields concrete implications for PKS Torgamba's management in operationalizing the QFD-AHP results into day-to-day practice.

4.1 Operationalizing the Top Priority: Weekly Payment System and Proportional Lot Sizing for Payment Administration

The Weekly Payment System (H1) occupies the highest rank in the implementation roadmap, and its execution requires the addition of one dedicated payment-administration clerk (Krani Administrasi Pembayaran) tasked with preparing payment documents and verifying their completeness. This staffing requirement, raised during the thesis examination as a necessary precondition for a credible twice-weekly payment commitment, is here formalized as a proportional lot-sizing design for the clerk's workload rather than a simple headcount addition.

Under the previous arrangement, a single clerk processed one large documentation batch per week, concentrating verification effort into a single end-of-week peak. The proposed design instead splits the same total weekly transaction volume into two verification-and-payment cycles per week (approximately every 3–4 days), with each cycle's lot size proportional to the FFB volume accumulated since the previous cycle rather than fixed to a calendar week. Using the mill's own 2025 throughput figure of 76,810,270 kg (≈ 76,810 tons) of third-party FFB per year as an illustrative basis, average weekly third-party volume is approximately 1,477 tons; dividing this into two proportional cycles yields approximately 738 tons of FFB transactions verified per cycle, roughly half the volume previously handled in a single weekly batch. Each cycle requires the clerk to verify FFB-receiving data, sorting results, net weight, applicable price, and supporting documents (such as the mill's MIRR 7 receiving form) before releasing payment within three days of FFB handover.

This proportional lot-sizing logic is grounded in classical workload-scheduling theory: Askin and Raghavan (1983) show that longer job-accumulation cycles increase workload variability, while Missbauer (2002) demonstrates that smaller lot sizes reduce work-in-process and shorten flow time. Applying these principles to administrative payment processing, halving the batch size while doubling processing frequency is expected to (a) reduce the peak workload borne by the payment clerk in any single cycle, (b) allow data discrepancies to be identified and corrected earlier, before they accumulate into a larger end-of-week reconciliation problem, and (c) make the twice-weekly payment commitment operationally sustainable rather than dependent on ad hoc overtime. This example illustrates, in concrete workforce and process terms, how a QFD-AHP technical priority (H1, technical importance 3.825, 28.0% share of total priority) can be translated from a strategic ranking into an implementable operational design – the second novelty contribution of this study.

4.2 Short-, Medium-, and Long-Term Managerial Actions

For the short-term horizon (0–6 months), alongside the Weekly Payment System, management should finalize an FFB

reference-pricing formula that transparently combines the CPO reference price, kernel price, actual extraction rate, and processing-cost components, published daily via an announcement board and supplier WhatsApp group; document and socialize FFB quality-acceptance criteria – including acceptance/rejection standards, grading, and a sorting-complaint mechanism – refreshed at least every six months; and institute a monthly management-supplier coordination forum that functions as a genuine two-way dialogue channel, with every meeting concluding in written, trackable follow-up actions rather than one-way information delivery.

For the medium-term horizon (6–18 months), management should expand FFB Receiving Station (SPB) capacity, recalibrate weighing equipment on a routine schedule, and implement a digital queueing system targeting under three hours of waiting time per vehicle; formalize a written long-term partnership agreement specifying both parties' rights and obligations, a dispute-resolution mechanism, and incentives for suppliers who consistently meet volume and quality commitments, reviewed annually rather than every three months; and conduct technical extension and training for plasma smallholders on harvesting practices, post-harvest handling to limit free-fatty-acid increases, seedling selection, and soil-based fertilization, at least twice a year.

For the long-term horizon (18–24 months), management should develop a real-time FFB price and market-information platform accessible to suppliers, requiring a capital-expenditure proposal and collaboration with external partners such as a telecommunications provider; this platform is expected to reduce information asymmetry that has historically contributed to suppliers' perception of unequal treatment.

4.3 Implications for Supplier-Side Practice and Wider Replication

For third-party suppliers, the findings suggest that formalizing partnership terms – payment-timing guarantees, transparent pricing mechanisms, and responsive complaint-handling procedures – through a written agreement, together with continued investment in their own plasma-farmer supply-chain capacity, would strengthen their negotiating position and long-term security as PKS Torgamba's priority partners. For PTPN IV Regional 1 more broadly, the AHP-QFD supplier-needs profile and roadmap developed here provide a replicable decision-support template that other mills within the regional group facing similar dependency on third-party FFB can adapt to their own local supplier context.

CONCLUSION

This study applied an integrated AHP-QFD approach to identify and prioritize third-party FFB supplier needs at PKS Torgamba, PTPN IV Regional 1. The results identified four criteria: financial (57.4%), operational (24.9%), relational (12.4%), and technical (5.3%), with payment timeliness as the highest priority (42.5%) and an acceptable consistency ratio (CR = 0.0225). The first-level House of Quality prioritized eight technical responses, led by a twice-weekly payment system (28.0%), transparent FFB reference pricing (20.5%), and socialization of quality criteria (15.0%), collectively accounting for approximately 63% of total priority. The study contributes theoretically by extending AHP-QFD to supplier-partnership retention in agroindustrial supply chains and practically by linking strategic priorities to payment-administration workload and a phased implementation roadmap. However, its scope is limited to one mill, three regularly active suppliers, and the first-level HoQ. Future research should expand respondents and supplier coverage, explore additional QFD phases and decision-making methods, incorporate competitor benchmarking and sustainability criteria, evaluate long-term

implementation outcomes, and develop digital decision-support systems.

Declaration by Authors

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