EPRA International Journal of Agriculture and Rural Economic Research (ARER)- Peer-Reviewed Journal
Volume: 14 | Issue: 3 | March 2026 | Journal DOI: 10.36713/epra0813| Impact Factor SJIF(2026): 8.801| ISSN: 2321 – 7847

EVOLVING TRENDS AND CHALLENGES IN AGRICULTURAL EXPORT MARKETS: A COMPREHENSIVE REVIEW

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Article DOI: https://doi.org/10.36713/epra26487
DOI No: 10.36713/epra26487

ABSTRACT----------
This literature review synthesizes contemporary research on the evolving trends, structural challenges, and strategic responses shaping global agricultural export markets. The reviewed studies highlight major transitions driven by digitalization, ESG requirements, technological innovation, and shifting market structures. Evidence shows that technological formalization, including hybrid seed adoption and proprietary input systems, is reshaping production quality and market competitiveness. ESG standards have become essential for market access, though adoption requires stronger incentives and supportive financing. Digital tools improve market access, reduce information asymmetry, and strengthen supply-chain transparency; however, their effectiveness depends on adequate physical infrastructure and institutional capacity. Supply-chain vulnerabilities such as weak storage, port congestion, and logistical bottlenecks remain significant barriers that increase costs and amplify systemic risks. Policy decisions, including export restrictions, can worsen global price volatility and undermine market stability. At the firm level, proactive market orientation, organizational innovation, and rapid internationalization enhance export performance, while layered digital capabilities support resilience and long-term competitiveness. Overall, the review demonstrates that agricultural export success depends on the integration of advanced technologies, resilient infrastructure, coherent policy frameworks, and strategic organizational capabilities. The literature also reveals gaps related to quantifying systemic inefficiencies and understanding organizational change within export-oriented agri-food firms.
KEYWORDS: *Agricultural Export Markets; Digital Transformation; ESG Compliance; Technological Innovation; Market Orientation Strategies; Infrastructure Constraints*----------

INTRODUCTION

Global agricultural export environment is undergoing rapid and unprecedented transformation driven by digitalization, climate shocks, supply chain fragility, evolving trade policies, market power concentration, technological advancements, and shifting consumer expectations. These structural changes necessitate a comprehensive synthesis of emerging empirical evidence to understand how agricultural export systems are evolving, which capabilities are required for competitiveness, and where persistent vulnerabilities remain. This literature review synthesizes findings from a diverse set of empirical, conceptual, and modeling studies to examine the evolving landscape of agricultural export markets. Understanding the evolving nature of these challenges requires a holistic review of empirical studies and conceptual frameworks across a wide spectrum of agricultural, economic, supply chain, and international business literatures.

The insights of the selected publications hold direct relevance as they highlight universal pressures: the rising importance of sustainability, the fragility of global supply chains, increasing reliance on digital tools, and the need for new organizational and strategic capabilities in competitive trade environments. Collectively, these studies expose persistent gaps that are directly applicable to the agricultural export policy and firm strategy of most international export systems.

The primary purpose of this literature review is to synthesize current research on technological, organizational, market, logistical, and policy-driven transformations affecting agricultural export systems globally. Existing literature is often fragmented, thus, some studies explore technological innovation, others analyze supply chain risks or export behavior, while others examine sustainability or policy shocks. This review integrates these parallel strands to construct a coherent narrative and identify cross-cutting patterns. The contributions of this review include the following;

Volume: 14 | Issue: 3 | March 2026 | Journal DOI: 10.36713/epra0813| Impact Factor SJIF(2026): 8.801| ISSN: 2321 – 7847

1. Synthesizing global evidence on technological, institutional, environmental, and market-driven changes affecting agricultural export systems.
2. Critically analyzing the quality, methodology, and limitations of existing studies to evaluate how robust or generalizable their findings are.
3. Identifying core challenges (i.e. logistical, structural, policy-driven, and behavioral) that constrain export efficiency and resilience, especially in high-volume systems such as grains.
4. Proposing future research directions and policy pathways to strengthen export resilience and competitiveness.

Structure of the Literature Review

This literature review is structured thematically into five major sections that reflect the core transformations occurring in global agricultural export markets. It begins by examining technological and market-driven transitions that are reshaping production systems and influencing export competitiveness. The second section explores the expanding role of digital transformation, including ICT tools, blockchain applications, and data-driven innovations that are redefining market access and value-chain transparency. The third section analyzes supply-chain vulnerabilities, highlighting how infrastructure constraints and crisis-driven risks continue to undermine export reliability and efficiency. The review then moves to strategic firm behavior, emphasizing the roles of innovation, market orientation, and internationalization in determining which firms successfully adapt to evolving market pressures. Collectively, these sections provide a comprehensive synthesis of emerging trends and challenges shaping contemporary agricultural export systems.

METHODOLOGY

A systematic literature review was done concerning Evolving Trends and Challenges in Agricultural Export Markets. A systematic literature review was adopted in this study because the subject matter was narrower and more specific to warrant a scoping literature review method. A review protocol was outlined prior to conducting the systematic review, which is in accordance with the review guidelines proposed by Kitchenham *et al*. (2010). The research questions were first defined, after which the key words identified in this research were input into databases to select the relevant literature materials. The databases that were used to source literature materials in this study included: Science Direct, Google Scholar, Web of Science, and Research Gate. Search Keywords or statements used in this study are as follows:

1. Evolving trends AND Challenges AND Agricultural export markets
2. Factors AND agricultural produce export AND emerging trends
3. Challenges AND agricultural export AND solutions

A selection criterion consisting of "documents within agricultural export, export market, international market, and published between 2020 - 2025" was used to filter the documents and select relevant literature. A total of 87 literature materials were obtained using the above keywords and criteria for searching literature in the various search engines. Out of this number, only 25 were selected based on the information they provided. All other pertinent information was gathered from the selected literature materials and subsequently synthesised in accordance with the main theme of the research, emerging trends in agricultural export. A thematic analysis was used to discuss the relevant information captured in the literature section.

REVIEW FINDINGS

Technological and Market-Driven Transitions in Agricultural Export Systems

Technological transformation and market-driven structural changes are among the most significant forces reshaping global agricultural exports. Across the reviewed studies, several key transitions emerge: the rise of market formalization and hybrid technologies (Ter Steeg & Louwaars, 2024), the growing centrality of ESG-driven value creation (Almeida *et al*., 2025), and the intensifying pressures of digitization and digital market entry (Rizov *et al*., 2022). These trends highlight how technological adoption and evolving market expectations jointly influence competitiveness, supply chain reliability, and farmer inclusion.

Market-Driven Formalization and Technological Transition in Agricultural Systems

The transition toward more commercialized, technologically intensive agricultural systems is a major trend across global markets. Ter Steeg & Louwaars (2024) demonstrate that vegetable seed markets in sub-Saharan Africa are undergoing a "market-driven linear trajectory" of development in which farming systems become increasingly formalized, pushing producers toward the adoption of advanced hybrids. This shift is driven by the private sector's focus on high-margin seed technologies that deliver predictable yield, disease resistance, and year-round production capacity (Ter Steeg & Louwaars, 2024).

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This dynamic mirrors broader transitions in export agriculture globally, where yield stability, uniformity, and specialized quality attributes are critical for meeting the demands of international buyers. The U.S. export system, especially for corn, soybeans, cotton, and high-value horticultural crops, faces similar pressure to integrate advanced input technologies to maintain competitiveness in markets that increasingly demand consistency, food safety, and sustainability. The reliance on hybrids and proprietary varieties also reflects global trends in intellectual property–driven value creation, where private firms invest heavily in research to generate competitive differentiation (Ter Steeg & Louwaars, 2024).

ESG Standards as a New Market Access Imperative

A major structural transition in agricultural export markets is the shift toward Environmental, Social, and Governance (ESG) compliance as a pre-condition for market access. Almeida *et al*. (2025) showed that ESG is no longer a voluntary branding tool but a core requirement that directly influences export intensity, market opportunities, and access to financial capital. Based on co-designing an ESG Rapid Assessment tool with Australian sugarcane growers, Almeida *et al*. (2025) found that while the ESG assessment tool is generally well received by farmers, its influence on actual behavioral change remains limited. Specifically, 75% of farmers reported that the ESG tool was easy to use, and 62.5% indicated that it provided valuable support for farm management and decision-making. However, despite this positive perception, only 25% of farmers expressed a willingness to modify their production practices in the absence of stronger market incentives, highlighting a clear gap between awareness and implementation. These findings highlight the fact that knowledge and assessment tools alone cannot deliver behavioral change. Instead, clear policy incentives, supply-chain pressure from multi-national buyers, and access to sustainability-linked financing are required to drive adoption (Almeida *et al*., 2025).

U.S. exporters, especially in soybeans, beef, cotton, and specialty crops face mounting pressure from international buyers who increasingly require verifiable sustainability credentials. European and Asian markets already mandate compliance with carbon accounting, deforestation-free supply chains, and responsible labor practices. The ESG adoption gap identified by Almeida *et al*. (2025) suggests that similar challenges exist in the U.S., where farmers may value ESG tools but lack the incentives or financial support to fully adopt sustainable practices. While the co-design approach strengthens practical relevance, the study is limited by its targeted sample of sustainability-curious farmers, potentially overestimating professional readiness in the broader population. Still, the results provide strong evidence that ESG adoption is both a challenge and an opportunity for export-oriented agriculture.

Digital Market Entry and Productivity Growth

One of the most transformative market shifts in agricultural trade is the role of digitalization in reducing entry barriers and expanding market reach. Rizov *et al*. (2022) demonstrates that simple website adoption functions analogously to foreign market entry, significantly increasing firm productivity and reducing market concentration through negative selection (where less productive firms experience the largest productivity gains). Grounded in heterogeneous firm trade theory, particularly the Helpman–Melitz model, the study provides empirical evidence from UK and Spanish firms demonstrating the transformative impact of digital adoption on export performance. The findings indicate that adopting digital tools lowers foreign market entry costs, expands the potential market size accessible to firms, and stimulates productivity-enhancing investments that strengthen competitiveness. In addition, digital adoption contributes to reduced market concentration by increasing competitive pressure, particularly as less productive firms benefit the most from these efficiency gains and improved access to international markets.

For U.S. agricultural exporters, these findings suggest that digital platforms (websites, B2B marketplaces, e-commerce channels) represent a critical strategic pathway to expanding global reach while minimizing traditional sunk costs associated with internationalization. Digital adoption is especially important for small and mid-size agribusinesses that may not have large export budgets but can leverage online presence to access foreign buyers directly. A limitation lies in the early time period of analysis (1995–2010), which may not reflect current digital market realities characterized by platform dominance, AI-driven logistics, and higher capital costs. Nonetheless, the identification of digitalization as a pro-competitive force remains a foundational insight relevant to contemporary agricultural exports.

Digital Capabilities as Drivers of Supply Chain Resilience and Market Competitiveness

Digitalization is increasingly recognized as a critical driver of supply-chain resilience, and Taghikhah et al. (2025) provide important clarity by presenting a taxonomy of five digital capability bundles; (i) Logistics Tech, (ii) Secure Data, (iii) Client Value, (iv) Insight Decision, and (v) Innovate Tech, each linked to specific resilience outcomes within agri-food export systems. Their findings show that Logistics Tech capabilities support short-term persistence during

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disruptions, while Secure Data capabilities underpin long-term persistence by strengthening system robustness. In contrast, the combined capabilities of Client Value, Insight Decision, and Innovate Tech are associated with deeper forms of resilience, enabling supply chains to adapt and transform in response to evolving challenges. This categorization is especially vital for international agricultural exporters whose operations are increasingly threatened by geopolitical shocks, extreme weather events, port congestion, and volatile transportation costs. By enhancing visibility across the value chain, improving forecast accuracy, and increasing operational agility, digital capabilities provide the foundational support needed to maintain export reliability in an increasingly turbulent global trade environment.

Section Synthesis

Across the reviewed literature, five major transitions clearly emerge as defining the future of agricultural export systems. First, technological formalization, driven largely by the growing dominance of hybrid and proprietary inputs, is reshaping input markets and directly influencing export quality, as highlighted by Ter Steeg and Louwaars (2024). Second, ESG expectations have moved from optional initiatives to binding market requirements that now determine competitiveness, access to capital, and buyer preferences, according to Almeida et al. (2025). Third, digitalization continues to play a transformative role by lowering market-entry barriers, boosting productivity, and expanding opportunities for exporters to reach global buyers, as demonstrated in the work of Rizov et al. (2022). Fourth, integrated digital capabilities have become essential for building supply-chain resilience in an increasingly shock-prone global environment, a point emphasized by Taghikhah et al. (2025). Finally, as firms navigate these technological and sustainability-driven shifts, market power dynamics and value-capture pressures are expected to intensify, making strategic adaptation crucial for maintaining competitiveness in the evolving export landscape. These transitions collectively demonstrate that agricultural export competitiveness depends not only on production efficiency but also on the strategic integration of technology, sustainability, and digital-enabled market engagement.

Digital Transformation, ICT Tools, Blockchain, and Data-Driven Market Innovation

Digital transformation is one of the most disruptive forces reshaping global agricultural exports. Across the reviewed studies, digital tools spanning from e-agriculture platforms to blockchain and ICT extensions have demonstrated the ability to enhance farmer participation in markets, reduce transaction costs, improve value-chain transparency, and mitigate systemic inefficiencies. Yet, the extent of their impact varies significantly depending on digital literacy, institutional readiness, physical infrastructure, and the depth of value-chain integration.

ICT Solutions as Catalysts for Market Access and Efficiency

Abate *et al*. (2023) assessed the impact of ICT solutions on farmer performance in Ethiopia and demonstrated that digital platforms significantly enhance market participation, income stability, and information accuracy. The study finds that farmers using ICT tools exhibit markedly improved access to price information, weather updates, and agronomic guidance, leading to better decision-making and higher productivity. According to the findings of Abate et al. (2023), the use of ICT tools plays a significant role in improving farmers' decision-making and market participation. The study shows that ICT adoption increases access to timely and reliable price information, thereby reducing information asymmetry that typically disadvantages farmers in market negotiations. Farmers who engage with digital advisory tools also demonstrate better production planning, benefiting from improved access to agronomic and market guidance. Furthermore, market access is enhanced through more transparent price discovery mechanisms enabled by digital platforms, allowing farmers to engage more confidently and efficiently in market transactions.

These insights directly apply to the U.S. context, where many small and mid-sized producers, especially in rural states, continue to face information gaps related to export requirements, logistics, and trade policy shifts. ICT-enabled advisory systems can substantially lower these barriers by providing real-time data on commodity prices, export demand trends, freight rates, and port congestion.

Digital Market-Oriented Innovations and Blockchain Adoption

Liu (2025) examined blockchain adoption by agricultural firms in China, Thailand, Malaysia, and Indonesia, highlighting how digital trust mechanisms reduce fraud, enhance traceability, and improve market competitiveness. The study by Liu (2025) found that the perceived usefulness of blockchain technology plays a crucial role in mediating both trust and adoption behavior among agricultural firms. By enhancing the reliability and security of transactional data, blockchain significantly reduces transaction risks within export-oriented value chains, providing a more stable and verifiable exchange environment. In addition, the digital transparency created through blockchain systems

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strengthens buyer confidence, as stakeholders can more easily verify product origins, quality standards, and compliance records, all of which are essential in increasingly competitive and regulation-driven global markets.

Blockchain is particularly relevant to high-value U.S. agricultural exports, such as beef, organic produce, and specialty grains, where traceability and authenticity are essential for accessing EU, Middle Eastern, and premium Asian markets. The findings also support broader global trends, showing that transparent, tamper-proof data systems significantly enhance compliance with international quality standards. The cross-country approach by Liu (2025) strengthens generalizability, though cultural and regulatory differences may influence adoption patterns. The emphasis on trust-building mechanisms holds strong relevance for international exporters facing rising traceability requirements from global buyers.

The Role of Online Marketing, Social Media, and E-Commerce in Export Visibility

The reviewed studies (i.e. Rizov *et al*., 2022; Agbotsey and Ramazzotti, 2023) reveal a consistent theme: digital marketing tools enhance export visibility and reduce traditional market-entry costs. The work of Rizov *et al*. (2022), where the authors analyzed UK and Spanish firms, demonstrated that simple website adoption acts as a low-cost channel for foreign market entry, generating productivity gains and reducing concentration through competitive pressure. This aligns with the findings of Agbotsey and Ramazzotti (2023), who similarly reported that digital tools, such as price alert systems and online trade portals, generate efficiencies across four core value-chain activities, namely upstream sourcing, transformation, logistics, and market access. Their study demonstrates that the adoption of digital platforms significantly reduces logistics delays, strengthens coordination between suppliers and buyers, improves market transparency, and enables small firms to operate more competitively by lowering information and transaction barriers, thereby enhancing overall value-chain performance and integration.

For international agricultural exporters, these insights underscore the potential of digital branding, e-commerce, and online trading portals (such as Alibaba, Global Trade, and B2BConnect) to expand reach into emerging markets without the high sunk costs associated with traditional export channels.

Weak Digital Foundations and Infrastructure Inefficiencies

Garima *et al*. (2026) provide one of the most insightful analyses of systemic constraints facing digitally enabled agricultural export systems. Examining India's soybean value chain, Garima et al. (2026) highlight how persistent structural inefficiencies, particularly gaps in rural infrastructure, significantly undermine the potential benefits of digitalization within the sector. Their findings reveal that inadequate physical facilities remain a major constraint, with about 39% of farmers resorting to using trucks as makeshift storage due to insufficient warehouse capacity, while 67% experience prolonged waiting times at processing centers, leading to post-harvest losses and increased transaction costs. The generally poor quality of available warehouse facilities further forces farmers to adopt sub-optimal storage practices, ultimately reducing product quality and market value. As a result, the authors conclude that although digital tools may improve information flow and coordination, they do little to compensate for fundamental deficiencies in physical infrastructure, thereby limiting the overall effectiveness of digital interventions in enhancing value-chain performance.

These results highlight a fundamental principle that indicates that digitalization amplifies efficiency only when embedded within a functional physical ecosystem. In advanced economies such as the United States, similar structural constraints also persist within the economic system and continue to limit the efficiency of value-chain operations despite high levels of technological advancement. These constraints include chronic port delays, particularly along the West Coast, where congestion disrupts shipping schedules, as well as rail capacity bottlenecks that slow the movement of goods across regions. In addition, deteriorating rural roads and bridges weaken last-mile logistics and raise transportation costs, while limited digital connectivity in many rural counties restricts the effective use of digital platforms for coordination, monitoring, and market access. Collectively, these challenges demonstrate that even in highly developed economies, infrastructural and connectivity gaps remain critical barriers to achieving seamless integration and optimal performance across agricultural and industrial value chains. Thus, Garima *et al*. (2026) demonstrate that digital solutions must be complemented by logistics modernization, or they risk reinforcing systemic inequities.

Digital Extension Services and Farmer Adoption Dynamics

Literature highlights the importance of digital extension services in driving adoption. For instance, Abate *et al*. (2023) show that digital literacy and training significantly influence ICT use. Liu (2025) finds that perceived usefulness and

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trust drive blockchain adoption. Agbotsey & Ramazzotti (2023) show that smallholder adoption depends on accessibility and user-friendliness of digital tools. These findings further emphasize that digital transformation is not merely a technological shift but a behavioral and institutional one. Effective digital tools must consider user capabilities, trust in digital systems, alignment with market incentives, and compatibility with existing production practices.

Again, despite the technological advancement of some countries, such as the U.S agricultural sector, the system continues to face digital literacy challenges in rural areas, suggesting that behavioral drivers remain a critical determinant of digital adoption.

Section Synthesis

The studies reviewed collectively reveal several overarching insights into the role of digitalization in value-chain development and export performance. Across multiple contexts, digitalization is shown to enhance market access and strengthen export competitiveness by improving coordination, visibility, and responsiveness in trade activities (Abate et al., 2023; Agbotsey & Ramazzotti, 2023; Rizov et al., 2022). In addition, the use of blockchain and traceability systems has been found to increase buyer confidence and facilitate entry into premium markets by improving transparency and product credibility (Liu, 2025). The literature further demonstrates that digital platforms significantly reduce information asymmetry and transaction costs, thereby benefiting both producers and exporters through more efficient market interactions. Moreover, digital resilience capabilities, particularly through predictive analytics and real-time decision-support systems, enable exporters to better withstand disruptions and external shocks (Taghikhah et al., 2025). However, these benefits are not fully realized in the absence of adequate physical infrastructure, as digital tools alone are insufficient without parallel investments in logistics and storage systems, underscoring the need for integrated development strategies (Garima et al., 2026). Taken together, these insights highlight digital transformation as a core determinant of future agricultural export competitiveness, shaping value-chain efficiency, market access, and resilience in an increasingly complex global trading environment.

Supply Chain Vulnerabilities, Infrastructure Constraints, and Systemic Risks in Export Agriculture

Supply chain fragility and infrastructure constraints emerge repeatedly across literature as primary threats to export reliability, market reputation, and economic returns. The reviewed studies converge on three interrelated themes: (1) physical infrastructure and logistics bottlenecks that shift costs and risks onto producers, (2) systemic, shock-amplifying dynamics (policy and behavioral) that can create large international spillovers, and (3) short-term farm-level adaptations that, while locally rational, often produce aggregate inefficiencies and inequities. Each theme has direct implications for U.S. agricultural export systems, particularly for bulk commodities (e.g., grains, oilseeds) where timing, storage, and transport are critical.

Physical Infrastructure and Logistical Bottlenecks

Multiple studies show that physical infrastructure, ports, rail, roads, warehousing, and on-farm storage remain a binding constraint for export efficiency. Garima *et al*. (2026) document how misalignments between farm-level decisions (harvest timing, storage) and centralized infrastructure (receival sites, port slots) force growers to adopt compensatory strategies such as investing in on-farm storage or mobile freight capacity. These solutions reduce immediate delivery risk for individual farms but increase aggregate costs (e.g., higher road wear, increased fuel use) and can exacerbate congestion downstream (Garima *et al*., 2026). Similarly, information synthesized in Ma *et al*. (2024) highlights that improving physical market linkages (better storage, transport, and digital coordination) is crucial for enabling participation in international markets and reducing transaction costs. For U.S. exporters, the clear analogue is the recurring port and rail capacity problems that can cause shipment delays, demurrage fees, and contract penalties; issues that directly erode export competitiveness (Garima *et al*., 2026; Ma *et al*., 2024).

Systemic Risk, Policy Responses, and Shock Amplification

Beyond physical bottlenecks, several papers emphasize that policy choices and behavioral responses can amplify shocks across global markets. Kuhla *et al*. (2025) introduce Agrimate, an agent-based model that explicitly models strategic and commercial stockholding, showing that export restrictions and panic stockpiling act as shock multipliers, magnifying price volatility and worsening food insecurity during multi-breadbasket failures. The model's key insight is that policy instruments intended to protect domestic supply often propagate scarcity and price spikes internationally, undermining long-run trust and market stability (Kuhla *et al*., 2025).

This finding is particularly salient for countries that are export focused, because unilateral policy shifts (export curbs, emergency export licensing, or sudden changes in domestic biofuel mandates) can trigger cascading effects in

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dependent import markets. The literature thus cautions that policy decisions by major exporters carry outsized systemic responsibility (Kuhla *et al*., 2025; Taghikhah *et al*., 2025).

Farm-Level Adaptations and Aggregate Inefficiencies

Farmers respond adaptively to logistical and institutional failures, investing in on-farm storage, shifting harvest timing, or using informal local traders, but these adaptations can create negative externalities. Garima *et al*. (2026) find that such decentralized coping strategies, while rational at the farm level, can lead to system-wide inefficiency (e.g., suboptimal routing, increased road maintenance costs, misaligned inventory flows) and reinforce spatial inequities because wealthier producers can afford better workarounds. These micro-to-macro spillovers iterate the arguments of Taghikhah *et al*. (2025), who argue that resilience requires not only engineering responses (short-term persistence) but socio-ecological adaptations (longer-term transformation). If too many actors pursue isolated, private solutions, the system may drift toward brittle fragmentation instead of coordinated resilience (Taghikhah *et al*., 2025).

Traceability, Fraud Risk, and Quality-Control Bottlenecks

Digital tools promise improved traceability but literature warns that technical solutions alone cannot eliminate upstream quality-control problems. Khan *et al*. (2022) reported the capacity of blockchain to enhance traceability and reduce fraud during crises, yet they also acknowledge "garbage in—garbage out" risks. Blockchain secures records but cannot ensure the quality of data entered without robust sensing, auditing, and institutional enforcement (Khan *et al*., 2022). For high-value U.S. exports (organic, non-GMO, animal products), establishing upstream verification and sensor-to-ledger integrity is therefore imperative. While blockchain enhances trust among trading partners, scaling up requires compatible investments into internet of things (IoT), independent verification, and governance frameworks that cross jurisdictional boundaries, a non-trivial coordination problem largely unaddressed in extant field studies.

Equity and Distributional Implications of Logistics Failures

Several authors emphasize the distributional consequences of logistical failures. Garima *et al*. (2026) and Abate *et al*. (2023) note that infrastructure shortcomings disproportionately harm smaller, more remote producers who lack capital to invest in compensatory assets. This suggests that rural counties and small-scale farms could lose market share or accept price penalties if investments are not made to reduce regional disparities in transport and storage capacity (Garima *et al*., 2026; Abate *et al*., 2023).

Policy Implications and Governance Levers

The reviewed literature points to several important policy directions for reducing supply-chain vulnerabilities and strengthening value-chain resilience. Key among these is the need for targeted infrastructure investments that prioritize multimodal connectivity across rail, road, and ports, alongside the modernization of rural storage systems to reduce post-harvest losses and logistics inefficiencies (Garima et al., 2026; Ma et al., 2024). The studies also emphasize the importance of coordinated international policy signaling to prevent destabilizing export restrictions, advocating instead for stronger multilateral mechanisms for crisis management among major exporting countries to limit the amplification of global supply shocks (Kuhla et al., 2025). In addition, public–private partnerships are recommended as a strategy to scale integrated digital traceability systems, including the development of shared standards for sensor data, auditing procedures, and system interoperability to ensure transparency and efficiency across borders (Khan et al., 2022; Taghikhah et al., 2025). Finally, equity-focused support measures, such as targeted subsidies and access to low-cost credit, are identified as essential for enabling small producers to adopt necessary logistics and digital upgrades, thereby ensuring that technological transformation is inclusive and does not widen existing inequalities (Abate et al., 2023).

Summary and Transition

In sum, literature strongly indicates that export reliability depends on an integrated approach that combines physical infrastructure upgrades, policy coordination to avoid shock-amplifying protectionism, scalable digital verification, and equity-oriented measures to avoid deepening regional disparities. These findings set the stage for the next section, which evaluates firm-level strategic responses (i.e. innovation, market orientation, organizational change, and internationalization speed) that determine which firms thrive under the constraints and opportunities described above.

Strategic Firm Behavior — Innovation, Market Orientation, And Internationalization

Firm-level strategy and organizational capability determine which exporters capture value from the structural shifts described above. The literature in this section centers around four inter-related strategic domains that shape export outcomes: (1) market orientation (proactive vs. responsive), (2) organizational innovation and the learning-by-

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exporting mechanism, (3) the speed and pattern of internationalization for new ventures, and (4) digital adoption and ambidextrous capability bundles. The studies reviewed provide both empirical evidence and conceptual clarity on how these strategies operate and interact.

Proactive vs. Responsive Export Market Orientation (P-EMO and R-EMO)

Faroque *et al*. (2025) distinguishes two complementary export market orientations (EMO): Proactive EMO (P-EMO), which searches for latent or future customer needs, and Responsive EMO (R-EMO), which focuses on meeting currently expressed customer demands. Empirical evidence from 319 B2B exporting firms shows that P-EMO strongly predicts opportunity recognition while R-EMO predicts opportunity exploitation, and that environmental dynamism magnifies the benefits of P-EMO (Faroque *et al*., 2025). Implications for agricultural exporters include the fact that; (i) Pursuing P-EMO is critical in high-dynamism contexts (e.g., rapidly changing food safety standards or emergent consumer preferences), enabling firms to spot new product niches (e.g., climate-resilient traits, verified sustainability attributes) before competitors (Faroque *et al*., 2025). (ii) R-EMO remains essential for maintaining contractual reliability with large buyers who demand consistent quality and timely delivery (Faroque *et al*., 2025).

Organizational Innovation and Learning-By-Exporting (LBE)

Juergensen *et al*. (2024) shows that the classic learning-by-exporting (LBE) effect, where exporting firms derive productivity and innovation benefits from foreign market engagement, materializes only when firms simultaneously enact organizational innovations (e.g., new routines, managerial processes). Their panel evidence from German manufacturing reveals that organizational innovation mediates the transformation of market knowledge into product innovation outcomes (Juergensen *et al*., 2024). For agricultural exporters: (i) export exposure is necessary but not sufficient for innovation as firms must institutionalize new organizational practices (e.g., dedicated export teams, integrated quality assurance, or supplier coordination units) to capture LBE gains (Juergensen *et al*., 2024). (ii) Policy supports that accelerate organizational change (extension services, managerial training, subsidies for process redesign) can amplify the innovation returns to exporting (Juergensen *et al*., 2024).

Speed of Internationalization and Survival of New Ventures

Gripsrud, Hunneman, and Solberg (2023) discover that both early entry (short time to first export) and rapid geographic expansion (speed of entering multiple countries) enhance the probability of new ventures in export markets. The survival advantage of countries or firms that internationalize quickly supports a resource perspective which indicates firms must rapidly exploit temporary advantages before competitors erode them (Gripsrud *et al*., 2023). Similarly, the implications for agricultural export firms include the fact that rapid, broad-market entry can help niche food producers and agribusiness startups capture early demand and hedge country-specific demand shocks (Gripsrud *et al*., 2023). However, agricultural goods face distinct constraints, perishability, phytosanitary regulations, and complex logistics, which may moderate the survival advantage of hyper-fast entry (Gripsrud *et al*., 2023).

Digital Adoption, Productivity, and Organizational Ambidexterity

Digital adoption operates at both tactical and strategic levels: at the tactical level, websites and e-commerce lower entry costs and raise productivity (Rizov *et al*. 2022); at the strategic level, integrated capability bundles (Taghikhah *et al*., 2025) and blockchain (Khan *et al*., 2022; Liu, 2025) support resilience and trust-building. Rizov *et al*. (2022) demonstrates that entry into digital markets produces productivity gains, especially for initially less-productive firms, thereby reducing concentration and increasing competition (Rizov *et al*. 2022). Taghikhah *et al*. (2025) and Khan *et al*. (2022) extend this by arguing that digital capabilities must be configured for different resilience tasks: Logistics Tech for persistence; Secure Data for long-term robustness; and Insight Decision/Innovate Tech for adaptation and transformation (Taghikhah *et al*., 2025; Khan *et al*., 2022).

These imply the adoption of layered digital capabilities. Exporters should not treat digital tools as one-off investments but as capability bundles that support both operational efficiency and strategic innovation (Taghikhah *et al*., 2025). Furthermore, they must balance short-term exploitative digital tools (e.g., online marketplaces) with long-term transformative investments (e.g., integrated traceability, AI-enabled forecasting) (Rizov *et al*. 2022; Taghikhah *et al*., 2025).

Interactions Among Strategy Domains

The reviewed studies suggest important cross-domain interactions indicating that firms with proactive market sensing (P-EMO) benefit more if they have organizational structures capable of adopting new knowledge (Faroque *et al*., 2025; Juergensen *et al*., 2024). Additionally, digital channels can accelerate early entry by lowering fixed costs (Rizov

Volume: 14 | Issue: 3 | March 2026 | Journal DOI: 10.36713/epra0813| Impact Factor SJIF(2026): 8.801| ISSN: 2321 – 7847

et al. 2022), thereby supporting rapid internationalization strategies of export firms (Gripsrud *et al*., 2023; Rizov *et al*. 2022). Finally, resilient digital capabilities enable firms to maintain responsiveness (R-EMO) while experimenting with proactive strategies (P-EMO) in turbulent markets (Taghikhah *et al*., 2025; Faroque *et al*., 2025; Taghikhah *et al*., 2025).

Table 1: Thematic Summary of Findings from Literature

Theme	Key Findings Across Studies	Literature
1. Technological & Market-Driven Transitions	1. Rising adoption of hybrid seeds and formalized input systems enhances yield, quality, and export readiness. 2. ESG standards are becoming compulsory for market access; farmers value ESG tools but lack incentives to change behavior. 3. Digital entry (e.g., websites) increases productivity, reduces market concentration, and enhances export competitiveness. 4. Digital capability bundles (LogisticsTech, SecureData, InsightDecision) support resilience and competitiveness.	Ter Steeg & Louwaars (2024); Almeida *et al*. (2025); Rizov *et al*. (2022); Taghikhah *et al*. (2025)
2. Digital Transformation & ICT Adoption	1. ICT tools enhance market participation, reduce information asymmetry, and support income stability. 2. Blockchain improves traceability, enhances buyer trust, and reduces fraud. 3. Digital marketing (e-commerce, online branding) expands export visibility and lowers entry barriers. 4. Digital tools remain limited without supportive infrastructure (storage, roads, internet).	Abate *et al*. (2023); Liu (2025); Agbotsey & Ramazzotti (2023); Garima *et al*. (2026)
3. Supply Chain Vulnerabilities & Infrastructure Constraints	1. Weak infrastructure (storage, ports, processing) forces farmers into inefficient coping strategies (mobile storage, long queues). 2. Policy choices (export bans, stockpiling) amplify shocks, creating global volatility. 3. Logistics failures create equity gaps—small producers face higher costs and reduced export participation. 4. Blockchain enhances transparency but requires robust upstream data verification.	Garima *et al*. (2026); Kuhla *et al*. (2025); Ma *et al*. (2024); Khan *et al*. (2022)
4. Firm-Level Strategic Behavior & Competitiveness	1. Proactive Export Market Orientation (P-EMO) drives new opportunity discovery; Responsive EMO supports customer retention. 2. Learning-by-exporting benefits arise only when paired with organizational innovation. 3. Fast internationalization increases survival odds in foreign markets. 4. Digital adoption enhances productivity and enables agile strategic responses.	Faroque *et al*. (2025); Juergensen *et al*. (2024); Gripsrud *et al*. (2023); Rizov *et al*. (2022)
5. Policy, Governance & Equity Implications	1. Export restrictions worsen market instability during crises; multilateral coordination is essential. 2. Infrastructure modernization must integrate physical (roads/storage) with digital (traceability, forecasting) systems. 3. ESG adoption requires incentive-compatible financing and buyer pressure. 4. Equity-focused policy support helps smallholders participate in export-led growth.	Kuhla *et al*. (2025); Almeida *et al*. (2025); Garima *et al*. (2026); Abate *et al*. (2023)

Major Research Gaps

The existing body of literature reveals important research gaps that warrant further investigation. One major gap lies in the limited quantification of aggregate welfare impacts, as few studies comprehensively measure how micro-level adaptations, such as the use of trucks for storage or other coping strategies, and persistent infrastructure failures

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translate into national-level export losses and broader economic costs. In parallel, there is insufficient evidence on organizational change within agricultural exporting firms, with a particular lack of sector-specific research identifying which organizational innovations and management practices most effectively support learning-by-exporting and long-term competitiveness in agri-food enterprises (Juergensen et al., 2024). These gaps highlight the need for future research to move beyond firm-level or localized analyses toward integrated assessments that connect operational constraints and organizational behavior to macroeconomic export performance and sector-wide development outcomes.

Policy and Managerial Implications

The policy and managerial implications drawn from the literature emphasize the need for an integrated and forward-looking approach to strengthening agricultural value chains and export performance. Public investment should prioritize the development of integrated digital–physical infrastructure, including multimodal transportation networks, improved rural connectivity, and interoperable digital platforms, to ensure that digital solutions are effectively supported by adequate physical systems (Garima et al., 2026; Taghikhah et al., 2025). In parallel, governments and supply-chain leaders are encouraged to design ESG-focused incentive mechanisms, such as green procurement policies and sustainability-linked financing, to convert ESG awareness into tangible operational improvements and responsible business practices (Almeida et al., 2025). The literature also highlights the importance of promoting organizational capability-building, with extension services and export promotion agencies integrating organizational innovation and management training to help firms transform export experiences into learning and productivity gains (Juergensen et al., 2024). Furthermore, strengthening multilateral crisis governance is critical, as major exporting countries should coordinate to minimize the use of export restrictions during crises and instead support international buffer mechanisms that reduce the amplification of supply shocks (Kuhla et al., 2025). Finally, export support programs should be designed to enable high-potential agricultural SMEs to internationalize rapidly by providing assistance with regulatory compliance, market entry strategies, and logistics capacity development, thereby enhancing their competitiveness in global markets (Gripsrud et al., 2023).

Conclusion

This literature review systematically integrated evidence from the selected studies to identify emerging patterns, key developments, and critical constraints shaping contemporary agricultural export markets. The evidence points to a multifaceted transformation driven by technological adoption (digital tools, blockchain, hybrid seeds), market pressures (ESG, buyer requirements), infrastructural constraints (ports, rail, storage), and strategic firm responses (EMO, organizational innovation, digital ambidexterity).

Technological and market formalization are reshaping value chains. The private-sector push toward high-margin hybrids and proprietary inputs is altering production and export quality requirements. ESG has become a market-access filter. Tools that translate global reporting frameworks to farm-level actions are useful but insufficient without market incentives and financing. Digital adoption is pro-competitive but infrastructure-dependent. Website adoption and e-commerce can boost productivity and reduce concentration in early diffusion contexts, but gains depend on underlying physical and institutional infrastructure. Supply chain fragility arises from both physical bottlenecks and policy behavior. Farm-level compensatory investments are rational but can aggregate into system inefficiencies, and policy-driven export restrictions can amplify shocks. Firm-level ambidexterity matters. Combining proactive market sensing, responsive delivery, organizational innovation, and layered digital capabilities yields competitive advantage, but achieving and sustaining ambidexterity is organizationally demanding.

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