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Identification and Prioritization of Wheat Supply Chain Challenges

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A B S T R A C T

Wheat, as a strategic commodity, plays a pivotal role in ensuring food security in Iran. The wheat supply chain comprises multiple stages, including production, harvesting, storage, processing, transportation, and distribution. At each of these stages, various challenges may arise that can affect productivity, product quality, and ultimately food security. This study was conducted with the aim of systematically identifying and prioritizing the challenges within the wheat supply chain. To achieve this objective, a mixed-method approach was employed, incorporating a systematic literature review and expert elicitation. The literature review indicates that the challenges within the wheat supply chain can be categorized into production, processing, distribution, and managerial challenges. Through the examination of relevant scientific studies and the collection of expert opinions, multiple challenges were identified across the stages of production, harvesting, storage, processing, transportation, and distribution. Subsequently, through data analysis and thematic categorization, the challenges were extracted and prioritized based on their frequency and significance. The findings revealed that the challenges of the wheat supply chain are rooted in structural issues, such that 70% of the ten key identified challenges are managerial in nature. At the top of this prioritization were: (1) the absence of an appropriate guaranteed purchase price for wheat, (2) lack of coordination among supply chain institutions, and (3) insecurity of land ownership. These findings indicate that policy inefficiencies outweigh and exacerbate technical challenges such as water resource limitations. Therefore, it is recommended that a fundamental transition be made from administratively controlled pricing toward sustainable economic models, alongside the establishment of a governance body to address systemic coordination failures.

Keywords: *Food security, policymaking, agriculture, systematic review, expert judgment.*

1. Introduction

The increasing complexity of global food systems has positioned agricultural supply chains, particularly those related to staple crops such as wheat, at the center of scholarly and policy debates on food security, sustainability, and economic resilience. Wheat, as one of the most widely consumed cereals globally, plays a fundamental role in ensuring food availability and stability across both developed and developing economies. Consequently, the performance and resilience of the wheat supply chain have become critical determinants of national food security and socio-economic stability (Guiomar et al., 2021; Yadav et al., 2022). In recent years, the wheat supply chain has been exposed to a wide range of disruptions, including climate change, geopolitical tensions, market volatility, and technological transitions, all of which have intensified the need for systematic identification and prioritization of its challenges (Raihan & Tuspekova, 2022; Raj et al., 2022; Yao, 2025).

From a structural perspective, the wheat supply chain is a multi-stage system encompassing production, storage, transportation, processing, and distribution, each of which is characterized by specific operational and strategic challenges. Research indicates that inefficiencies or disruptions in any stage of this chain can propagate throughout the system, leading to reduced productivity, increased costs, and compromised product quality (Hosseini-Motlagh et al., 2021; Naderi et al., 2020; Pourmohammadi et al., 2020). In particular, uncertainties in demand forecasting, transportation constraints, and infrastructure limitations have been identified as key bottlenecks affecting the overall performance of wheat supply chains (Mogale et al., 2022; Stephen & Extension, 2024). Moreover, the integration of these stages into a cohesive and coordinated system remains a significant challenge, particularly in contexts where institutional fragmentation and governance inefficiencies prevail (Grabs & Carodenuto, 2021; Grohmann et al., 2023).

One of the most critical dimensions of the wheat supply chain relates to sustainability and resilience. Recent studies emphasize that traditional supply chain models, which primarily focus on cost efficiency, are no longer sufficient to address contemporary challenges such as environmental degradation, resource scarcity, and social inequality. Instead, there is a growing consensus on the need to adopt sustainable and resilient supply chain frameworks that balance economic, environmental, and social objectives (Alsayegh et al., 2020; León Bravo et al., 2021; Sharifi et al., 2023). For instance, climate change has significantly impacted wheat production through increased frequency of droughts, temperature fluctuations, and pest outbreaks, thereby exacerbating risks and uncertainties in the supply chain (Abdalla et al., 2023; Chedid et al., 2019). Similarly, environmental constraints such as water scarcity and soil degradation have further complicated production processes, particularly in arid and semi-arid regions (Hasheminejad et al., 2019; Hassen & Chen, 2020).

In parallel with environmental challenges, economic and financial constraints constitute another major category of barriers within the wheat supply chain. Fluctuations in input costs, limited access to financial resources, and inefficient pricing mechanisms have been identified as critical factors affecting the profitability and sustainability of wheat production and distribution systems (Sarvari & Yazdani, 2021; Vaezi et al., 2024). These challenges are often compounded by macroeconomic instability, including inflation and exchange rate volatility, which directly influence production costs and market dynamics. Furthermore, the lack of effective financial management practices and risk mitigation mechanisms within the supply chain exacerbates these issues, leading to inefficiencies and increased vulnerability to external shocks (Hasheminejad et al., 2020; Mousavi Shamsabad et al., 2021).

Another important dimension concerns the role of technology and innovation in enhancing supply chain performance. The advent of digital technologies, such as blockchain, the Internet of Things (IoT), and big data analytics, has created new opportunities for improving transparency, traceability, and efficiency in agricultural supply chains. Studies demonstrate that blockchain-based systems can significantly enhance trust among stakeholders by providing immutable and transparent records of transactions and product flows (Bandinelli et al., 2023; Farooq et al., 2024; Rathore et al., 2022). Similarly, IoT-based solutions enable real-time monitoring of storage conditions and transportation processes, thereby reducing losses and improving quality control (Nadimi et al., 2023; Rajabzadeh et al., 2022). However, despite these technological advancements, their adoption in many agricultural contexts remains limited due to infrastructural constraints, high implementation costs, and resistance to change among stakeholders (Chinthamu et al., 2023; Pakseresht et al., 2023; Sharma et al., 2025).

In addition to technological barriers, institutional and governance-related challenges play a crucial role in shaping

the performance of the wheat supply chain. Effective governance mechanisms, including regulatory frameworks, market structures, and stakeholder coordination, are essential for ensuring the efficient functioning of supply chains. However, in many cases, fragmented governance systems, lack of coordination among stakeholders, and inconsistent policy interventions have led to inefficiencies and reduced system performance (Deng et al., 2021; McLoughlin & Meehan, 2021). For example, the absence of integrated market systems and transparent pricing mechanisms can distort incentives for producers and other supply chain actors, ultimately affecting production and distribution outcomes (Rajabi & Karbasi, 2021; Vaezi et al., 2024). Moreover, the role of intermediaries and informal market structures further complicates the governance landscape, often leading to inequitable distribution of benefits among stakeholders (Ghaziani et al., 2023; Jaleta et al., 2019).

Human and organizational factors also represent a significant category of challenges in the wheat supply chain. The availability of skilled labor, knowledge management practices, and organizational learning capabilities are critical determinants of supply chain performance. However, studies indicate that many agricultural systems suffer from a lack of skilled human resources, inadequate training programs, and limited knowledge dissemination mechanisms (Eryarsoy et al., 2022; Mousavi Shamsabad et al., 2021). This is particularly problematic in the context of adopting new technologies and innovative practices, where human capital plays a central role in facilitating change and improving efficiency. Furthermore, resistance to innovation and lack of awareness among farmers and other stakeholders hinder the effective implementation of modern supply chain solutions (Kumar ،& Sahoo، 2025; Sharifian Jazi et al., 2025).

Another critical issue within the wheat supply chain is the prevalence of losses and waste across different stages. Research shows that a significant proportion of agricultural products, including wheat, is lost during harvesting, storage, transportation, and processing due to inefficiencies and inadequate infrastructure (Dossa et al., 2020; Mesterházy et al., 2020). These losses not only reduce the overall efficiency of the supply chain but also have serious implications for food security and environmental sustainability. Addressing these challenges requires a comprehensive understanding of loss hotspots and the implementation of targeted interventions to minimize waste and improve resource utilization (Ghaziani et al., 2023; Pancino et al., 2019).

In the Iranian context, the wheat supply chain faces a unique set of challenges that are influenced by specific economic, institutional, and environmental conditions. Studies highlight issues such as inefficient subsidy systems, lack of coordination among government agencies, and structural inefficiencies in the supply chain as major barriers to performance improvement (Pourmohammadi, 2021; Vaezi et al., 2024). Additionally, the dependence on government interventions and the absence of market-based mechanisms have limited the flexibility and adaptability of the supply chain, making it more vulnerable to external shocks and internal inefficiencies (Naderi et al., 2020; Rajabi & Karbasi, 2021). These challenges underscore the need for context-specific analyses that consider the unique characteristics of national supply chains while also drawing on insights from global research.

Despite the extensive body of literature on agricultural supply chains, there remains a significant gap in the systematic identification and prioritization of challenges specific to the wheat supply chain, particularly in developing countries. While previous studies have addressed individual aspects such as sustainability, risk management, or technological adoption, there is a lack of comprehensive frameworks that integrate these dimensions into a unified analysis. Moreover, the divergence between global research priorities and local contextual needs further complicates the development of effective policy and management strategies (Sharifi et al., 2023; Yousefi-Babadi et al., 2023). Therefore, a systematic approach that combines insights from the literature with expert perspectives is essential for identifying the most critical challenges and informing evidence-based decision-making.

Given the strategic importance of wheat in ensuring food security and the increasing complexity of its supply chain, this study aims to systematically identify and prioritize the key challenges of the wheat supply chain by integrating findings from a systematic literature review with expert evaluations.

2. Methods and Materials

The objective of this study is to accurately and comprehensively identify the challenges present in the wheat supply chain. To achieve this objective, a mixed methodological approach was adopted. First, a systematic literature review (SLR) was conducted to extract the most significant challenges of the wheat supply chain and other essential agricultural commodities from existing scientific

studies. Subsequently, experts and specialists in the fields of agriculture, food industries, policymaking, and supply chain management were surveyed through a structured questionnaire. They were asked, first, to determine whether each of the identified challenges is relevant to the wheat supply chain context, and second, to assess the level of importance of each identified challenge. For conducting the systematic literature review, this study employs the methodology proposed by Okoli and Schabram (2010), which has been widely accepted and utilized in studies aiming to conduct systematic reviews. The proposed method by Okoli and Schabram (2010) consists of an eight-step process.

The first step in the systematic literature review is defining the purpose of the review. In accordance with the selected research method, the systematic literature review approach was chosen to answer the research question: "What are the most significant challenges in the wheat supply chain?" At this stage, considering the limited number of studies that exclusively focus on wheat supply chain challenges, and given that some challenges related to other essential agricultural commodities (such as barley and maize) overlap with those of the wheat supply chain, all challenges associated with essential agricultural commodities—particularly with an emphasis on wheat—were initially identified. In the subsequent expert consultation stage, the relevance of these challenges to the research topic was validated and ranked based on their importance. Therefore, the primary objective of the systematic literature review in this study is to identify the most significant challenges related to the supply chain of essential agricultural commodities, with a particular focus on wheat, as reported in global research literature.

Following the determination of the objective, the protocol for conducting the systematic review was developed. Sources published in both Persian and English were searched. For Persian-language sources, the keywords used included "wheat supply chain," "wheat supply chain challenges," and "agricultural supply chain challenges." Additionally, Boolean combinations (using operators such as "and" and "or") constructed from the terms "challenge," "wheat," and "supply chain" were examined. Persian databases used for the search included IranDoc, the Scientific Information Database (SID), and MagIran. For English-language sources, the keywords used were "wheat supply chain," "wheat supply chain challenges," and "agriculture supply chain challenges." Boolean combinations using the terms "wheat," "challenge," and "supply chain" were also applied. The databases searched in this section included Scopus, Web of Science, Google Scholar, ScienceDirect, and ProQuest Agricultural and Environmental Science Database.

In determining the temporal scope of the search, it is important to note that supply chain-related topics, particularly in the agricultural sector, have undergone significant transformation over the past decade due to emerging phenomena such as globalization, technological advancements, climate change, and shifts in trade policies. Moreover, the current structure of agricultural supply chains has been substantially reshaped by innovations implemented over the past fifteen years, particularly in the adoption of advanced technologies such as the Internet of Things and blockchain. Additionally, recent events such as the COVID-19 pandemic and climate change have significantly altered the conditions of agricultural supply chains compared to previous decades (Shi & Jiang, 2016; Aubry & Kebir, 2013; Dutta et al., 2017; Guiomar et al., 2021). Therefore, the search in both Persian and English databases was conducted over a fifteen-year period from 2009 to 2024 (Gregorian calendar), in order to ensure the identification of challenges relevant to the current and real-world conditions of the wheat supply chain.

After defining the review protocol, the search process was conducted based on the established criteria. In this study, screening criteria included factors such as the language of publication and the publication period. Only studies published as scientific articles, theses, and books indexed in the selected databases were included. Technical reports and non-indexed publications were excluded. Furthermore, the titles, abstracts, and conclusions of the identified studies were reviewed to assess their relevance to the main research question, which served as an additional filtering criterion. At this stage, the initial search yielded 487 studies, which were reduced to 157 studies after applying the screening criteria.

Following the initial screening, a quality assessment of the remaining studies was conducted through full-text analysis. Given that the purpose of this systematic review is solely to identify challenges mentioned in the literature, and that the relevance and importance of these challenges are later validated through expert consultation, the quality assessment approach aimed to minimize the exclusion of studies. Consequently, all studies that demonstrated at least minimal thematic relevance to the research question and addressed challenges in the wheat supply chain or other essential agricultural commodities were retained as much as possible. At this stage, 83 studies that did not meet the

quality assessment criteria were excluded, resulting in a final set of 74 studies forming the primary research corpus.

After screening and quality assessment, the next step involved data extraction from the remaining studies. In addition to extracting bibliographic information (including title, authors, year of publication, and source), the specific supply chain challenges identified within each study were also extracted. Through detailed content analysis of the 74 selected studies, a total of 60 distinct challenges were identified. A substantial portion of these challenges directly pertains to the wheat supply chain, while others relate to the supply chains of similar essential agricultural commodities that share structural and operational similarities with wheat. Additionally, some of the identified challenges were derived from domestic studies focusing on the wheat supply chain, while others originated from international research.

Figure 1

The stages of the systematic literature review (SLR) process

Following data extraction, the synthesis of findings was conducted. In this stage, the identified challenges were coded, enabling the identification of which studies referred to specific codes. The resulting codes were then grouped into broader thematic categories, allowing the frequency of references to each category to be determined. The coding and grouping process was performed using ATLAS.ti software. After coding and thematic analysis, the 60 identified challenges were categorized into 15 distinct groups. Some challenges were assigned to more than one group due to conceptual overlap. In addition to thematic grouping, challenges were also categorized based on their association with specific stages of the wheat supply chain, with each challenge assigned to only one stage in this classification.

At this stage, experts from the fields of agriculture, food industries, policymaking, and supply chain management—comprising both practitioners and academics—were selected. The expert panel consisted of six major wheat farmers at the national level, four university faculty members specializing in various agricultural disciplines, and five senior executive managers from the Government Trading Corporation of Iran. A questionnaire was distributed to each expert to facilitate the prioritization of the identified challenges. The experts' evaluations were then collected and analyzed. Finally, the results obtained from the systematic literature review and expert consultation were integrated and analyzed. The final report of the systematic review includes a detailed presentation of findings, synthesized results, identified challenges, assigned codes, categorized groups, and the frequency of occurrence of each code and category within the reviewed studies.

3. Findings and Results

Among the 74 studies selected for analysis, 22 studies addressed challenges related to the wheat and agricultural

supply chain in Iran, while 52 were international studies that, in various ways, examined challenges in the wheat supply chain or other essential agricultural commodities. Following a comprehensive review and content analysis of the 74 selected studies within the systematic literature review framework, a total of 60 distinct challenges were identified. The majority of these challenges are directly related to the wheat supply chain, while others pertain to the supply chains of other essential agricultural commodities that share significant structural and operational similarities with the wheat supply chain. The coding and categorization of the identified challenges were conducted using ATLAS.ti software. Through open and axial coding, as well as contextual and thematic analysis, the set of 60 challenges was finalized. Each challenge was also selectively coded based on its association with one of the stages of the wheat supply chain and grouped accordingly. In this classification, each challenge was assigned to only one stage.

Various scientific sources generally identify similar stages for the wheat supply chain. These stages typically include: production (cultivation and harvesting, with crop management and harvesting time as critical control points); post-harvest management (drying and cleaning to control moisture and remove contaminants); storage (short-term and long-term storage requiring temperature, humidity, and pest control); transportation (movement from farms to storage and processing facilities); processing (milling and blending, focusing on quality differentiation and product integrity); distribution (routing of processed wheat products, emphasizing inventory management and demand forecasting); and retail (marketing and sales, where pricing plays a critical role). Studies focusing specifically on the wheat supply chain also identify similar stages. Based on both international and domestic literature, the wheat supply chain stages can be summarized as follows: (1) production, (2) transportation, (3) storage, (4) processing, and (5) distribution and retail. Considering that some identified challenges are general in nature and pertain to the entire supply chain rather than a specific stage, an additional "general" category was included in the stage-based classification. Table 1 provides detailed information, presenting the full list of identified challenges along with their thematic categorization, stage-based classification, and the relevant research sources. The list is organized based on the frequency of references to each challenge in the reviewed studies.

Table 1

List of Challenges, Classifications, and Related Research Sources

Challenge Code	Challenge Title	Thematic Classification	Supply Chain Stage Classification
A1	Inefficiency of logistics and transportation networks	Logistics and transportation – infrastructure challenges	Transportation
A2	Deficiencies in information sharing and lack of effective communication among supply chain actors; lack of integration among stakeholders	Coordination, communication, and data sharing	General
A3	Low quality of final product	Quality and safety	Production
A4	Environmental and contextual uncertainties such as fluctuations in supply and demand, transportation, pricing, and geopolitical factors	Production and product – logistics and transportation – financial and economic	General
A5	Insufficient or uneven distribution of wheat storage facilities	Logistics and transportation – infrastructure challenges	Storage
A6	Inappropriate policies, decisions, and legal frameworks; high compliance costs	Security and monitoring – policy and regulation – financial and economic	General
A7	Inefficient structure, planning, management, coordination, and supply chain processes	Policy and regulation – managerial challenges	General
A8	Inefficiency in the use of information and communication technologies	Technology and innovation – infrastructure challenges	General
A9	Climate change and environmental variations	Environment and climate	Production
A10	Lack of small-scale and accurate data	Technology and innovation – coordination and data sharing	General
A11	Uncertainty in access to financial and human resources, fertilizers, pesticides, and raw materials; high input costs	Production and product – financial and economic	Production
A12	Lack of transparency	Policy and regulation – managerial challenges	General
A13	Supply-demand mismatch	Production and product	Production – Distribution/Retail

A14	Inefficient financial management, increased costs, and limited access to finance	Financial and economic	General
A15	Quality degradation, waste, and contamination along the post-harvest supply chain	Quality and safety	Transportation – Storage – Processing
A16	Lack of necessary technological infrastructure	Technology and innovation – infrastructure challenges	General
A17	Environmental degradation due to wheat production	Environment and climate – sustainability challenges	Production
A18	Marketing challenges	Managerial challenges	Distribution/Retail
A19	Security issues, fraud, unauthorized access, theft, and data security concerns	Security and monitoring – technology and innovation	General
A20	Shortage of skilled labor and technological expertise	Labor and knowledge	General
A21	Limited natural resources	Environment and climate	Production
A22	Insufficient research, weak knowledge management, and lack of farmer awareness of modern techniques	Labor and knowledge	Production
A23	Economic competitiveness and sustainability challenges in global and domestic markets	Financial and economic – sustainability challenges	General
A24	Inefficient use of agricultural land capacity; small landholding sizes	Production and product	Production
A25	Declining productivity and unstable wheat production levels	Production and product – sustainability challenges	Production
A26	Inadequate risk management and prevention mechanisms	Managerial challenges	General
A27	Regulatory and technological changes	Technology and innovation – policy and regulation	General
A28	Lack of access to appropriate transportation routes and infrastructure	Logistics and transportation – infrastructure challenges	Transportation
A29	Lack of access to operational data and insights	Technology and innovation – coordination and data sharing	General
A30	Improper use of fertilizers and pesticides affecting product safety	Quality and safety	Production
A31	Governance structures for market regulation	Policy and regulation	Distribution/Retail
A32	Real-time monitoring challenges and high compliance costs	Policy and regulation	General
A33	Increased complexity due to sustainability requirements	Sustainability challenges	General
A34	Resistance to adopting new technologies	Technology and innovation – managerial challenges	General
A35	Decline in wheat quality due to high testing costs and lack of effective quality control systems	Quality and safety – financial and economic	General
A36	Natural pests causing high product loss	Environment and climate – quality and safety	Production – Storage
A37	Lack of compatibility among supply chain technologies	Technology and innovation – infrastructure challenges	General
A38	Geographic dispersion of the wheat supply chain	Logistics and transportation	Transportation
A39	Complexity in blending high- and low-quality wheat to meet standards	Quality and safety	Production – Processing
A40	Ineffective implementation of strategies	Managerial challenges	General
A41	Exploitation of farmers and monopolistic structures in the supply chain	Production and product – technology and innovation	Production
A42	Lack of disease-resistant wheat varieties and dependence on sensitive high-yield varieties	Production and product – sustainability challenges	Production
A43	Processing capacity limitations	Infrastructure challenges	Processing
A44	Lack of standardization in agricultural products	Quality and safety	Production
A45	Reliance on self-reporting by farmers for quality and safety assessment	Security and monitoring – quality and safety	Production
A46	Excessive government intervention	Policy and regulation – managerial challenges	General
A47	Role of cooperatives	Policy and regulation – managerial challenges	General
A48	Delay in digital transformation	Technology and innovation	General
A49	Inefficient inventory management and inability to maintain optimal stock levels	Managerial challenges	Storage
A50	Low energy efficiency across the supply chain	Financial and economic – sustainability challenges	General
A51	Ineffective waste management in the supply chain	Production and product – managerial challenges	Production
A52	Per capita wheat consumption exceeding global average	Policy and regulation – managerial challenges	General

A53	Interdependence between high-quality and low-quality wheat production in the same land	Quality and safety	Production
A54	High costs of pesticides and fungicides	Financial and economic	Production
A55	Geopolitical positioning affecting global wheat supply chains	Logistics and transportation	Transportation
A56	Dispute resolution mechanisms	Policy and regulation	General
A57	Farmers' dependence on government subsidies	Financial and economic	Production
A58	Insecurity of land ownership	Socio-cultural constraints	Production
A59	Cultural barriers in supply markets	Socio-cultural constraints	Distribution/Retail
A60	Lack of innovation in production and processing	Technology and innovation	Production – Processing

The analysis of the final results indicates that the key challenges of the wheat supply chain are rooted not in farms and silos, but in policymaking arenas. The clear dominance of challenges such as the "failure to set an appropriate guaranteed purchase price" (Rank 1) and "lack of coordination among institutions" (Rank 2) strongly confirms that 70% of the major issues identified by experts are institutional and managerial in nature. This has a critical operational implication: any effort aimed solely at technical improvement (such as purchasing new equipment or constructing silos) without resolving structural and institutional problems such as administratively imposed pricing or the absence of secure land tenure (Rank 3) will amount to only a temporary remedy. This finding shows that the wheat supply chain suffers more from "policy" and "institutional" problems than from purely "technical" ones.

Table 2

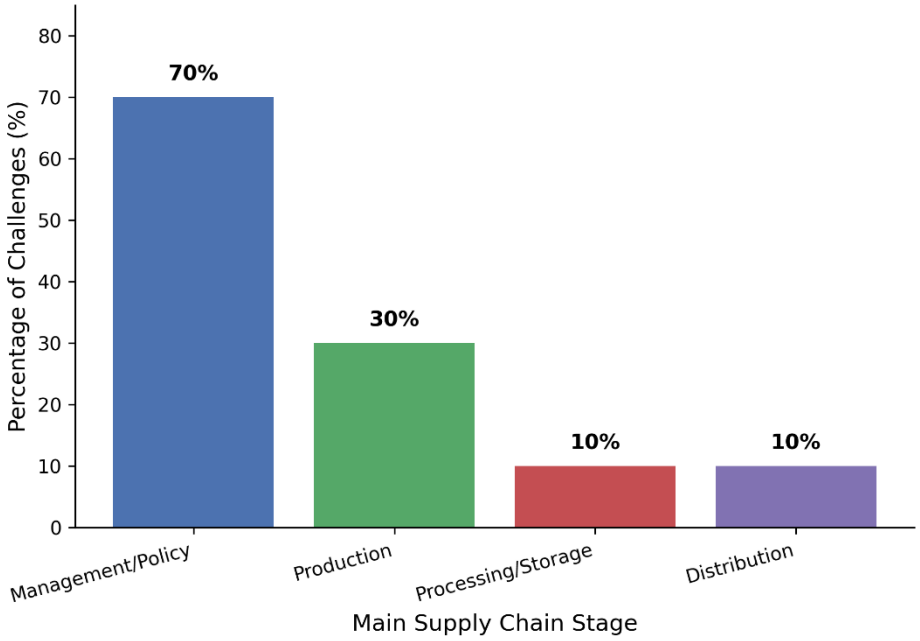
Key Wheat Supply Chain Challenges Based on Expert Prioritization

Rank	Challenge	Main Supply Chain Stage
1	Failure to set an appropriate guaranteed purchase price for wheat and its misalignment with production costs	Management/Policymaking
2	Lack of coordination and integration among different supply chain institutions	Management/Policymaking
3	Lack of secure land tenure for farmers	Management/Policymaking/Production
4	Severe exchange rate volatility and inflation affecting production and procurement costs	Management/Policymaking
5	Limited water resources and recurrent droughts	Production
6	Problems arising from intermediaries and brokers, and the absence of a commodity exchange system	Distribution/Management
7	Inefficiency in tariff-setting structures and flour and bread subsidy systems	Management/Policymaking
8	Deficiencies in the equitable distribution of agricultural inputs and the existence of black markets	Production/Distribution
9	Insufficient investment in research and development	Management/Production
10	Lack of sufficient capacity for appropriate long-term wheat storage	Processing/Storage

Figure 2 clearly demonstrates the importance of governance and macro-level management in shaping the wheat supply chain crisis. Among the ten principal challenges, the management/policymaking domain (including macroeconomic challenges) accounts for 7 challenges, representing a decisive 70% share of critical priorities. By contrast, the operational and technical stages of the supply chain account for a substantially smaller share: the production stage (including water resources and inputs) includes only 3 challenges, representing 30%. Likewise, the processing/storage and distribution stages (excluding inputs) each include only 1 challenge, corresponding to a very low 10% share of the main priorities. The concentration of 70% of the challenges in the policymaking domain (such as pricing and organizational disintegration) demonstrates that the principal source of inefficiency lies not in the lack of technical knowledge or merely logistical issues, but in the absence of an integrated governance system and appropriate economic policies. In effect, policy inefficiencies intensify existing technical challenges (such as water resource constraints in production) and impede their resolution. This finding outlines a clear course of action for policymakers: structural reforms in management and policymaking must take precedence over all other measures, because without addressing this 70% share, investment in the remaining 30% of technical challenges would, in practice, amount to investing in a defective system.

Figure 2

Top Challenges by Main Supply Chain Stage



A comparison between the critical priorities identified by Iranian experts and the emphases of the global literature revealed through the systematic literature review (SLR) shows a vital bipolar gap with two major dimensions.

1. **Structural indigenous crisis:** This crisis is reflected in distinctive priorities that are infrequently emphasized in the global literature, yet ranked highest in Iran. The challenge of the "failure to set an appropriate guaranteed purchase price" (Rank 1) lies at the core of this crisis. While global studies focus on diverse support instruments such as price risk coverage and crop insurance (United States) and regulation through commodity exchanges (European Union), Iran's top priority is focused solely on defective administratively imposed pricing. This strongly confirms that the root of the crisis is an Iran-specific political-economic mechanism that operates contrary to global market-oriented trends. Alongside this, the "lack of secure land tenure" (Rank 3) has also emerged as a severe institutional challenge at the top of Iran's priorities, whereas in the global literature it is more commonly discussed as an economic challenge in developing countries (such as Lebanon and Brazil), rather than as a principal factor disrupting food security at the macro level.
2. **Difference in sustainability and quality priorities:** This deep gap indicates a systemic deviation in the focus of Iran's supply chain. Challenges such as "low final product quality" and "waste management," which receive the highest emphasis in the global literature (given the annual 30% agricultural product losses in Iran and the global need to reduce them), were ranked by Iranian experts at much lower levels (Ranks 15 to 19). Similarly, issues such as transparency, traceability, and the use of emerging technologies such as the Internet of Things (IoT) and blockchain—which are recognized globally as core solutions for reducing waste and ensuring quality—are considered medium- to low-priority issues in Iran. This supports a systemic conclusion: the policymaking crisis (Ranks 1 and 3) has undermined quality-oriented incentives and shifted the focus of the supply chain away from long-term goals of "sustainability and quality" toward the immediate concern of "survival and financial provision."

Table 3

Gap Between Iranian Expert Priorities and the Emphases of the Global Literature (SLR)

Importance Rank (Iranian Experts)	Challenge (Example)	Global Emphasis (SLR)	Type of Gap
1	Failure to set an appropriate guaranteed purchase price	Low	Structural indigenous crisis (focus on administratively imposed pricing rather than market risk management)
3	Lack of secure land tenure	Low	Indigenous institutional crisis (intensification of a development-related challenge at the top of priorities)
Low (Ranks 15 to 19)	Low final product quality / waste management	Very high	Priority divergence/systemic crisis (shift in focus from sustainability to survival)
Medium (Rank 10)	Lack of sufficient storage capacity	High	Lower priority than policymaking (institutional problems are more acute than infrastructure problems)

The comprehensive prioritization of challenges confirms that financial, performance-related, and quality-related issues occupy the top ranks. Challenges such as inefficient financial management (A14), with the highest score, lead the list, followed by performance-related issues (A25) and quality-related issues (A3). This indicates that experts perceive a combination of macroeconomic problems (such as financial management) and their consequences on production (such as declining yield and quality) as their most critical day-to-day concerns. In addition, issues related to technology and information management (A8 and A9) appear in the middle of the list, reflecting their growing importance. A total of 20 major challenges were identified, forming the core of the wheat supply chain crisis and demonstrating the overwhelming dominance of macroeconomic and environmental factors over purely technical issues. Challenges such as inefficient financial management (A14), declining productivity (A25), and quality-related issues (A3) rank at the top, indicating a threefold interaction among a dysfunctional macroeconomic environment, its direct impact on production, and its ultimate effect on quality. The simultaneous high ranking of environmental challenges (A9, A21, A24) and waste-related issues (A36, A51) suggests that experts perceive resource depletion and increased losses as interconnected and as a persistent threat. Furthermore, the high importance of governance structures (A31) and inefficiencies in information technology (A8) confirms that even for managing existing resources and risks (A26), the necessary institutional and informational infrastructures are lacking in Iran. These 20 challenges delineate the frontline in addressing inefficiency and represent the primary priorities for policymakers.

Table 4

High-Importance Wheat Supply Chain Challenges (Ranks 1–20)

No.	Challenge Code	Challenge	Total Score
1	A14	Inefficient financial management, rising costs, limited financial resources, and financing constraints	32
2	A25	Declining productivity and instability in wheat production levels	31
3	A3	Low quality of final product	30
4	A36	Natural pests causing high product loss and waste	30
5	A50	Low energy efficiency across the supply chain	30
6	A8	Inefficiency in the use of information and communication technologies	29
7	A9	Climate and environmental changes	29
8	A11	Uncertainty in access to financial and human resources and agricultural inputs	28
9	A21	Limited natural resources	28
10	A24	Inefficient use of agricultural land capacity and small landholding sizes	28
11	A51	Ineffective waste management in the supply chain	28
12	A31	Governance structures for market regulation	27
13	A35	Decline in wheat quality due to high contamination testing costs	27
14	A1	Inefficiency of logistics and transportation networks	26
15	A2	Deficiencies in information sharing and lack of effective communication	26
16	A4	Environmental and contextual uncertainty in the supply chain	26
17	A6	Inappropriate policies, legal frameworks, and compliance costs	26
18	A15	Post-harvest quality degradation, waste, and contamination	26
19	A22	Insufficient research, weak knowledge management, and lack of farmer knowledge	26
20	A26	Inadequate risk management and prevention mechanisms	26

Twenty challenges of moderate importance, which complement and intensify the core challenges, primarily focus on structural, infrastructural, and human-related barriers. Issues such as resistance to technology adoption (A34), shortage of skilled labor (A20), and lack of innovation (A60) indicate that the human factor in the wheat supply chain constitutes a critical bottleneck, showing reluctance toward change or modernization. In this category, major infrastructural deficiencies are also evident, including inefficient inventory management (A49), lack of adequate storage facilities (A5), and processing limitations (A43). Notably, challenges such as excessive government intervention (A46) and farmers' dependence on subsidies (A57) highlight that the business environment in this supply chain remains heavily state-controlled and regulation-driven. This condition exacerbates the lack of transparency (A12) and the absence of standardization (A44), thereby hindering improvement and competitiveness.

Table 5

Moderate-Importance Wheat Supply Chain Challenges (Ranks 21–40)

No.	Challenge Code	Challenge	Total Score
21	A39	Complexity in blending high- and low-quality wheat to meet standards	26
22	A54	High costs of pesticides and fungicides	26
23	A57	Farmers' dependence on government subsidies	26
24	A5	Insufficient or uneven distribution of storage facilities	25
25	A13	Supply-demand mismatch	25
26	A20	Shortage of skilled labor and technological expertise	25
27	A34	Resistance to adopting new technologies	25
28	A37	Lack of compatibility among supply chain technologies	25
29	A44	Lack of standardization in agricultural products	25
30	A49	Inefficient inventory management	25
31	A58	Insecurity of land ownership	25
32	A60	Lack of innovation in production and processing	25
33	A12	Lack of transparency	24
34	A28	Lack of access to appropriate transportation infrastructure	24
35	A30	Improper use of fertilizers and pesticides	24
36	A16	Lack of technological infrastructure	23
37	A27	Changes in regulations and technologies	23
38	A42	Lack of disease-resistant wheat varieties	23
39	A43	Processing capacity limitations	23
40	A46	Excessive government intervention	23

Challenges at the bottom of the list, with scores of 13 or lower, represent issues that, from the experts' perspective, are either not contextually relevant in Iran or are not considered high priorities compared to more critical problems. For instance, challenges such as cultural barriers (A59) or exploitation by landowners (A41), although discussed in the global literature, are either of low importance or not perceived as critical and widespread issues by Iranian experts. Similarly, the low ranking of challenges related to global competitiveness (A23) and data security (A19) indicates that the primary focus remains on internal operational issues, while broader concerns such as international trade dynamics or digital security have not yet emerged as immediate priorities.

Table 6

Low-Importance and Contextually Irrelevant Challenges in Iran (Ranks 41–60)

No.	Challenge Code	Challenge	Total Score
41	A7	Inefficient supply chain structure, planning, and coordination	13
42	A55	Geopolitical position in the global wheat supply chain	13
43	A48	Delay in digital transformation	12
44	A33	Increased complexity due to sustainability pressures	11
45	A32	Real-time monitoring across the supply chain	9
46	A52	Per capita wheat consumption above global average	9
47	A17	Environmental degradation due to wheat production	8

48	A53	Interdependence between high- and low-quality wheat production	7
49	A10	Lack of small-scale and accurate data	6
50	A18	Marketing challenges	6
51	A38	Geographic dispersion of the supply chain	6
52	A40	Ineffective implementation of strategies	5
53	A45	Reliance on farmer self-reporting for quality and safety	5
54	A29	Lack of access to operational data and insights	4
55	A19	Security issues, fraud, and data breaches	3
56	A23	Economic competitiveness in global markets	3
57	A47	Role of cooperatives	3
58	A56	Dispute resolution mechanisms	3
59	A41	Exploitation of farmers and monopolistic structures	2
60	A59	Cultural barriers in supply markets	1

4. Discussion and Conclusion

The findings of this study provide a comprehensive and structured understanding of the challenges facing the wheat supply chain, revealing a clear hierarchy in which institutional, financial, and macroeconomic factors dominate over purely technical and operational issues. The prioritization results indicate that challenges such as inefficient financial management (A14), declining productivity (A25), and low product quality (A3) are perceived by experts as the most critical issues. This pattern reflects a systemic interaction between macroeconomic instability, its direct impact on agricultural production, and the downstream consequences for product quality. These findings are consistent with prior research emphasizing that financial constraints and macroeconomic volatility significantly influence agricultural supply chain performance, particularly in developing economies where access to capital and stable pricing mechanisms is limited (Sarvari & Yazdani, 2021; Vaezi et al., 2024). Moreover, the prominence of financial management challenges aligns with studies highlighting the importance of effective resource allocation and financial planning in ensuring supply chain resilience and sustainability (Hasheminejad et al., 2020; Mousavi Shamsabad et al., 2021).

A key insight from the results is the dominant role of governance and policymaking challenges in shaping the inefficiencies of the wheat supply chain. The high ranking of issues such as lack of coordination among institutions and ineffective regulatory frameworks indicates that structural and institutional deficiencies constitute the primary bottlenecks. This finding is strongly supported by the literature, which underscores the critical role of governance mechanisms and stakeholder coordination in agricultural supply chains (Grohmann et al., 2023; McLoughlin & Meehan, 2021). In particular, the absence of integrated governance systems and coherent policy frameworks has been shown to lead to fragmentation, inefficiency, and suboptimal performance across supply chain stages (Deng et al., 2021; Grabs & Carodenuto, 2021). The results of this study reinforce this perspective by demonstrating that even technical challenges, such as inefficiencies in logistics or storage, are often exacerbated by weak institutional coordination and policy inconsistencies.

Another important dimension of the findings relates to the environmental and sustainability challenges identified by experts. Issues such as climate change (A9), natural resource constraints (A21), and environmental degradation (A17) were ranked among the high-importance challenges, indicating a strong awareness of sustainability-related risks within the wheat supply chain. These findings are consistent with a growing body of research emphasizing the vulnerability of agricultural systems to environmental changes and the need for sustainable supply chain practices (Chedid et al., 2019; Raihan & Tuspekova, 2022). Additionally, the simultaneous prioritization of environmental challenges and waste-related issues (such as A36 and A51) suggests that experts perceive these factors as interconnected components of a broader sustainability problem. This aligns with studies highlighting the role of circular economy practices and waste reduction strategies in improving the sustainability of agri-food supply chains (Dossa et al., 2020; Pancino et al., 2019).

The findings also reveal a notable gap between global research priorities and local expert assessments, particularly in relation to quality management and technological innovation. While the literature emphasizes the importance of advanced technologies such as blockchain and IoT in enhancing traceability, transparency, and efficiency (Farooq et al., 2024; Nadimi et al., 2023; Rathore et al., 2022), these issues were ranked at moderate levels by experts. This discrepancy suggests that in the Iranian context, more immediate concerns such as financial stability and

institutional reform take precedence over technological advancements. This observation is supported by studies indicating that the adoption of advanced technologies in agricultural supply chains is often constrained by infrastructural limitations, high costs, and resistance to change (Chinthamu et al., 2023; Pakseresht et al., 2023). Furthermore, the relatively lower prioritization of digital transformation challenges reflects the presence of more fundamental systemic issues that must be addressed before technological solutions can be effectively implemented (Sharma et al., 2025).

Human and organizational factors constitute another critical area highlighted by the findings. The identification of challenges related to lack of skilled labor, insufficient knowledge management, and resistance to innovation indicates that human capital limitations play a significant role in hindering supply chain performance. This finding is consistent with the resource-based view of supply chain management, which emphasizes the importance of organizational learning and human capabilities in achieving competitive advantage and resilience (Eryarsoy et al., 2022). Additionally, the role of knowledge management in improving supply chain performance has been well documented, particularly in the context of agricultural systems where knowledge dissemination and farmer education are essential for adopting new practices and technologies (Mousavi Shamsabad et al., 2021). The persistence of these challenges suggests that investments in human capital development and organizational learning are critical for enhancing the effectiveness of the wheat supply chain.

The results also highlight the significance of supply chain design and network optimization challenges. Issues such as inefficiencies in transportation networks (A1), lack of storage infrastructure (A5), and processing limitations (A43) indicate that structural deficiencies in supply chain design continue to affect performance. These findings are consistent with research emphasizing the importance of optimizing supply chain networks to improve efficiency, reduce costs, and enhance responsiveness (Hosseini-Motlagh et al., 2021; Pourmohammadi et al., 2020). Furthermore, the presence of uncertainty in supply and demand (A4) underscores the need for robust and flexible supply chain designs capable of adapting to dynamic conditions. This aligns with studies advocating the use of stochastic and robust optimization models to address uncertainty and improve decision-making in supply chain management (Sharifi et al., 2023; Yousefi-Babadi et al., 2023).

Another notable finding is the relatively low prioritization of global competitiveness and digital security challenges. Issues such as data security (A19) and international market competitiveness (A23) were ranked among the least important by experts. This suggests that the primary focus remains on addressing internal inefficiencies rather than engaging with broader global challenges. However, the literature indicates that globalization and digitalization are increasingly shaping agricultural supply chains, and failure to address these issues may limit future competitiveness and integration into global markets (Bandinelli et al., 2023; Yadav et al., 2022). Therefore, while these challenges may not be immediate priorities, they should not be overlooked in long-term strategic planning.

In addition, the findings emphasize the importance of resilience in the wheat supply chain, particularly in the context of recent global disruptions such as the COVID-19 pandemic. The identification of risk management challenges (A26) and the need for adaptive capacity highlight the importance of building resilient supply chain systems capable of withstanding shocks and uncertainties. This is consistent with studies demonstrating that supply chain resilience is a critical factor in maintaining stability and performance during crises (Raj et al., 2022; Yao, 2025). Moreover, the role of stakeholder collaboration and multi-actor engagement in enhancing resilience has been widely recognized in the literature, further reinforcing the importance of coordinated governance and integrated systems (Deng et al., 2021).

Overall, the discussion of findings reveals that the wheat supply chain operates as a complex socio-economic system in which technical, environmental, and organizational factors are deeply intertwined with institutional and policy-related dynamics. The dominance of macro-level challenges suggests that addressing structural and governance issues should be a priority for policymakers. At the same time, efforts to improve technical efficiency, adopt innovative technologies, and enhance human capabilities remain essential components of a comprehensive strategy for improving supply chain performance.

This study has several limitations that should be considered when interpreting the results. First, the reliance on expert judgment introduces a degree of subjectivity, as the prioritization of challenges may reflect individual perspectives and experiences rather than purely objective criteria. Second, the study focuses primarily on the Iranian context, which may limit the generalizability of the findings to other countries with different institutional, economic, and

environmental conditions. Third, the systematic literature review, although comprehensive, may not have captured all relevant studies due to database limitations or language restrictions. Finally, the study does not incorporate quantitative modeling or empirical validation of the identified challenges, which could provide additional insights into their relative impact and interrelationships.

Future research should aim to address the limitations of this study by incorporating more diverse data sources and methodological approaches. For example, combining expert judgment with quantitative modeling techniques such as structural equation modeling or system dynamics could provide a more robust analysis of the relationships among challenges. Additionally, comparative studies across different countries and regions could help identify context-specific versus universal challenges in the wheat supply chain. Further research is also needed to explore the role of emerging technologies in addressing supply chain challenges, particularly in developing contexts where adoption barriers are significant. Finally, longitudinal studies could provide insights into how supply chain challenges evolve over time and how policy interventions influence their dynamics.

From a practical perspective, the findings of this study suggest that policymakers and practitioners should prioritize structural and institutional reforms as a foundation for improving the wheat supply chain. Efforts to enhance coordination among stakeholders, improve financial management systems, and establish transparent and efficient regulatory frameworks are essential for addressing the root causes of inefficiency. In addition, investments in infrastructure, technology, and human capital should be aligned with broader policy objectives to ensure a holistic approach to supply chain improvement. Practitioners should also focus on enhancing risk management capabilities and adopting sustainable practices to address environmental challenges and reduce waste. Ultimately, a coordinated and integrated approach that combines policy reform, technological innovation, and capacity building is necessary to achieve a resilient and efficient wheat supply chain.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

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