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Optimizing Loss Reduction in On-Farm Tea Production at PTPN IV Through Value Stream Mapping

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Abstrak

PT Perkebunan Nusantara IV, sebagai salah satu perusahaan terkemuka dalam industri teh di Indonesia, menghadapi tantangan signifikan akibat fluktuasi dan stagnasi harga teh yang umumnya dipengaruhi oleh dinamika permintaan pasar. Di sisi lain, biaya produksi perusahaan sangat dipengaruhi oleh tingginya beban operasional, khususnya pada lini on-farm, di mana tenaga kerja, bahan baku, serta berbagai proses produksi turut membentuk struktur biaya secara keseluruhan. Aktivitas operasional pada lini on-farm, seperti penanaman, pemeliharaan, dan pemanenan teh, memegang peranan penting dalam menentukan biaya produksi yang pada akhirnya mempengaruhi harga jual teh. Mengingat tantangan tersebut, terdapat kebutuhan mendesak untuk menurunkan biaya produksi dan meningkatkan efisiensi operasional. Penelitian ini bertujuan untuk mengevaluasi dan menganalisis proses produksi teh pada lini on-farm di PT Perkebunan Nusantara IV dengan menggunakan metode Value Stream Mapping (VSM). Melalui pemetaan kondisi eksisting proses produksi, penelitian ini mengidentifikasi aktivitas yang bernilai tambah maupun tidak bernilai tambah, serta sumber-sumber pemborosan yang menyebabkan tingginya biaya operasional. Fokus utama juga diberikan pada pemborosan tersembunyi dan ketidakefisienan yang tidak langsung terlihat namun berdampak besar terhadap total biaya produksi. Hasil analisis ini menghasilkan pemetaan kondisi ideal (future state) yang menyarankan berbagai perbaikan untuk menghilangkan pemborosan dan meningkatkan efisiensi operasional secara keseluruhan. Rekomendasi perbaikan tersebut meliputi optimalisasi pemanfaatan tenaga kerja, pengurangan aktivitas transportasi yang tidak perlu, dan minimalisasi kelebihan persediaan. Dengan menerapkan perbaikan ini, PT Perkebunan Nusantara IV diharapkan dapat menurunkan biaya produksi, meningkatkan mutu produk, serta memperkuat daya saingnya di pasar teh global. Kesimpulannya, penerapan metode Value Stream Mapping menawarkan pendekatan yang praktis dan efektif dalam meningkatkan efisiensi produksi serta memperkuat posisi pasar PT Perkebunan Nusantara IV dalam menghadapi tantangan industri secara global.

Kata Kunci: Value Stream Mapping; efisiensi produksi; PT Perkebunan Nusantara IV; on-farm; pemborosan; biaya produksi; daya saing; harga teh.

Abstract

PT Perkebunan Nusantara IV, one of the leading companies in the Indonesian tea industry, faces significant challenges due to the fluctuating and often stagnant prices of tea, which are primarily driven by changes in market demand. Simultaneously, the company's production costs are heavily influenced by high operational expenses, especially on the on-farm line, where labor, raw materials, and various production processes contribute to the overall cost structure. The operational activities within the on-farm line, including planting, maintenance, and harvesting of tea, play a critical role in determining the production costs that ultimately shape the price of the tea. Given these challenges, there is a pressing need to identify ways to reduce production costs and improve operational efficiency. This research aims to evaluate and analyze the tea production process on the on-farm line at PT Perkebunan Nusantara IV by employing the Value Stream Mapping (VSM) methodology. By mapping the current state of the production process, the study identifies both value-adding and non-value-adding activities, as well as sources of waste that contribute to higher operational costs. The research also focuses on identifying hidden wastes and inefficiencies that may not be immediately apparent but have a significant impact on the overall production costs. The results of this analysis lead to the development of a future state value stream map, which suggests improvements designed to eliminate waste and enhance overall operational efficiency. These improvements include optimizing labor utilization, reducing unnecessary transportation, and minimizing excess inventory. By implementing these changes, PT Perkebunan Nusantara IV is expected to reduce production costs, improve the quality of the product, and increase its

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competitiveness in the global tea market. In conclusion, the application of the Value Stream Mapping methodology offers a practical and effective approach to improving production efficiency and strengthening the market position of PT Perkebunan Nusantara IV in the face of global market challenges.

Keywords: Value Stream Mapping; production efficiency; PT Perkebunan Nusantara IV; on-farm; waste; production cost; competitiveness; tea prices.

1. Introduction

Indonesia's tea industry, once a major contributor to national export earnings, has experienced a steady decline in productivity and profitability over the last two decades. Within this context, PT Perkebunan Nusantara IV (PTPN IV)—a key state-owned enterprise operating under the PalmCo sub-holding—faces critical operational and financial challenges. In 2023, the company's tea units reported significant losses: approximately IDR 57.2 billion in Regional II and IDR 9.1 billion in Regional IV. The underlying causes extend beyond market-price volatility to structural inefficiencies throughout the on-farm production chain.

Field observations reveal persistent use of obsolete TRI tea clones, sub-optimal harvesting efficiency, inconsistent maintenance cycles, and a mismatch between field output and market requirements. Quality indicators—particularly the proportion of *Pucuk Memenuhi Syarat (PMS)*—remained below 60%, limiting the share of premium-grade processed tea. Simultaneously, production costs have risen due to high labor intensity, inefficient transport layouts, and mechanical downtime.

To address these systemic weaknesses, PTPN IV, in collaboration with PT Riset Perkebunan Nusantara (RPN), initiated a corporate turnaround study emphasizing cost reduction, process discipline, and Lean-based management. The present research builds on that initiative by applying Value Stream Mapping (VSM) to diagnose inefficiencies and quantify potential improvements in productivity, cost structure, and product quality. Through this approach, the study seeks to identify non-value-adding activities, redesign workflows, and establish a replicable Lean framework for sustainable performance recovery across the company's tea estates.

2. Literature Review

A review of previous studies highlights the evolution and relevance of efficiency improvement methodologies—particularly Lean Management, Value Stream Mapping (VSM), Activity-Based Costing (ABC), and organizational rightsizing—in enhancing productivity, reducing costs, and promoting sustainable business performance across sectors.

The study published in the *International Journal of Management and Accounting Education (IJMAE, 2020)*emphasizes the effectiveness of the Activity-Based Costing (ABC) method in identifying and managing cost structures with greater accuracy. By focusing on activities that generate costs, this approach enables more precise cost control, improves process efficiency, and eliminates non-value-added activities. ABC also supports optimal resource allocation, allowing firms to reduce operational expenses while maintaining product quality and long-term profitability.

Chia-Nan Wang et al. (2024) demonstrated the practical impact of Value Stream Mapping (VSM) in a lightbox manufacturing company. Through the mapping of current and future process states, the study successfully reduced lead time from 87.2 hours to 6.42 hours and improved process cycle efficiency (PCE) from 0.337% to 4.54%. This represented a thirteenfold increase in process efficiency, significantly minimizing waste and improving product quality. The research confirms that VSM is a robust tool for waste identification and production process enhancement in industrial operations.

Feng-Kuang Wang, Bambang Rahardjo, and Pere R. Rovira (2022) further integrated Lean Six Sigma (LSS) with VSM 4.0 in designing human-centered workstations. Using the DMAIC (Define, Measure, Analyze, Improve, Control)methodology, they improved the yield rate from 98% to 100%, achieving direct cost savings of EUR 3,180. The ergonomic redesign of workspace layout enhanced worker comfort and productivity, including for employees with intellectual disabilities. This study illustrates how combining LSS and VSM 4.0 supports digital transformation under the Industry 4.0 framework, while simultaneously improving human well-being and manufacturing competitiveness.

Suharto (2021) applied Lean Six Sigma principles to the canned fish industry and utilized VSM to identify major waste categories such as defects, waiting, and over-inventory. The study employed Root Cause Analysis (RCA) and Failure Mode and Effect Analysis (FMEA) to prioritize corrective actions. These interventions reduced production defects, improved raw material quality, and generated measurable cost savings, confirming the significant role of Lean-based analysis in improving process performance and product consistency.

Kardiyono et al. (2019) explored the concept of Green Value Stream Mapping (GVSM) in improving the productivity of local soybean agribusiness. Their findings indicated that green productivity levels remained low, primarily due to inefficient on-farm activities and post-harvest handling. GVSM helped identify waste and bottlenecks in the production chain, enabling environmentally sustainable redesigns that balanced productivity improvement with ecological responsibility. The study contributed to the integration of Lean thinking and sustainability in agricultural production systems.

Wilkinson (2012) addressed the concept of rightsizing as a strategic process to align organizational structure and size with environmental and strategic objectives in a sustainable and humane manner. Rather than focusing solely on workforce reduction, rightsizing emphasizes function optimization, resource alignment, and transparent communication to maintain employee morale and organizational stability during transformation.

Finally, MacLean, Monty, and Dotson (1999) examined organizational capacity optimization and structure selection for quality improvement. Their study identified the importance of selecting appropriate organizational models—centralized, decentralized, shared-service, or hybrid—to improve coordination and operational efficiency. They also emphasized the risks of inadequate resource capacity and the need for well-planned restructuring to ensure effective performance.

Collectively, these studies underscore that continuous improvement and cost optimization require an integrative approach—linking financial accuracy (ABC), process visualization (VSM), quality management (LSS), and organizational alignment (rightsizing). Within the context of state-owned agribusinesses such as PTPN IV, these principles provide a comprehensive foundation for enhancing operational efficiency, reducing production costs, and supporting long-term sustainability through Lean-based transformation.

3. Methodology

This study adopts a mixed-method exploratory approach that integrates both qualitative and quantitative dimensions to provide a comprehensive understanding of efficiency issues in PTPN IV's tea on-farm operations. The qualitative component captures managerial perspectives, field practices, and behavioral patterns across operational processes, while the quantitative component supplies measurable indicators related to productivity, cost, and labor efficiency. By merging these two perspectives, the analysis becomes both empirically grounded and practically relevant, ensuring that the research findings contribute directly to operational decision-making.

To strengthen data validity, a triangulation technique was employed through three complementary sources: (1) Field observations, which involved measuring harvesting time, walking distances, and waiting periods across representative tea blocks; (2) Structured interviews with plantation managers, field supervisors, and operators to capture firsthand insights on challenges and improvement opportunities; and (3) Document analysis of internal records, including cost and productivity reports, RPN's technical audit (Letter No. 112608/RPN/XI/2024), and operational data covering the 2022–2024 period. Together, these data streams provide a robust foundation for identifying process inefficiencies and designing targeted interventions.

The analytical framework applied in this research comprises four key stages. The first stage, Current State Mapping, documents the existing on-farm workflow—from tea plucking to the temporary wet-leaf storage (Tempat Penimbunan Basah)—and quantifies each activity's cycle time, lead time, and resource utilization. The second stage, Root Cause Analysis, employs the Ishikawa (Fishbone) diagram to categorize inefficiencies according to five primary factors: Man, Machine, Method, Material, and Environment. The third stage, Future State Design, develops a Value Stream Mapping (VSM)-based model that proposes strategic improvements, including rightsizing of unproductive areas, replanting with superior clones, enhancement of mechanization, and optimization of harvest scheduling. The final stage, Quantitative Simulation, models potential improvements by estimating projected gains in productivity (kg/ha/year), increases in labor utilization, improvements in Grade I tea output, and overall cost savings expressed in billions of Indonesian rupiah per year.

The scope of this study is confined to on-farm operations in four key tea estates managed by PTPN IV—Bah Butong and Tobasari in Regional II, and Danau Kembar and Kayu Aro in Regional IV. Off-farm activities, including factory processing and downstream marketing, are intentionally excluded to maintain analytical focus on field-level efficiency. The study assumes that all technological and operational conditions—such as machinery capacity, clone distribution, and work procedures—remain constant during the 2023–2024 observation period. This scoping ensures that the findings specifically reflect the impact of operational and managerial variables within the tea cultivation process, thus providing actionable insights for strategic improvement at the plantation level.

4. Results and Discussion

The results of the Value Stream Mapping (VSM) analysis reveal a series of interrelated inefficiencies embedded within the operational framework of PT Perkebunan Nusantara IV's (PTPN IV) tea on-farm activities. These inefficiencies manifest primarily through excessive motion, waiting, and process redundancies that have accumulated over time due to outdated operational structures, inconsistent field supervision, and limited integration between on-farm activities and downstream processing schedules. Through the mapping of current workflows, time-motion observations, and interviews with estate management, a clearer picture emerges of how inefficiencies in daily field operations contribute directly to both rising production costs and declining product quality.

The current state mapping exercise indicates that the total daily process cycle for tea plucking and collection averages 540 minutes, with approximately 118 minutes—or 22%—classified as non-value-adding activities. This proportion is substantial, as it implies that nearly one-fourth of all operational time is spent on actions that neither enhance productivity nor contribute to quality improvement. Within the context of Lean Manufacturing, such a figure underscores the existence of systemic waste that must be addressed through structured process redesign and standardization.

A detailed examination of these inefficiencies reveals four primary categories of waste: motion, waiting, inventory, and defect waste. The first and most visible is motion waste, which arises from inefficient field layouts and the absence of structured haul routes between tea blocks and collection points. Workers spend a significant amount of time walking long distances to transport plucked leaves, often traversing steep or uneven terrain. The cumulative effect of these extended walking paths translates into considerable time loss and worker fatigue, ultimately reducing plucking efficiency and output per person.

The second major issue, waiting waste, occurs during the collection and loading process. The study found recurring delays between the completion of plucking and the arrival of transport vehicles to haul the wet leaves (*Daun Teh Basah* or DTB) to the processing facility. This misalignment is primarily due to inconsistent truck allocation and poor synchronization between harvesting and logistics teams. During these idle periods, freshly plucked leaves begin to oxidize prematurely, leading to potential declines in product quality and lower processing yields.

The third type, inventory waste, is linked to the overaccumulation of harvested tea leaves that exceed the factory's intake capacity. When leaf volumes surpass processing capacity, they remain in temporary storage (*Tempat Penimbunan Basah*), often under conditions that do not adequately prevent oxidation or moisture loss. This delay not only shortens the shelf life of the raw material but also contributes to grade deterioration, undermining both yield efficiency and market competitiveness.

Lastly, defect waste emerges from low-quality inputs, particularly the low *Pucuk Memenuhi Syarat (PMS)* ratio, which was consistently recorded below 60% across observed estates. A low PMS percentage indicates a high proportion of mature, coarse, or mechanically damaged leaves that do not meet the standards for Grade I tea. Consequently, a larger share of processed output falls into lower-grade categories, which command significantly lower prices in domestic and export markets.

Beyond these tangible categories of waste, the current-state VSM diagram also uncovered redundant administrative checkpoints and overlapping reporting loops. Multiple verification steps—implemented as part of internal control procedures—have unintentionally created delays in the flow of operational information, resulting in duplicated work and paperwork congestion. These inefficiencies reflect an outdated organizational habit of prioritizing procedural compliance over real-time responsiveness, a pattern that ultimately hampers decision-making agility in field operations.

To identify the underlying causes of these inefficiencies, a Root Cause Analysis was conducted using the Ishikawa (Fishbone) diagram, categorizing contributing factors into five domains: Man, Method, Machine, Material, and Environment.

Under the Man category, the findings highlight several workforce-related issues. Many field workers lack specialized training in selective plucking techniques and remain unfamiliar with yield-maximizing practices, such as proper plucking intervals and height control. Supervisory oversight is also inconsistent, resulting in uneven performance between shifts and across different divisions (*afdeling*). The limited understanding of quality metrics—such as the importance of PMS ratio or moisture content—further constrains the ability of field personnel to align their practices with corporate quality objectives.

The Method category reflects procedural weaknesses, particularly the absence of standardized operating procedures for harvest scheduling, load collection, and leaf transport. Without structured coordination between harvesting and logistics teams, synchronization failures frequently occur. Some blocks are harvested ahead of schedule, while others are delayed, creating irregularities in supply to the factory. This imbalance disrupts downstream processing rhythms and causes underutilization of available machinery and labor during non-peak hours.

In the Machine category, mechanical degradation and limited equipment availability pose major constraints. Most withering and rolling units have exceeded their optimal service life, leading to reduced operational reliability and inconsistent drying outcomes. Additionally, the shortage of small-capacity transport vehicles has created bottlenecks at collection points, as larger trucks cannot easily access narrow or steep block roads. The resulting logistical inefficiencies exacerbate both waiting and motion waste.

The Material factor primarily concerns clone performance variability. The continued reliance on TRI clones, which yield below 2,500 kg/ha/year, constrains overall productivity compared to newer GMB clones, which can produce over 3,000 kg/ha/year under similar conditions. This genetic gap not only reduces yield but also affects uniformity and leaf texture, influencing processing efficiency and final tea quality.

Lastly, the Environment factor encompasses the physical and geographic challenges inherent in many of PTPN IV's tea estates. Steep terrain, uneven block topography, and inadequate drainage systems extend walking distances and elevate worker fatigue levels, further reducing plucking efficiency. These environmental constraints require adaptive operational strategies—such as block zoning or alternate transport routing—to mitigate their impact on cycle time and output quality.

Having established the structural and causal origins of inefficiency, the Future State Design phase of the VSM analysis outlines a strategic roadmap to transform PTPN IV's on-farm operations into a more Lean, data-driven, and performance-oriented system. This transformation is anchored on five key interventions, each addressing a distinct aspect of the operational value stream.

The first is rightsizing and reallocation, which involves the systematic identification and decommissioning of approximately 405.93 hectares of underperforming tea blocks. By redirecting resources toward higher-yield zones and concentrating field operations, the company can achieve better labor utilization and improve land productivity. This approach aligns with Lean's principle of resource optimization—ensuring that every unit of input (land, labor, or capital) contributes effectively to value creation.

The second intervention focuses on clone replanting, emphasizing the gradual replacement of TRI clones with GMB varieties that possess higher productivity potential (>3,000 kg/ha/year) and greater disease resistance, particularly against blister blight (*Exobasidium vexans*). This genetic upgrading initiative not only enhances long-term yield potential but also improves raw material consistency, thereby increasing the proportion of Grade I leaves suitable for premium tea production.

The third proposed improvement is operational scheduling optimization, which introduces a structured harvesting calendar designed to minimize idle periods, especially during weekends and public holidays. Historically, such periods have been characterized by reduced activity and idle machinery, creating uneven production loads that hinder throughput efficiency. A rotational scheduling system would allow continuous, balanced harvesting, stabilizing both factory input and labor deployment.

The fourth intervention is machine refurbishment and maintenance standardization. Refurbishing aging withering and oxidation units is critical to restoring process reliability and consistency. Preventive maintenance programs should be institutionalized to minimize mechanical downtime and reduce the risk of quality deterioration during critical drying stages. Refurbishment also supports the reduction of operational variability, a central objective in Lean process management.

Finally, the fifth strategic intervention is work standardization through the implementation of unified Standard Operating Procedures (SOPs). Establishing consistent standards for plucking intervals, load weight, and quality checkpoints ensures that operational practices are uniform across all divisions and estates. Standardization minimizes human error, reduces process variability, and fosters accountability by clearly defining performance expectations.

The integration of these five improvement strategies constitutes a comprehensive operational transformation plan. Collectively, they represent the evolution from a fragmented, labor-intensive, and reactive management model toward a streamlined, data-informed, and continuous-improvement-oriented system. Beyond improving internal efficiency, the expected outcomes of the future-state design extend to financial and strategic dimensions. By reducing non-value-adding time, labor productivity is projected to rise by 15%, while cost savings of approximately IDR 6.8 billion per year are anticipated. Moreover, increasing the proportion of Grade I output to 60% enhances PTPN IV's competitive position in both domestic and export tea markets, where quality differentials strongly influence pricing.

The results of this study highlight a key managerial insight: operational inefficiencies are rarely caused by isolated factors. Instead, they arise from the interaction between human behavior, outdated systems, inadequate technology, and environmental constraints. Thus, improvement efforts must be holistic—integrating field-level interventions with organizational restructuring, skill enhancement, and data-driven monitoring. Implementing VSM not only visualizes inefficiencies but also establishes a shared language for continuous improvement across departments, bridging the gap between operational execution and strategic oversight.

In conclusion, the VSM analysis provides PTPN IV with a diagnostic and prescriptive framework for achieving operational excellence in its tea division. The future-state design aligns with the company's broader transformation under PalmCo, emphasizing agility, digital integration, and performance accountability. When fully implemented, this Lean-based approach is expected to significantly reduce waste, improve labor efficiency, and enhance the consistency of Grade I output—transforming tea production from a loss-making segment into a sustainable profit center. In doing so, it repositions PTPN IV as a leading model for Lean-driven agribusiness management within Indonesia's state-owned plantation sector.

5. Managerial Implications

The implementation of Value Stream Mapping (VSM) in PTPN IV's tea production system provides both strategic and operational benefits that extend beyond short-term efficiency gains. At the operational level, VSM serves as a decision-support tool, enabling managers to visualize bottlenecks, identify sources of waste, and quantify non-value-adding activities across various stages of production. This analytical visibility allows more accurate resource reallocation, workforce optimization, and targeted cost reduction. From a performance perspective, linking VSM outcomes to the Balanced Scorecard (BSC) framework facilitates alignment between operational metrics—such as cost per kilogram, PMS percentage, and equipment downtime—and higher-level financial and learning objectives. This integration ensures that field-level improvements translate directly into measurable corporate performance indicators.

At the organizational level, VSM supports data-driven restructuring by grounding rightsizing decisions in objective productivity evidence rather than subjective judgment. This minimizes the risk of arbitrary downsizing and preserves employee morale during transformation. Moreover, the standardized VSM templates developed for Regional II and IV can be disseminated across other estates, promoting knowledge transfer and best-practice replication throughout the organization. The adoption of digital integration—embedding VSM metrics into real-time monitoring dashboards—further strengthens managerial control by enabling predictive maintenance, optimized harvest scheduling, and dynamic cost forecasting. Collectively, these managerial shifts position PTPN IV to evolve from a cost-centered, compliance-driven enterprise into a modern, data-oriented agribusiness leader aligned with PalmCo's broader digital transformation agenda

6. Conclusion & Recommendations

his study demonstrates that Value Stream Mapping (VSM) is a powerful and adaptable tool for diagnosing inefficiencies and guiding systematic improvements within plantation operations. By integrating Lean principles, cost-structure analysis, and

rightsizing strategies, VSM provides a structured pathway for transforming PTPN IV's tea division from a loss-making unit into a profitable and sustainable business.

The research yields several key conclusions. First, high on-farm costs—representing approximately 59–72% of total production costs—are the principal drivers of negative profit margins. Second, non-value-adding activities, accounting for about 22% of operational time, are concentrated mainly in motion and waiting wastes. Third, the introduction of Lean-based process redesign can improve labor efficiency by 15% and reduce annual costs by around IDR 6.8 billion. Fourth, strategic clone replanting and machine refurbishment initiatives are projected to raise Grade I tea output to 60%, thereby increasing market value and revenue potential. Finally, the institutionalization of VSM and Activity-Based Costing (ABC) frameworks reinforces evidence-based management and supports a sustainable corporate turnaround.

ased on the research findings and analytical insights derived from the Value Stream Mapping (VSM) implementation, this study proposes a series of strategic recommendations to guide PT Perkebunan Nusantara IV (PTPN IV) toward achieving operational excellence and sustainable profitability in its tea business segment. These recommendations are designed to transform the company from a traditionally structured, cost-centered organization into a Lean, data-driven, and performance-oriented enterprise that embodies continuous improvement at every operational level.

The first and most fundamental recommendation is to institutionalize Lean Management principles across all tea estates within PTPN IV. Lean philosophy is not merely a set of efficiency techniques but a mindset shift that emphasizes value creation, waste elimination, and employee empowerment. Institutionalization involves integrating Lean thinking into standard operating procedures (SOPs), management evaluations, and employee key performance indicators (KPIs). Through the consistent application of tools such as Value Stream Mapping, 5S, Kaizen, and Root Cause Analysis, managers can continuously identify process bottlenecks, assess operational risks, and initiate corrective actions without waiting for external interventions. By embedding Lean practices into the organizational culture, PTPN IV can ensure that improvement initiatives are self-sustaining, scalable, and adaptable to changing market conditions.

The second strategic recommendation is to extend the scope of Value Stream Mapping beyond on-farm operations to include off-farm processes such as factory processing, warehousing, packaging, and marketing channels. The integration of these functions under a unified Lean framework enables a holistic, end-to-end efficiency model that minimizes waste across the entire value chain. While the current study focused on on-farm inefficiencies, downstream activities often contribute to similar challenges, including inventory buildup, unbalanced workloads, and inconsistent product quality. By mapping value streams from plucking to packaging, PTPN IV can synchronize field production with factory capacity, reduce lead time between harvesting and processing, and optimize logistics coordination. This alignment ensures that improvements achieved in the field are not negated by inefficiencies at later stages, thereby maximizing the cumulative value delivered to customers and stakeholders.

The third recommendation emphasizes the implementation of digital dashboards at the afdeling (division) level. Digitalization is a critical enabler of Lean management, providing real-time visibility into key operational metrics such as productivity per hectare, plucking efficiency, PMS percentage, equipment downtime, and cost per kilogram of production. By utilizing digital dashboards integrated with enterprise resource planning (ERP) or plantation management systems, decision-makers at both estate and regional levels can monitor progress, detect anomalies, and take corrective action promptly. Furthermore, predictive analytics can be applied to forecast seasonal productivity trends, identify risk factors such as weather variability or labor shortages, and recommend preventive measures. This real-time data transparency not only enhances accountability but also supports strategic agility, aligning operational performance with corporate objectives under PalmCo's digital transformation roadmap.

The fourth strategic recommendation involves developing structured Lean training and internal certification programs. The sustainability of improvement initiatives depends on the capability of human resources to understand, apply, and champion Lean principles. PTPN IV should therefore establish a dedicated training framework that equips employees at various organizational levels—ranging from field supervisors to estate managers—with the analytical and problem-solving skills necessary to execute Lean projects effectively. Certification programs such as "Lean Practitioner" or "VSM Champion" can serve as motivational and professional development milestones, fostering a new generation of leaders committed to process excellence. Beyond technical training, emphasis should also be placed on behavioral transformation, encouraging a proactive mindset where employees are empowered to identify waste, propose improvements, and collaborate across functions.

The fifth recommendation centers on cross-regional benchmarking between Region II and Region IV, two operational areas that present contrasting performance profiles in terms of productivity and cost efficiency. Establishing a structured benchmarking mechanism allows the company to capture and disseminate best practices in harvesting methods, labor management, and machine utilization. Regional comparisons also help identify the contextual factors that influence performance outcomes—such as terrain, clone type, or managerial style—so that improvement strategies can be adapted rather than uniformly imposed. Benchmarking sessions can be formalized through quarterly review meetings, plantation audits, or inter-regional exchange programs that facilitate knowledge sharing and foster a sense of healthy competition. Over time, this system will contribute to greater operational standardization, balanced performance across estates, and stronger organizational cohesion.

The sixth and final recommendation is to pursue sustainability and value addition as complementary dimensions of Lean transformation. While Lean primarily targets waste reduction and process efficiency, long-term competitiveness also depends on the company's ability to create higher-value products and minimize environmental impact. PTPN IV should therefore integrate

green productivity initiatives—such as composting, organic fertilizer application, and energy-efficient machinery—into its operational redesign. These initiatives not only reduce input dependency and carbon footprint but also align with global sustainability standards increasingly demanded by premium tea markets. Additionally, product diversification into specialty and premium-grade teas, such as organic, flavored, or single-origin variants, can open new revenue streams and enhance brand equity. Combining Lean efficiency with value innovation enables PTPN IV to compete not only on cost but also on differentiation, capturing higher margins in both domestic and international markets.

If these six initiatives are executed comprehensively, the cumulative impact is projected to restore the profitability of PTPN IV's tea division within two fiscal years. Operational cost reductions, enhanced labor productivity, and improved Grade I output will directly strengthen financial performance, while organizational learning, digital integration, and cultural transformation will ensure sustainability. Furthermore, the adoption of Lean and digital tools across multiple regions will position PTPN IV as a national benchmark for Lean-based plantation management, demonstrating that state-owned agribusinesses can achieve global competitiveness through process discipline, technological innovation, and continuous improvement.

At a broader level, these recommendations carry strategic implications for Indonesia's agribusiness sector. They illustrate that modernization does not necessarily require massive capital investment; instead, it can be achieved through the intelligent redesign of workflows, data-driven decision-making, and the empowerment of human capital. PTPN IV's transformation journey can therefore serve as a model of operational excellence and governance reform for other plantation enterprises under the PTPN Group and beyond. By institutionalizing Lean principles, integrating digital systems, and fostering a culture of learning and accountability, PTPN IV can not only recover from financial losses but also redefine the operational standards for sustainable tea production in Indonesia's state-owned enterprise landscape.

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