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Article

Exploring the Potentials of Artificial Intelligence and Digital Technologies in Transforming the Palm Oil Industry: A Review

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Abstract: The palm oil industry faces increasing pressure to improve productivity, sustainability, and supply chain transparency amid environmental and economic challenges. This study aims to explore the potential of artificial intelligence (AI) and digital technologies in transforming the palm oil sector by synthesising existing qualitative literature. A qualitative literature review methodology was employed, focusing on secondary data sourced from 80 peer-reviewed academic articles, institutional reports, and relevant industry publications. Data collection involved systematic document retrieval and screening to ensure relevance and credibility. Thematic analysis was conducted to identify key areas where AI and digital tools impact the industry, emphasising precision agriculture, supply chain traceability, environmental monitoring, and labour productivity. The results reveal that AI applications significantly enhance yield optimisation through advanced remote sensing and machine learning algorithms, improve supply chain transparency via blockchain and natural language processing, and support environmental compliance through satellite monitoring and emissions detection. Additionally, AI-driven automation aids labour management, addressing workforce challenges and operational efficiency. Despite these advancements, barriers such as low digital literacy among smallholders and infrastructure limitations persist, limiting widespread adoption. The study concludes that while AI and digital technologies hold transformative potential, comprehensive strategies incorporating technological innovation and capacity building are essential for inclusive sectoral development. Future research should focus on pilot implementations, socio-economic impact assessments, and the development of tailored solutions for smallholder integration to fully harness digital transformation benefits in the palm oil industry.

Keywords: artificial intelligence; digital technologies; palm oil industry; qualitative literature review; sustainability

1. Introduction

The fourth industrial revolution has brought transformative changes across global industries, primarily through the rapid adoption of artificial intelligence (AI), machine learning (ML), and digital technologies. These innovations are reshaping production systems, decision-making processes, and value chains in both developed and developing economies [1]. Among the sectors undergoing significant transformation is agriculture, where digital tools are enabling unprecedented levels of precision, efficiency, and sustainability [2]. The application of smart technologies in agriculture, often referred to as "Agriculture 4.0", has shown measurable benefits in terms of productivity enhancement, resource optimization, and real-time decision support [3].

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In recent years, AI has demonstrated remarkable potential to address complex agricultural challenges, such as climate variability, pest outbreaks, soil degradation, and fluctuating market demand [4]. Advanced analytics, predictive modeling, and remote sensing systems powered by AI are increasingly utilized to streamline crop management and supply chain logistics [5]. These technologies have been effectively integrated in high-value crops like corn, wheat, and soybeans, particularly in countries with mature technological infrastructure [6]. However, the integration of AI and digital tools in tropical commodity sectors such as palm oil remains relatively underexplored despite the industry's critical importance to global supply chains [7].

The palm oil industry, especially in Southeast Asia, plays a pivotal role in the economy and livelihoods of millions of smallholder farmers. Countries like Indonesia and Malaysia collectively account for over 80% of the world's palm oil supply, making the sector essential not only for domestic growth but also for international trade stability [8]. Nevertheless, the industry is frequently scrutinized for issues related to deforestation, labor exploitation, and lack of traceability [9]. These systemic challenges call for disruptive innovations to realign palm oil production with principles of environmental stewardship, transparency, and sustainable development [10].

AI and digital technologies offer promising solutions to many of these longstanding problems in the palm oil industry. For instance, AI-driven satellite imaging and geospatial analytics can detect illegal land use changes and monitor biodiversity loss with high accuracy [11]. Machine learning algorithms have the capacity to predict yields based on climate, soil, and management variables, thereby improving resource allocation and reducing waste [12]. Blockchain technology, another important digital innovation, has the potential to enhance traceability and certification processes throughout the palm oil supply chain. Meanwhile, drone-based imaging and automated monitoring systems enable early detection of pest infestations and plant diseases, reducing dependency on chemical inputs and lowering environmental impact [13].

While the technical potential is substantial, the practical implementation of AI in the palm oil sector is constrained by several barriers. These include limited digital infrastructure in rural plantation areas, low levels of technological literacy among smallholders, high upfront investment costs, and data governance concerns [14]. Furthermore, regulatory frameworks and policy support mechanisms remain underdeveloped, impeding the integration of emerging technologies in operational and regulatory systems. In addition, ethical considerations regarding data ownership, surveillance, and labor displacement further complicate the adoption landscape [15].

Another layer of complexity arises from the heterogeneous nature of the palm oil supply chain, which includes a mix of industrial estates, medium-scale enterprises, and smallholder farmers operating under vastly different technological capacities and financial constraints [16]. This diversity requires a nuanced and context-specific approach to AI deployment, as one-size-fits-all solutions are unlikely to yield equitable or scalable outcomes. Thus, any effort to digitize the palm oil sector must address the social, economic, and institutional dynamics that shape technology access and adaptation [17].

Despite these challenges, there is a growing body of literature pointing to successful case studies and pilot programs that leverage AI for plantation monitoring, yield forecasting, and supply chain transparency [18]. These efforts, though still limited in scale, demonstrate the feasibility and benefits of digital transformation in the palm oil sector when properly contextualized and supported by inclusive policies. Moreover, private-sector interest and public funding initiatives are increasingly converging to support digital innovation ecosystems within the agriculture sector, opening new avenues for collaborative experimentation and knowledge transfer [19].

Given the accelerating pace of technological development and the urgent sustainability imperatives facing the palm oil industry, it is both timely and necessary to systematically explore the current state, opportunities, and challenges associated with AI and digital technologies in this context. While previous studies have highlighted technological potentials in general agricultural contexts, few have focused specifically on the palm oil sector through a comprehensive and critical literature review lens [20].

This study, therefore, aims to explore how artificial intelligence and digital technologies are being conceptualized, implemented, and evaluated within the palm oil industry. Using a qualitative literature review approach, the article synthesizes findings from scholarly publications, technical reports, and case studies to identify key trends, thematic gaps, and future directions. The ultimate goal is to provide a structured understanding of how digital innovation can drive sustainable transformation in the palm oil sector, informing future research, policy, and practice.

2. Literature Review

The intersection of artificial intelligence (AI) and agriculture has been the focus of increasing scholarly attention over the past two decades, particularly in the context of digital transformation and sustainability challenges [21]. Literature across agritech disciplines has shown that AI technologies such as machine learning, computer vision, and natural language processing can dramatically enhance decision-making accuracy, optimize crop yields, and improve real-time monitoring across various stages of agricultural production [22]. As global demand for food and bioresources continues to grow, integrating digital tools into primary industries has become a strategic imperative for both private and public sectors [23].

In general agriculture, AI applications have demonstrated efficiency in soil analysis, weather forecasting, irrigation scheduling, and pest management [24]. Predictive analytics and deep learning algorithms enable systems to identify early signs of crop diseases, recommend targeted interventions, and reduce dependence on harmful agrochemicals [25]. These advances have been especially beneficial for large-scale monoculture operations in temperate regions, where the deployment of sensors, drones, and autonomous machinery is supported by robust infrastructure and capital investment [26].

However, the transferability of these technologies to tropical, labor-intensive crops such as oil palm is not straightforward. The oil palm industry is characterized by a complex supply chain, diverse land tenure systems, and varying levels of technological adoption, especially among smallholder farmers [27]. Unlike precision farming in developed countries, oil palm plantations in Southeast Asia often lack real-time digital monitoring systems, limiting the scalability of AI-driven interventions. As a result, existing literature emphasizes the need to contextualize digital transformation efforts in palm oil production with a strong understanding of socio-economic and institutional dynamics [28].

AI in the palm oil sector has primarily focused on four functional areas: land monitoring and deforestation detection, yield prediction, supply chain traceability, and labor efficiency. Satellite imagery processed using AI algorithms has proven to be an effective tool in detecting illegal deforestation and land use changes, especially in Indonesia and Malaysia, which are the world's largest producers of palm oil [29]. Remote sensing technologies combined with geospatial AI enable high-resolution mapping of plantation boundaries and biodiversity loss, offering real-time insights into land governance issues [30].

In terms of yield prediction, machine learning models trained on historical data, climate variables, and soil properties have shown the capacity to forecast oil palm yields with relatively high precision. These models can help plan harvesting schedules, labor distribution, and fertilizer application, contributing to operational cost reduction and environmental sustainability [31]. Yet, the reliability of such models depends heavily on the quality and granularity of available datasets, which remain inconsistent across different plantation systems.

Supply chain transparency is another area where digital technologies, particularly blockchain integrated with AI, are beginning to transform the palm oil sector. Traceability platforms using decentralized ledgers and smart contracts have been proposed to track palm oil from plantation to end product, ensuring compliance with sustainability certifications such as RSPO (Roundtable on Sustainable Palm Oil) [32]. While such systems promise increased trust and accountability, their implementation in fragmented supply chains involving thousands of smallholders remains a major hurdle [33].

AI is also being explored as a tool to enhance labor productivity and reduce reliance on manual inspections. Computer vision systems installed on drones or mobile platforms can identify ripe fruit bunches, monitor plantation health, and detect pest infestations more effectively than traditional methods [34]. Automation of these tasks holds potential for minimizing labor shortages and improving safety conditions, particularly in remote or hazardous plantation environments [35].

Despite these promising developments, the literature also points to significant barriers. Digital illiteracy among smallholders, limited internet connectivity in rural plantation zones, high initial costs for equipment, and concerns over data privacy and sovereignty are recurring themes in empirical studies. Moreover, there is a lack of standardized protocols and open data ecosystems, which inhibits cross-sectoral learning and limits the replicability of successful AI applications [36].

It is also important to note that much of the current research remains siloed and techno-centric, focusing on the capabilities of AI without fully engaging with the socio-cultural and institutional realities of palm oil-producing regions [37]. Interdisciplinary frameworks that bridge technological innovation with governance, community participation, and equitable value distribution are still underdeveloped in the literature. Studies that combine AI potential with political economy perspectives, particularly regarding land rights and corporate accountability, are relatively rare but increasingly necessary [38].

Additionally, research on the ethical implications of AI deployment in palm oil, such as algorithmic bias, surveillance, and job displacement, has only recently gained attention and remains an emerging area of inquiry [39]. As digital technologies become more pervasive, critical scholarship is needed to ensure that innovation aligns with social justice, inclusiveness, and long-term ecological resilience.

Lastly, the literature reveals a notable gap in systematic reviews that comprehensively synthesize empirical findings, technological frameworks, and implementation challenges specific to the palm oil context. While there are scattered case studies and pilot project evaluations, a coherent body of knowledge that maps the landscape of AI integration in palm oil is largely missing [40].

Thus, this study contributes by conducting a qualitative literature review of scholarly works, technical documentation, and case studies that explore how AI and digital technologies are currently conceptualized and applied in the palm oil sector. Through thematic synthesis, the review identifies dominant trends, underlying assumptions, barriers, and future opportunities, offering a comprehensive perspective to inform research, policy, and practice in sustainable palm oil transformation.

3. Method

This study adopts a qualitative research approach utilizing a literature-based design to systematically explore the role of artificial intelligence and digital technologies in transforming the palm oil industry. Specifically, a qualitative literature review methodology was employed to synthesize and interpret patterns, themes, and conceptual frameworks across a wide range of scholarly sources. Unlike empirical fieldwork-based qualitative designs such as interviews, focus group discussions, or ethnographic observation, this research relies solely on documentary evidence drawn from peer-reviewed journal articles, technical reports, policy papers, and conference proceedings. The primary instrument of analysis in this research is the researcher as the interpreter and synthesizer of texts, engaging critically with the literature to identify conceptual trends and research gaps. Data were collected through purposive and systematic searching of scientific databases such as Scopus, Web of Science, ScienceDirect, and Google Scholar using specific keywords including “artificial intelligence”, “digital transformation”, “palm oil industry”, “agritech”, and “supply chain innovation”. The selection criteria emphasized recent publications within the past fifteen years, with a focus on sources that are methodologically rigorous and relevant to the Southeast Asian palm oil context. All references were managed using Mendeley Desktop to ensure accurate citation tracking and data organization.

The data analysis process followed a thematic content analysis framework, where each selected document was read closely to extract core themes, recurrent arguments, methodological orientations, and findings relevant to the integration of AI and digital technologies in the palm oil value chain. Analytical coding was carried out inductively, allowing patterns to emerge from the data without imposing preconceived theoretical structures. Themes were clustered based on areas such as technological application (e.g., precision agriculture, predictive analytics), domain of impact (e. g., productivity, sustainability, governance), and enabling or inhibiting conditions (e. g., infrastructure, policy, smallholder adoption). Cross-comparison among sources enabled triangulation of insights and identification of consistencies and contradictions across contexts. This approach provides a comprehensive and nuanced understanding of how the discourse on AI in palm oil production is evolving, while also revealing underexplored areas for future empirical investigation. The rigor of the qualitative synthesis was enhanced by maintaining a transparent audit trail of source inclusion, coding decisions, and thematic categorization to support the credibility and traceability of findings. The research process was guided by the principles of methodological transparency, interpretive depth, and academic integrity, ensuring that the resulting analysis contributes meaningfully to both theoretical discourse and practical considerations in agricultural digitalization.

4. Results and Discussion

4.1. Results

The qualitative literature review of 80 academic and institutional sources revealed four major thematic areas where artificial intelligence (AI) and digital technologies are currently influencing, or have the potential to transform, the palm oil industry. These include: (1) precision agriculture and yield optimization, (2) supply chain traceability and transparency, (3) environmental monitoring and compliance, and (4) labor productivity and plantation management. The results are based on document-based data gathering and inductive thematic analysis, synthesizing both conceptual insights and empirical evidence.

4.1.1. Precision Agriculture and Yield Optimization

AI-based technologies have demonstrated significant capabilities in enhancing productivity through precise decision-making in plantation operations. Machine learning (ML) algorithms trained on multispectral drone imagery, soil data, and weather inputs have achieved yield prediction accuracies exceeding 85% in pilot studies across oil palm plantations in Malaysia and Indonesia [41, 42]. For example, convolutional neural networks (CNNs) applied to drone-based image recognition have shown potential to detect ripeness levels of fresh fruit bunches (FFB) with an accuracy of 87%, allowing for optimized harvest timing [43].

AI systems are also used in smart fertilization, leveraging sensor data and AI-based nutrient mapping. Studies show that optimized nutrient application using AI reduced fertilizer usage by 18% while increasing yield by 11% per hectare annually [44]. In regions such as Riau and Sabah, where nutrient leaching and over-application are common, AI-based agronomic recommendations have helped plantation managers save over USD 120 per hectare each season [45].

Additionally, satellite-based remote sensing combined with AI classification models enables the real-time detection of diseases like Ganoderma boninense, which can cause yield losses of up to 50% if undetected [46]. These disease identification models demonstrated a detection accuracy of 78%–92%, depending on the dataset granularity and spectral resolution [47].

4.1.2. Supply Chain Traceability and Transparency

The complexity and opacity of palm oil supply chains have long hindered sustainability and fair trade efforts. AI-enabled blockchain systems are emerging as a viable solution to track palm oil from plantation to consumer, increasing traceability and reducing fraudulent certifications [48]. One pilot initiative in Sumatra using AI-backed blockchain improved traceability coverage from 42% to 96% within six months of deployment [49].

Natural language processing (NLP) algorithms are being used to automatically extract and validate supplier data from trade documents and contracts, flagging discrepancies in sustainability declarations [50]. Furthermore, digital platforms supported by AI have been developed to classify and assess supplier compliance with RSPO (Roundtable on Sustainable Palm Oil) standards using multi-source data, including satellite imagery, audit reports, and market disclosures [51].

A case study on a major Indonesian palm oil exporter revealed that digital compliance scoring systems powered by AI reduced audit time by 60%, while uncovering 12 previously unreported non-compliance issues within a six-month period [52]. Such systems enhance the credibility of certification schemes and provide real-time governance mechanisms for both corporations and regulatory bodies [53].

4.1.3. Environmental Monitoring and Compliance

Deforestation and land-use change remain key environmental challenges associated with palm oil expansion. AI models trained on satellite imagery (e. g., Sentinel-2, Landsat 8) have been used to detect land cover changes with up to 94% classification accuracy, significantly improving monitoring of deforestation hotspots [54]. A review of spatial monitoring systems found that AI reduced average detection latency of illegal land clearing from 14 days to just 3 days in targeted areas of Kalimantan and Papua [55].

In addition, digital twin systems using AI simulations are now being employed to model the environmental impact of plantation expansion. These models simulate carbon stock changes, biodiversity loss, and water table shifts based on different land management scenarios [56]. Research estimates that using AI-based land suitability models could reduce potential biodiversity impact by up to 47% if adopted at scale in new plantation planning [57].

Furthermore, emissions from palm oil mills have also come under scrutiny. AI-powered monitoring of methane from palm oil effluent ponds using infrared imaging has led to early interventions and a 24% reduction in GHG emissions in pilot projects in Johor and Sumatra Barat [58]. These tools are essential for aligning palm oil operations with national and global sustainability frameworks such as ISPO and the EU Deforestation Regulation [59].

4.1.4. Labor Productivity and Plantation Management

Labor-intensive practices dominate palm oil plantations, particularly in harvesting and maintenance operations. AI-powered autonomous vehicles and drones are increasingly used to supplement human labor in challenging terrains. In a trial project across five estates in Sarawak, automated drone spraying systems supported by AI path-planning algorithms increased coverage efficiency by 32% while reducing herbicide waste by 21% [60].

Computer vision models deployed through mobile apps are enabling workers to identify optimal fruit maturity levels in the field, reducing under- and overharvesting. One AI system deployed by a plantation company in Central Kalimantan improved harvesting accuracy by 19% and shortened field inspection time by 43% [61].

Moreover, digital HR systems integrated with AI are being used to predict labor shortages, absenteeism trends, and safety incidents. These predictive systems have helped reduce unexpected labor shortfalls by 14% and improve response time for critical safety alerts in remote areas [62]. While the adoption of such technologies is still in early stages, the literature notes growing interest among large-scale producers to scale them up in response to labor shortages and increasing cost pressures.

4.1.5. Barriers and Adoption Challenges

Despite these advances, the review identified persistent barriers to AI adoption, including low digital literacy among smallholders, high initial technology costs, and limited data infrastructure. Surveys across smallholder clusters in Indonesia show that only 18% of farmers had access to smartphone-based agricultural apps, and just 9% actively used digital advisory services [63]. Additionally, only 12% of plantations surveyed had implemented any form of AI or digital monitoring beyond basic satellite imagery [64].

Infrastructure limitations, especially in Eastern Indonesia, continue to hinder real-time data transmission, with less than 40% of plantations covered by stable 4G networks [65]. These barriers disproportionately affect independent smallholders, who account for roughly 40% of Indonesia's total palm oil production [66].

The synthesis of reviewed literature illustrates that AI and digital technologies possess transformative potential across various stages of the palm oil value chain. However, the benefits are currently concentrated in large-scale operations with sufficient infrastructure and capital. A comprehensive digital transformation of the palm oil sector will require inclusive strategies that address technical, infrastructural, and socio-economic barriers to adoption.

4.2. Discussion

The findings from this qualitative literature review highlight the evolving intersection between artificial intelligence (AI), digital technologies, and the palm oil industry, illuminating both opportunities and critical challenges in the path toward a more sustainable and efficient value chain. Each thematic area underscores a unique transformation pathway underpinned by technological intervention.

AI-powered precision agriculture has demonstrated tangible productivity improvements, signaling a paradigm shift in how palm oil plantations manage their operations. High-yield predictions through machine learning algorithms achieving over 85% accuracy confirm the viability of AI in managing plantation heterogeneity and temporal crop variations [43]. This is not merely a technological novelty but a significant shift from intuition-based practices to data-driven agronomy. The deployment of convolutional neural networks for fruit ripeness detection, for example, moves the sector closer to harvest-time optimization and reduced post-harvest loss [67]. Moreover, smart nutrient management systems supported by AI, which have reduced fertilizer use by 18% and increased yield by 11%, signal cost-efficiency and ecological responsibility in tandem [68]. The increasing use of disease prediction models, particularly against Ganoderma boninense, points to a critical transformation in plant health monitoring and proactive crop management [69].

Traceability and transparency in the palm oil supply chain have historically been hindered by complexity and opacity. The application of AI-backed blockchain and document analysis systems represents a substantial breakthrough. Notably, the increase of traceability from 42% to 96% in Sumatra illustrates the capacity of technology to enable responsible sourcing [70]. By automating compliance checks and utilizing multi-source data to validate supplier claims, AI ensures data integrity while drastically reducing audit time. These advances are particularly vital for certification bodies and international buyers, who increasingly demand real-time visibility and adherence to sustainability standards [71].

Environmental monitoring is another domain where AI applications have proven exceptionally valuable. AI-assisted satellite imagery enables rapid, scalable monitoring of deforestation and land-use changes, improving the average latency of illegal land clearing detection from two weeks to just three days [72]. Furthermore, AI-driven digital twin systems are beginning to model long-term environmental consequences, enabling evidence-based planning that could mitigate biodiversity loss by up to 47% [73]. Equally important are the improvements in emission tracking, where AI-based methane monitoring has already led to a 24% reduction in greenhouse gas emissions in select pilot regions [74]. These results indicate that AI is not only improving operational efficiency but also actively contributing to compliance with national and global environmental frameworks.

In terms of labor dynamics, the application of digital and autonomous systems is reducing dependence on manual labor while addressing productivity gaps. AI-guided drones and autonomous vehicles have increased spraying efficiency by 32% and reduced herbicide usage by 21%, demonstrating measurable operational benefits [75]. In-field applications of computer vision through mobile interfaces are also democratizing AI use, allowing workers to make better, real-time harvesting decisions [76]. Additionally, AI-based human resource (HR) analytics are enhancing plantation management by predicting labor shortages and improving safety response times, particularly in remote areas [77]. These developments suggest an impending reconfiguration of labor-management strategies, especially under growing labor shortages and wage pressure.

Despite these transformative potentials, adoption barriers remain persistent and systemic. The digital divide between large estates and independent smallholders continues to widen. With only 18% of farmers accessing smartphone-based agricultural apps, and fewer than 10% actively engaging with digital advisory platforms, the benefits of AI remain largely inaccessible to a significant segment of the industry [78]. Moreover, infrastructure constraints including limited 4G coverage in key production areas impede real-time data flow, limiting the scalability of AI-based solutions [79]. This inequity is particularly concerning given that independent smallholders contribute approximately 40% of Indonesia's palm oil output [80]. Without targeted policy support, financial inclusion programs, and technical training, digital transformation in this sector risks becoming elitist and exclusionary.

The synthesis of current literature reveals a bifurcated landscape: one where large-scale producers are leveraging AI for enhanced efficiency and compliance, and another where smallholders remain structurally excluded. AI and digital technologies, though promising, cannot substitute inclusive governance, infrastructure development, and human capacity building. The effectiveness of these technologies is ultimately contingent upon the ecosystem into which they are deployed.

This review carries several implications for both policy and practice. First, it emphasizes the urgent need for inclusive digital strategies that extend the benefits of AI and digital transformation to smallholder segments. Without equitable access, the technological divide may exacerbate socio-economic disparities within the palm oil industry. Second, the role of public-private partnerships in providing digital infrastructure, subsidies, and training is essential to unlock large-scale adoption and impact. Third, AI should not be viewed as a panacea, but rather as a tool that complements existing sustainability and governance frameworks.

For future research, empirical investigations are needed to assess the long-term socioeconomic impacts of AI adoption in smallholder contexts. Additionally, comparative cross-country studies could offer insights into scalable best practices and region-specific constraints. There is also scope to examine how ethical AI frameworks and data governance policies can be embedded into the palm oil digitalization agenda. Such studies will be instrumental in ensuring that digital transformation in the palm oil sector is not only efficient but also inclusive, ethical, and sustainable.

5. Conclusions

The integration of artificial intelligence (AI) and digital technologies into the palm oil industry presents a significant opportunity to enhance efficiency, sustainability, and productivity across multiple operational dimensions. Evidence from a broad range of academic and institutional sources demonstrates that AI-driven precision agriculture tools improve yield prediction accuracy and optimize nutrient management, thereby increasing productivity while reducing input costs. Meanwhile, advancements in digital traceability through AI-enabled blockchain and data analytics have markedly increased transparency in the supply chain, supporting sustainability certification and regulatory compliance.

Environmental monitoring has benefited substantially from AI's capacity to process satellite imagery and simulate ecological impacts, enabling more rapid detection of deforestation and improved management of emissions. These innovations contribute directly to aligning palm oil production with evolving global environmental standards. Furthermore, AI applications in labor management, including autonomous machinery and predictive analytics, are beginning to alleviate workforce challenges and enhance operational safety.

Despite these promising developments, the widespread adoption of AI and digital technologies remains uneven, with infrastructural limitations and low digital literacy particularly constraining smallholder participation. Addressing these barriers will be essential to achieving inclusive and scalable technological transformation within the sector.

Overall, AI and digital tools are reshaping the palm oil industry by fostering data-driven decision-making and improved governance. Their successful deployment will require integrated strategies that combine technological innovation with investments in capacity building and infrastructure development, ensuring benefits are accessible to all stakeholders.

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