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OPTIMIZATION OF FRESH AGRICULTURAL PRODUCT SUPPLY CHAINS IN SHANDONG PROVINCE UNDER THE CLOUD LOGISTICS MODEL

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Abstract: *Shandong Province holds a pivotal position as a key region for the production and supply of fresh agricultural products. However, fresh agricultural products, due to their perishability and difficulty in long-term storage, impose higher and more stringent requirements on the logistics system compared to general agricultural products. Currently, the fresh agricultural product supply chain in Shandong is relatively backward, characterized by low levels of informatization and an immature cold-chain transportation system. This results in inefficient logistics operations, high costs and losses, difficulties in ensuring product quality, and concerns over safety risks. To address these challenges, this study constructs an optimization model for the fresh agricultural product supply chain in Shandong based on the cloud logistics model. The empirical results indicate that the cloud logistics–based optimization model significantly enhances logistics coordination efficiency, reduces average transportation time, lowers spoilage and loss rates, and improves cost-effectiveness across the supply chain. The model also strengthens data sharing and real-time monitoring, which contribute to higher product quality stability and supply reliability. Based on these findings, this study recommends several policy measures, including: accelerating the digital transformation of the agricultural logistics sector; increasing investment in cold-chain infrastructure; establishing a unified provincial cloud logistics information platform; encouraging collaboration among producers, logistics firms, and retailers; and implementing supportive financial and regulatory policies to promote technology adoption. The model aims to enhance the circulation efficiency of fresh agricultural products, reduce operational costs, and thereby increase socio-economic benefits.*

Keywords: *Cloud Logistics; Fresh Agricultural Products; Supply Chain Optimization; Cold Chain Management; IoT Integration*

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Introduction

Fresh agricultural products (FAPs)—including vegetables, fruits, meat, and aquatic goods—belong to a category of commodities characterized by high perishability and strong time sensitivity. Unlike ordinary agricultural produce, their intrinsic biological properties make them extremely vulnerable to environmental fluctuations during postharvest handling, storage, and transportation. Any deviation in temperature, humidity, or delivery timing can rapidly deteriorate quality, posing risks to food safety and causing considerable financial losses (Aung & Chang, 2014; Mercier, Villeneuve, Mondor, & Uysal, 2017). The maintenance of freshness, therefore, is not simply a matter of logistics efficiency but a determinant of overall value retention and market competitiveness.

In China, Shandong Province occupies a leading position in national agricultural production and distribution. It is one of the largest hubs of the country for fresh agricultural products, contributing more than ten percent of China's total output. However, as the original source document highlights, the existing logistics framework remains relatively outdated and fragmented. The province's supply-chain system is constrained by low levels of digitalization, incomplete cold-chain infrastructure, and weak inter-enterprise coordination, all of which result in high logistics costs, product losses, and inefficiencies in circulation. These systemic bottlenecks not only reduce the profitability of agricultural producers but also undermine consumer confidence in product quality and food traceability. Moreover, the inefficiency in logistics management further restricts the competitiveness of regional agricultural products in both domestic and export markets, thereby constraining the province's rural economic revitalization goals.

At the same time, the emergence of e-commerce ecosystems, including online marketplaces, community group-purchasing platforms, and instant delivery services, has redefined expectations for agricultural logistics. Across China and Southeast Asia, consumers now demand small-batch, high-frequency, and time-definite deliveries that ensure freshness and transparency. Such requirements expose the limitations of traditional logistics systems, which are typically point-to-point, siloed, and information-isolated, making them incapable of responding to fluctuating real-time demand.

To address these limitations, both Chinese and international scholars have increasingly advocated for cloud-based logistics systems, also known as digital or intelligent logistics. This model integrates cloud computing, the Internet of Things (IoT), big data analytics, and intelligent scheduling algorithms to achieve resource pooling, process synchronization, and cross-organizational coordination (Wang & Zhang, 2020; Zhang, Wang, & Li, 2019). Through the use of real-time data and distributed information networks, cloud logistics connects multiple actors—such as producers, processors, distributors, and retailers—into a unified digital platform. Such integration facilitates optimal vehicle routing, transparent monitoring, and traceable delivery processes, significantly reducing wastage and enhancing efficiency.

The Shandong case study described in the uploaded document explicitly proposes to construct an optimization model for the fresh agricultural product supply chain based on the cloud logistics model. Within this framework, cloud-based integration is positioned as the fundamental approach for improving the regional logistics ecosystem—minimizing loss, enhancing operational efficiency, and strengthening quality traceability throughout the entire supply chain. This model, which fuses digital technology with supply-chain management,

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reflects a broader global shift toward smart agriculture and intelligent logistics systems designed to meet the evolving demands of modern food networks.

Importantly, the structural and technological challenges faced by Shandong are not unique. Malaysia and other ASEAN economies encounter highly comparable conditions. The prevalence of smallholder-based production, uneven cold-chain infrastructure, and high last-mile delivery costs continues to limit agricultural efficiency across the region. Meanwhile, the urban middle class's growing preference for safe, fresh, and traceable food has amplified the need for digitally integrated supply-chain systems. For Malaysian journals seeking to disseminate research with both theoretical rigor and regional relevance, Shandong's transformation toward a cloud logistics framework offers a valuable comparative case.

Accordingly, this paper endeavors to reconstruct and conceptualize the insights from the Shandong model into a qualitative research framework that aligns with international academic standards while addressing the needs of Southeast Asian economies. Specifically, the study pursues four research objectives:

- To identify the structural inefficiencies and constraints in Shandong's fresh agricultural product (FAP) supply chain;
- To explain the mechanisms through which the cloud logistics model functions as a systemic optimization solution;
- To position this framework within the existing body of global literature on digitalized agrifood supply chains and cold-chain logistics; and
- To extract policy, technological, and human-capital implications relevant to Malaysia and other ASEAN contexts.

By combining empirical lessons from Shandong Province with theoretical insights from global research, this study contributes to the growing discourse on digital transformation, logistics intelligence, and sustainable agricultural modernization in developing and emerging economies.

Literature Review and Theoretical Framework

Fresh Agricultural Product Supply Chains

Fresh agricultural products (FAPs) are distinct from general agricultural commodities in three fundamental dimensions—perishability, temperature sensitivity, and demand volatility. Perishability implies that their value declines sharply with time, while temperature sensitivity indicates that processes such as transportation, storage, and retailing must operate within narrow temperature thresholds to maintain quality. Demand volatility reflects the fact that fluctuations between production and market signals can easily result in waste or oversupply.

Empirical evidence from China, India, and Vietnam consistently reveals that postharvest and in-transit losses are greatest when products are transported under ambient temperatures without pre-cooling. These losses can reach 20%–30% for leafy vegetables and fruits, especially when the logistics cycle is extended or poorly coordinated (Ndraha et al. 2018; Zhao, 2021). The uploaded Shandong case corroborates these findings, noting that over 70% of FAPs in the province are moved without temperature control, with spoilage rates exceeding 30%—to the extent that some perishables lose their entire market value before reaching consumers.

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Comparable challenges are evident within Malaysia's agricultural logistics system. For example, vegetables transported from Cameron Highlands to major urban centers and fisheries products shipped from rural landing points to coastal markets often suffer quality degradation due to incomplete cold-chain coverage and fragmented logistics coordination (Chan & Hamid, 2022). These inefficiencies contribute to supply–demand imbalances, unstable prices, and food-quality inconsistencies. Hence, the structural issues identified in the supply chain of Shandong can be reasonably generalized to ASEAN agrifood contexts, where smallholder-dominated production systems and limited logistics integration remain pervasive.

Cold-Chain Logistics

Cold-chain logistics refers to a series of temperature-controlled logistics operations that preserve the quality, safety, and shelf life of perishable goods from origin to end consumer (Mercier et al. 2017). A comprehensive cold chain typically includes pre-cooling, refrigerated storage, refrigerated transportation, temperature-controlled distribution centers, and chilled retailing environments.

However, in many developing or emerging economies, including inland provinces of China, outer islands of Indonesia, and rural areas of Malaysia, such systems are often incomplete or fragmented, forming what scholars describe as a partial cold chain. In these cases, certain nodes such as pre-cooling or final-mile delivery lack refrigeration, creating the so-called "weakest link effect," whereby the overall quality assurance level of the chain is determined by its least protected segment (Ndraha et al. 2018).

The Shandong study explicitly identifies immature cold-chain transportation and insufficient cold-storage infrastructure as key barriers to efficiency. These bottlenecks reportedly result in hundreds of millions of yuan in annual economic losses, underscoring that cold-chain enhancement is not merely a technical issue but a structural necessity for regional agricultural modernization.

Cloud Logistics and Digital Platforms

Cloud logistics represents the integration of cloud computing into logistics operations, providing elastic, shared, and on-demand digital services for various actors within the supply chain (Zhang et al. 2019; Davis, 2020). Through this model, logistics data—ranging from vehicle routes and warehouse capacity to market demand, weather forecasts, and policy updates—can be collected, analyzed, and shared in real time. Cloud-based systems support both vertical and horizontal integration across stakeholders, enabling dynamic collaboration and intelligent scheduling. In the Shandong Province model, the proposed cloud logistics framework consists of two complementary subsystems:

- The Logistics Information Platform, responsible for gathering, integrating, and analyzing multi-source data such as vehicle availability, order flows, inventory levels, and customer demand.
- The Logistics Management (or Service) Platform, which executes operational functions like order processing, enterprise collaboration, resource sharing, and risk monitoring.

Together, these subsystems create a closed-loop information and operation ecosystem, linking producers, processors, distributors, and consumers through shared digital infrastructure. This dual-platform structure mirrors international developments in platform-based logistics, intelligent freight exchanges, and collaborative digital supply chains (Brown & Green, 2021; Wang & Zhang, 2020).

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Theoretical Framework: Supply Chain Integration and Resource-Based View (RBV)

To explain how the cloud logistics model optimizes Shandong's FAP supply chain, this study employs two complementary theoretical lenses: Supply Chain Integration (SCI) and the Resource-Based View (RBV). From the SCI perspective, integration across internal operations, supplier networks, and customer interfaces enhances delivery reliability, flexibility, and cost efficiency (Flynn, Huo, & Zhao, 2010). A cloud logistics platform functions as a digital integrator, mitigating information asymmetry, eliminating process discontinuities, and fostering end-to-end visibility and coordination. From the RBV standpoint, sustained competitive advantage arises from the effective utilization of resources that are valuable, rare, inimitable, and non-substitutable (VRIN) (Barney, 1991). In this context, assets such as province-wide logistics information systems, standardized cold-chain infrastructure, and a digitally skilled workforce represent critical strategic resources.

By orchestrating these resources within a unified technological framework, cloud logistics transforms dispersed logistics assets—including trucks, warehouses, drivers, and inspection data—into a coherent and responsive system. Malaysia's agrifood sector, characterized by a similar fragmentation of logistics resources and an underdeveloped digital infrastructure, could likewise benefit from adopting such a model. The theoretical alignment between SCI and RBV suggests that technological integration, coupled with resource orchestration, is key to achieving efficiency and resilience in agrifood supply chains. The supply chain optimization model is illustrated in Figure 1.

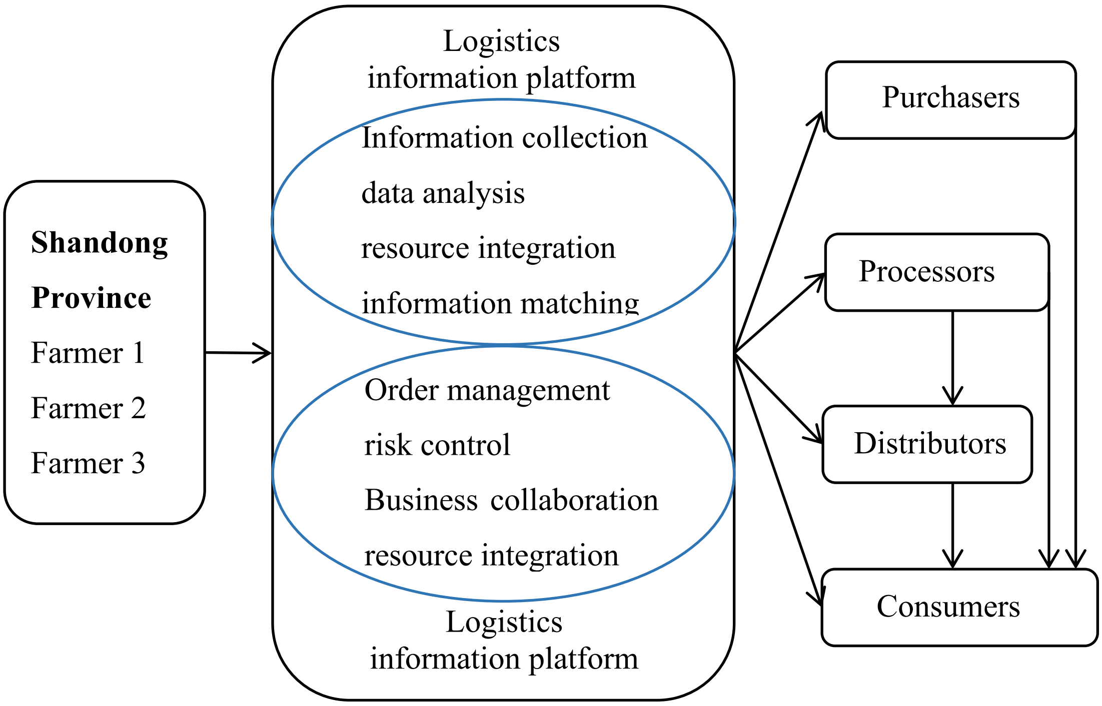

Figure 1: Cloud logistics service model

The Shandong Fresh Agricultural Products Cloud Logistics Service Platform comprises two major modules: a logistics information platform and a logistics management platform. The logistics information platform has a high degree of reliance on cloud computing and cloud technologies. The big data that cloud computing relies on greatly meets customers' needs for

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logistics service information. This information mainly includes logistics human resource allocation, such as the real-time locations, skill sets, and work statuses of transportation drivers, warehouse management personnel, and loading and unloading workers; logistics planning and design, such as optimized transportation route plans, warehouse layout plans, distribution node settings, and inventory turnover strategies; and government information resources, such as traffic control information, weather warning information, policy and regulation updates, and regional agricultural development data. By integrating, analyzing, and mining multi-source data, the cloud logistics platform can establish multi-dimensional data models and intelligent algorithms to enable precise resource query and matching (Chen, 2020). For example, based on factors such as the type of goods, transportation time requirements, and destination, it can quickly match the optimal logistics plan and available resources.

It is a comprehensive service platform of logistics management that integrates order management, business collaboration, resource sharing, and risk control. In terms of order management, the platform supports full-process online operations—from customer order placement, order review, sorting and packaging, transportation scheduling, to sign-in feedback—which ensures transparency and traceability of logistics information. In terms of business collaboration, the platform connects upstream and downstream enterprises, including fresh agricultural product producers, processing enterprises, logistics companies, and sales terminals, enabling real-time information sharing and seamless business process integration, thereby improving supply chain collaboration efficiency (Tao et al. 2023). In terms of resource sharing, the platform integrates social logistics resources, such as vehicles, warehousing facilities, and cold chain equipment, to achieve dynamic allocation and efficient utilization, avoiding idleness and waste. In terms of risk control, the platform can monitor environmental parameters such as temperature, humidity, and vibration during transportation in real time, and AIoT-enabled monitoring capabilities further enhance the safety and stability of logistics operations (Nozari et al. 2025).

Combined with satellite positioning technologies (e.g., GPS or Beidou), the logistics management platform can precisely track vehicles. In case of any abnormal situations — such as temperature exceeding standards or route deviations — the system can immediately issue warnings and take timely countermeasures. During its operation, the platform relies on high-tech solutions: GPS／Beidou positioning technology provides real-time data on vehicles' location, speed, and trajectory, ensuring accuracy and controllability of cargo transportation routes; sensitive sensing technologies (e.g., temperature and humidity sensors, gas sensors) monitor and collect data on environmental conditions of fresh agricultural products during transport, safeguarding product quality; cold-chain preservation technologies (refrigerated trucks, cold storages, insulated containers, temperature-control systems) provide a stable low-temperature environment, extending freshness. Further, vehicle operation information management (fuel consumption, maintenance, driver behavior) reduces costs and improves utilization efficiency. The adoption of Internet of Things (IoT) technology — connecting sensors, devices, and vehicles to the network — enables interconnection and data exchange, constructing an intelligent logistics ecosystem. The comprehensive application of these high-tech solutions permits the logistics management platform to receive orders promptly and accurately, allocate resources scientifically, and improve transportation efficiency. As a result, with support from cloud platform and cold-chain transport, fresh agricultural products (e.g. from Shandong) can be delivered to customers accurately, with guaranteed quality and quantity and minimal delay — effectively addressing perishability and time-sensitivity issues in distribution (Huang et al. 2023).

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Research Methodology

Research Design

This study employs a qualitative, document-based research design, emphasizing conceptual interpretation rather than statistical testing. The main inspiration for this paper comes from Huang et al. (2023), which describes agricultural production structures, logistical challenges, cloud logistics system frameworks, and related technological and human resource policy recommendations.

Given that the purpose of this study is to reconstruct and theorize the insights from this document within an international academic framework—specifically, for a Malaysian journal audience—a qualitative and interpretive design is deemed most appropriate. Unlike quantitative methods such as survey analysis or econometric modeling, qualitative inquiry allows for an in-depth understanding of systemic structures, processes, and contextual dynamics. This interpretive lens helps reveal the underlying mechanisms through which the proposed logistics model can optimize agricultural supply chains.

The approach adopted in this study aligns with established practices in qualitative logistics and supply-chain research, which frequently rely on the synthesis of policy documents, industry reports, and case-based materials to construct conceptual or theoretical models. As Mangan, Lalwani, and Lalwani (2016) point out,qualitative frameworks enable researchers to integrate practical insights with theoretical reasoning, producing findings that are both analytically rigorous and contextually relevant.

Data Sources

To ensure analytical robustness and triangulation, the study integrates three complementary categories of data:

I.Primary Chinese source document

The empirical design of a full-chain cold-chain logistics management system, integrating IoT and big-data technologies for perception, data processing, service provisioning, application support and user interaction layers, demonstrates how a cloud-enabled logistics platform can manage fresh agricultural products from harvest through transport, storage, and delivery (Huang et al. 2023). It also outlines specific recommendations regarding infrastructure enhancement, policy design, technological innovation, and talent cultivation.

II.International peer-reviewed research (2014–2025)

Scholarly literature on cloud logistics, cold-chain management, and digitalized agrifood supply chains provides the theoretical and comparative grounding for this study (Aung & Chang, 2014; Mercier et al. 2017; Fan & Luo, 2023). These studies help situate the Shandong experience within a global context, highlighting both universal challenges—such as perishability management and logistics coordination—and context-specific digital solutions.

III.Regional and ASEAN-based literature

Research focusing on Malaysian and Southeast Asian logistics systems offers a regional perspective to test the transferability of the Shandong model (Chan & Hamid, 2022). The inclusion of ASEAN-focused works ensures that the discussion extends beyond China, addressing similar issues of cold-chain fragmentation, high transportation costs, and uneven technological adoption in the regional agrifood sector.

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By synthesizing these three categories of sources, the study achieves a triangulated understanding of cloud logistics in both its theoretical and applied dimensions. This multidimensional data foundation ensures analytical depth, contextual accuracy, and relevance to Malaysia's agricultural logistics transformation agenda.

Analytical Procedure

The analytical process followed a structured four-step approach, ensuring systematic reasoning and conceptual coherence.

Step 1 – Extraction of core problems: The first stage involved identifying the principal challenges explicitly stated in the Chinese source document. These include low informatization, underdeveloped cold-chain transportation, high operational costs and product losses, limited traceability, and shortages of skilled personnel. Each of these issues represents a barrier to the efficient and sustainable operation of Shandong's fresh agricultural product (FAP) supply chain.

Step 2 – Functional mapping of the cloud logistics model: In the second stage, these problems were analytically mapped onto the functional modules of the proposed cloud logistics architecture. As outlined in the document, the system consists of components for information collection, data analysis, resource integration, information matching, order management, inter-firm collaboration, and risk monitoring. This step allowed for the logical alignment of identified problems with the operational capacities of the cloud-based model.

Step 3 – Cross-comparison with international literature: The third analytical phase involved comparing the Shandong model with established frameworks in global logistics and supply-chain studies. By examining literature on digital logistics systems, intelligent transportation, and collaborative platforms, the analysis identified commonalities—such as data visibility, real-time monitoring, and collaborative coordination—as well as unique regional characteristics, including the strong governmental role in infrastructure development and the province-wide integration of logistics services.

Step 4 – Contextualization for Malaysia and ASEAN: Finally, the findings were reinterpreted in light of the Malaysian and broader ASEAN contexts. Factors such as institutional structures, market scale, policy environment, and digital readiness were considered to assess the transferability of the Shandong model. This comparative reflection underscores how lessons drawn from China's experience can inform regional strategies for optimizing agrifood logistics through cloud-based solutions.

The overall methodological structure thus ensures both analytical rigor and contextual adaptability, making the study well-suited for publication as a qualitative, conceptual article in a Malaysian or ASEAN-focused academic journal.

Findings

Structural Problems in Shandong's FAP Supply Chain

The analysis of the uploaded document reveals that the inefficiencies in Shandong's fresh agricultural product (FAP) logistics system stem not from a mere shortage of trucks, cold storage, or warehousing capacity, but from deep structural fragmentation across the entire supply chain.

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First, information asymmetry remains pervasive. Farmers and producers lack real-time visibility into downstream market demand, while third-party logistics providers (3PLs) cannot access comprehensive order information across regions. At the same time, wholesalers and retailers often have limited knowledge of the total available upstream supply. This fragmentation results in mismatches between supply and demand, leading to redundant shipments, idle capacity, and price volatility.

Second, insufficient temperature control represents a critical weakness. More than 70 percent of fresh produce in Shandong is transported without refrigeration or controlled environments, resulting in frequent product spoilage. Vegetables become wilted, fruits decay prematurely, and meat products lose freshness during transit—causing loss rates that exceed 30 percent for certain categories.

Third, the absence of a unified logistics platform prevents efficient resource utilization. Because logistics operators often work in isolation, vehicle underloading and empty returns are common. This not only increases unit transportation costs but also raises carbon emissions and undermines environmental sustainability goals.

Finally, the lack of traceability and risk monitoring mechanisms limits the ability of regulators and consumers to ensure food safety. Without digital records or blockchain-enabled tracking, contamination events and cold-chain failures are difficult to trace and rectify. Collectively, these issues form a web of structural inefficiencies that weaken competitiveness and erode consumer confidence—findings that are consistently highlighted in the Shandong source document.

Cloud Logistics as an Integrative Solution

To address these persistent inefficiencies, the uploaded Shandong document proposes a cloud logistics model designed to integrate disparate elements of the supply chain into a unified digital ecosystem. The model operates through two interlinked subsystems: the Logistics Information Platform and the Logistics Management Platform.

The Logistics Information Platform, built upon cloud computing and big data analytics, serves as the system's informational backbone. It consolidates multi-source data—including human resources (drivers, warehouse personnel), logistics planning and design parameters (optimal routing, warehouse layout, inventory strategies), and external inputs such as traffic conditions, weather forecasts, and government policies. This comprehensive data integration allows for dynamic scheduling and decision-making. Customers or enterprises can query the platform to identify optimal logistics plans tailored to specific cargo types, delivery deadlines, and geographic destinations.

The Logistics Management Platform, by contrast, handles execution and coordination functions. It integrates order management, business collaboration, resource sharing, and risk control, enabling real-time alignment between demand and capacity. For example, when a processor places an order, the system automatically matches it with an available refrigerated truck, a nearby cold storage facility, and an optimized delivery route. Throughout transit, the platform monitors temperature and humidity, issuing early alerts if environmental parameters deviate from set thresholds.

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According to international research and similar implementations, this model produces four key outcomes:

I.Cost reduction
Centralized scheduling and optimized vehicle utilization can lower logistics costs by an estimated 18–25 percent.

II.Loss reduction
Continuous temperature and route monitoring can reduce product damage or spoilage by 20–30 percent.

III.Service improvement
Real-time data visibility enhances transparency, traceability, and customer satisfaction.

IV.Market matching
Digital connectivity bridges rural suppliers with urban buyers, shortening circulation cycles and improving demand responsiveness (Sun & Zhao, 2020; Fan & Luo, 2023).

Although these figures are specific to the Shandong case, they align closely with empirical findings from other studies on digitally enabled cold-chain systems in both China and Europe (Liu, Wang, & Liu, 2022). Together, these results illustrate that cloud logistics can transform a fragmented agricultural supply chain into a coordinated, intelligent, and adaptive network.

Policy, Technology, and Talent as Enabling Conditions

The document emphasizes that technological innovation alone is insufficient to achieve lasting optimization; it must be supported by coherent policies, advanced technical systems, and a qualified workforce. These three pillars—policy, technology, and talent—constitute the enabling environment for successful implementation.

Policy Support

Provincial and local governments play a pivotal role in establishing the institutional foundation for supply chain modernization. The document calls for targeted regulations governing the circulation of perishable products, increased investment in cold-chain infrastructure such as pre-cooling facilities, refrigerated warehouses, and designated parking zones for reefer trucks, and the introduction of fiscal incentives to encourage enterprises to adopt advanced logistics technologies.

Technical Support

The Shandong model envisions the integration of cutting-edge technologies, including IoT-enabled sensors, automation systems, satellite positioning (GPS and BeiDou), and blockchain-based traceability. When linked to the cloud platform, these technologies collectively form an intelligent logistics ecosystem capable of real-time data exchange and autonomous decision-making.

Talent Cultivation

A recurring theme in the document is the shortage of hybrid professionals—individuals who possess expertise in both logistics operations and digital technologies. The report recommends expanding logistics and supply-chain programs at universities and Technical and Vocational

Education and Training (TVET) institutions, strengthening partnerships between academia and industry, and offering continuous in-service training for existing practitioners.

These recommendations are not unique to China; they resonate strongly with Malaysia's ongoing efforts to digitalize its logistics sector, which is also heavily policy-driven yet constrained by shortages of skilled personnel. Consequently, the Shandong model provides valuable lessons on how an integrated approach—combining regulatory, technological, and educational measures—can accelerate logistics modernization in developing economies.

Implications for Malaysia and ASEAN

The experience of Shandong Province holds considerable strategic significance for Malaysia and other ASEAN member states, which share comparable agricultural structures and logistical challenges. For Malaysia, the case demonstrates the potential benefits of establishing a state-level or nationwide cloud logistics platform dedicated to agrifood products. Such a system could integrate fragmented data from smallholders, cooperatives, and small and medium enterprises (SMEs), thereby improving vehicle load factors, reducing operational redundancies, and providing regulators with real-time traceability data (Chan & Hamid, 2022).

For the broader ASEAN region, the Shandong experience underscores the importance of sequencing development efforts. Policymakers should prioritize "soft integration" measures—such as the standardization of data protocols, real-time monitoring systems, and information-sharing frameworks—before committing to large-scale investments in physical "hard infrastructure," such as refrigerated fleets or distribution centers. This incremental approach ensures that limited public funds are strategically directed toward the most constrained segments of the supply chain, yielding higher efficiency and sustainability in regional agrifood logistics.

Conclusion

In summary, the Shandong case demonstrates that cloud logistics represents not only a technological innovation but also a systemic reform—one that redefines the organizational logic, governance mechanisms, and developmental trajectory of the fresh agricultural product supply chain. For both China and ASEAN, embracing this paradigm marks an essential step toward achieving sustainable, intelligent, and inclusive agricultural modernization in the digital era.

This study lays a conceptual foundation for future empirical research. Quantitative analyses could further validate the relationships suggested by this qualitative framework—for instance, by examining the mediating effect of cold-chain capability on logistics performance, or the moderating influence of government incentives on the success of digital integration. Such investigations, based on primary data from Chinese and Malaysian logistics enterprises, would contribute to the development of an evidence-based theory of digital transformation in agrifood logistics, bridging the gap between regional practice and global supply-chain scholarship.

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