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METHODOLOGY "AGRIRISK & SUPPLY CONTINUITY METHODOLOGY" FOR FOOD SECURITY PLANNING BY PUBLIC AUTHORITIES

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Abstract. *The article is devoted to the study of the "AgriRisk & Supply Continuity Methodology" for food security planning by public authorities, aimed at improving agricultural risk management mechanisms in the United States. The purpose of the study is to enhance existing food security planning models through the development of an integrated AgriRisk & Supply Continuity methodology focused on state management of agricultural risks in the U.S. During the research process, general scientific methods of cognition were applied: analysis and synthesis, induction and deduction, system-structural and comparative approaches, as well as methods of statistical generalization and modeling. The results indicate that the U.S. food security system has a multilevel architecture that combines government regulation, research and analytical support, and private sector participation. It was established that the main coordinator of food policy is the U.S. Department of Agriculture through its Economic Research Service, which provides key analytical indicators for strategic planning. The theoretical analysis systematized the main approaches to food security planning: risk management; inventory-operational; techno-political; integrative-risk. The first focuses on identifying and quantifying risks; the second ensures supply stability through the creation of buffer reserves; the third emphasizes the introduction of digital technologies (AI, IoT, blockchain) combined with public regulation. The author's AgriRisk & Supply Continuity methodology generalizes existing scientific approaches, integrating financial-analytical, agroeconomic, logistic, and politico-strategic components into a unified management system. The practical significance of the study lies in the possibility for governmental bodies to use the developed methodology in shaping effective food security risk management policies.*

Keywords: *food security, risk management, public regulation, import dependence, AgriRisk.*

Introduction

In today's geopolitical context, the issue of food security has gained particular importance, as the global economy is marked by growing fragility and the unpredictability of international relations. Frequent trade conflicts, political sanctions, climate disasters, and disruptions in global supply chains are forming a new architecture of food risks. For countries highly integrated into the global economy, such as the United States, maintaining stable food supply has become not only an economic matter but also an element of national security. Dependence on imports of certain categories of goods – fruits, vegetables, coffee, seafood – increases the vulnerability of the food system to external shocks, requiring the creation of adaptive risk management mechanisms.

Under these conditions, the system of public food security planning must be not only reactive but also predictive, capable of promptly assessing potential threats and developing preventive solutions. The high dynamics of political, economic, and climatic processes require new approaches to risk assessment and management that integrate financial, production, logistic, and strategic components. Therefore, the development of integrated models aimed at strengthening the resilience of food systems is a relevant direction of modern scientific research. In this context, methodologies that combine analytical tools of public administration with mechanisms of corporate risk management to form a unified food security system are of particular significance.

Literature Review

The issue of the "AgriRisk & Supply Continuity Methodology" for food security planning by public authorities has been thoroughly covered in foreign scientific literature, reflecting strong research interest in the resilience of agri-food supply chains, risk management, and policy strategies for ensuring food security. Among contemporary influential works, it is worth noting studies by Y. Guo, F. Liu, J. S. Song, and S. Wang [1], who analyze supply chain resilience from the perspective of inventory management, emphasizing the role of adaptive logistic strategies in risk reduction.

A significant contribution was also made by S. Hosseini Shekarabi, R. Kiani Mavi, and F. Romero Macau [2], who provided a critical review of risk mitigation methods, optimization models, and technological solutions forming the basis for the development of integrated approaches such as "AgriRisk & Supply Continuity."

Research by I.-Y. Huang and co-authors [3] systematically examines the resilience of food systems to sudden shocks, including natural disasters and political crises, and proposes a model for assessing the readiness of public institutions to respond. Important for the methodological framework are the results of Y. Iskandar, C. Mala, and W. Windarko [4], who summarized political and technological approaches to strengthening food resilience, as well as P. Luo and T. Tanaka [5], who analyzed the impact of import dependence on national food security, forming a basis for political indicators in risk planning.

Among applied studies, a notable contribution was made by I. Medvediev, D. Muzylyov, and J. Montewka [6], who used fuzzy logic to model risks in the grain supply chain between Ukraine and Poland, demonstrating the potential adaptability of "AgriRisk" to specific regional conditions. A. Profita and D. Kuncoro [7] also explored the integration of agricultural risk management in Indonesia, confirming the universality of approaches to ensuring agricultural supply continuity.

Conceptual frameworks for risk assessment and strategies for strengthening agri-food supply chains are presented by R. Singh and G. Dwivedi [8], who propose a model for assessing system vulnerability and strategic planning relevant to public management of food reserves. The historical and critical development of the concept of "resilience" in agribusiness is discussed by J. Stone [9], while M. Yuan, H. Hu, M. Xue, and J. Li [11] developed a resilience strategy framework accounting for climate change. In addition, analytical data from the U.S. Department of Agriculture [10] provided the empirical basis for assessing import dependence and food risks.

Besides academic sources, expert online publications from Food Security Portal, FAO Insights, and Global Supply Chain Review were used, highlighting current approaches to the digitalization of agricultural risks and public monitoring of food stability.

Despite the considerable number of foreign studies, there is still a lack of systematized materials that directly describe the practical implementation of the "AgriRisk & Supply Continuity Methodology" in public administration. Therefore, methods of scientific analysis, generalization, and systematization were applied to integrate scientific and practical approaches to food security planning.

The study relies on a systemic and interdisciplinary approach that combines principles of economic analysis, risk management theory, and the concept of resilience in agri-food systems. General scientific methods were used in the process: analysis and synthesis for summarizing theoretical positions; induction and deduction for shaping the logical structure of the study; the comparative method for identifying differences among existing food security models; and systematization for building a classification of planning approaches. To assess statistical trends, methods of economic and statistical analysis were applied, including dynamic series and comparative indicators. The methodological foundation of the author's AgriRisk & Supply Continuity model lies in integrating financial-analytical, agroeconomic, and logistic parameters into a unified food security risk management system.

Purpose of the Study

The aim of the research is to improve existing food security planning models through the development of an integrated AgriRisk & Supply Continuity methodology oriented toward state management of agricultural risks in the United States. Within this goal, three main objectives were set: to conduct a general review of the food security problem and related statistical indicators; to analyze the main theoretical approaches and models for building food resilience; to provide practical recommendations for implementing the author's methodology into the U.S. system of public planning.

Research Results

The U.S. food security system has a multilevel architecture integrating government regulation, the private sector, and research-analytical support. The central coordinating body is the U.S. Department of Agriculture (USDA), specifically its Economic Research Service (ERS) [10], which monitors, evaluates, and forecasts food supply conditions, forms strategic demand and supply balances, tracks domestic production and import dynamics, and develops response scenarios to potential risks within the food system. Through the ERS, key statistical indicators are generated, forming the basis for governmental planning and policy decisions in food security.

The U.S. food security planning methodology is based on the combination of 1) economic forecasting; 2) ecological approach; 3) principles of systemic resilience in the agri-food sector. This approach originates from the ecological school, where the main objective is to preserve system functionality under external changes, and it transforms into a state policy of sustainable development [3], aimed at ensuring self-sufficiency in food while managing import dependence. Consequently, U.S. public food security planning has a dual character: on one hand, it focuses on supporting domestic production and food sovereignty; on the other, it aims to stabilize external supplies within global supply chains [11].

Despite significant agricultural capacity, the U.S. remains an import-dependent country, explained by the diversification of food consumption and the need to ensure year-round availability. According to USDA ERS [10], in 2024 the total volume of food imports reached USD 204.9 billion, which is 8.4% higher than in 2023 and nearly 41% more than in 2020. The largest import partners include Mexico, Canada, Chile, China, Colombia, Vietnam, and Indonesia. These countries supply fruits, vegetables, coffee, seafood, and sugar – products whose domestic production in the U.S. is either climatically limited or economically unviable (Table 1).

Table 1 – Volume of imports of main food products

Year	Total food imports, USD billion	Fruit imports	Vegetable imports	Coffee, tea and spices imports	Cocoa and chocolate imports
2020	144.8	20.5	15.6	8.3	5.0
2021	170.7	23.7	16.8	9.8	5.6
2022	194.4	27.1	18.3	13.0	6.0
2023	189.2	27.6	19.8	11.3	6.2
2024	204.9	29.9	21.4	12.7	8.1

Source: U.S. Department of Agriculture, Economic Research Service [10]

Over the five-year period, food imports increased by 41%, which reflects not so much a decline in domestic production as a structural change in consumption patterns: rising demand for tropical fruits, seafood, spices, and other products not typical for the local agroclimate. At the same time, this trend illustrates the globalization of diets and the growing role of international logistics networks in ensuring national food stability.

The increase in import volumes is not a direct indicator of production shortages – U.S. agriculture remains export-oriented, yet the trade structure shows a shift toward goods with higher added value. This highlights the need for flexible state planning that takes into account both domestic resources and external integration [5].

Despite overall market stability, food prices in the U.S. continue to rise, particularly for imported products. Over the past five years, the cost of imported fruits has increased by 34.1%, vegetables by 21.6%, coffee, tea, and spices by 49.1%, and cocoa and chocolate by 75.9%. The most significant price increases were recorded in

2023–2024, driven by global inflationary fluctuations, supply chain disruptions, and energy risks.

The main dynamics of price changes for key imported food products are presented in Table 2.

Table 2 – Dynamics of price changes for key food products in the United States

Product category	2020 (USD/ton)	2021 (USD/ton)	2022 (USD/ton)	2023 (USD/ton)	2024 (USD/ton)	Change, %
Fruits	1,447	1,607	1,790	1,817	1,940	+34.1
Vegetables	1,270	1,261	1,334	1,431	1,545	+21.6
Coffee, tea, spices	3,702	4,188	5,378	5,294	5,521	+49.1
Cocoa and chocolate	3,629	3,676	3,997	4,595	6,383	+75.9

Source: U.S. Department of Agriculture, Economic Research Service [10]

Such an increase in import prices indicates the growing external risks within the food security system. It reflects the sensitivity of the U.S. agricultural sector to global trade conflicts, climate shocks, and logistical barriers. Therefore, strategic government planning is aimed at creating an adaptive management system capable of responding quickly to risks, as well as developing a digital infrastructure for forecasting and optimizing supply chains.

The food security planning system in the United States is organized as an institutionally coordinated model within the framework of critical infrastructure. In particular, the Food and Agriculture sector includes governmental and industry coordination councils, mechanisms for cooperation and joint risk management among federal and state authorities, and private businesses. This architecture sets the rules of interaction and ensures integrated planning for the continuity of food supply [11].

This strategy is complemented by federal-level instruments. The established Supply Chain Resilience Center conducts system vulnerability analysis, coordinates cooperation with the private sector, and provides strategic risk forecasting to support the stability of the national food market. Its activities aim to strengthen cross-sectoral collaboration in supply monitoring and crisis management [4].

Nevertheless, the approaches applied in public administration are based on theoretical foundations developed in contemporary scientific literature. One of them is the risk management approach, described in the work of S. A. Hosseini Shekarabi, R. Kiani Mavi, and F. R. Romero Macau [2]. According to this approach, food security planning relies on risk identification, quantitative assessment, and the use of robust optimization models for predicting the effects of supply chain disruptions. The core idea lies in building an adaptive management system that allows not only crisis prevention but also the rapid restoration of food system functionality at different levels – from state to corporate [2].

The inventory-operational approach was elaborated by Y. Guo, F. Liu, J. S. Song, and S. Wang [1]. This approach focuses on the use of inventories as a buffer in the event of supply disruptions or demand fluctuations. It involves the creation of "virtual inventories," implementation of Vendor-Managed Inventory systems, and diversification of suppliers. The approach is applied at both meso- and micro-management levels, with its main goal being the maintenance of supply stability at minimal financial cost and high operational responsiveness [1].

Technological and political approaches to ensuring food security are thoroughly described in the study by Y. Iskandar, C. Mala, and W. Windarko [4]. The main instruments here include modern digital technologies – Internet of Things, Artificial Intelligence, and blockchain – which provide real-time forecasting, traceability, and control. They enable flexible regulation of supply volumes depending on market demand changes, minimize logistic disruption risks, and ensure transparency across supply chains. The central idea of this approach is to build a system capable of self-adaptation through the integration of technological and political solutions [4].

An important component of this methodology is the digitalization of the agricultural sector, which enhances data management efficiency, market transparency, and the speed of crisis response. Among the technologies applied, key roles are played by Artificial Intelligence (AI), Internet of Things (IoT), blockchain, Big Data, and automated forecasting systems [11] (Table 3).

In addition, modern scientific literature highlights integrative approaches that combine elements of the previously mentioned concepts. In particular, R. Singh and G.

Dwivedi propose a multi-criteria framework for risk assessment based on Fuzzy AHP, F-TOPSIS, and F-QFD methods. This approach enables systematic ranking of threats, prioritization, and alignment of response strategies while considering cross-sectoral interactions. Its core idea lies in ensuring flexible planning based on the principles of risk management, technological monitoring, and state regulation [8].

Table 3 – Technological solutions used in the development of food security strategies in the United States

Technological direction	Main function	Expected effect for food security planning
Artificial Intelligence (AI)	Demand forecasting, risk analysis	Resource allocation optimization, early shortage warning
Internet of Things (IoT)	Monitoring of production and logistics	Improved data accuracy, real-time supply chain control
Blockchain	Product origin verification	Reduced risk of counterfeiting, increased system trust
Big Data Analytics	Analysis of price and climate trends	Integration of environmental and economic parameters into planning
Cloud Computing	Data exchange between agencies	Coordination of decisions among government institutions

Source: Yuan, Hu, Xue & Li [11]

The main approaches to food security planning in the United States are systematized in Table 4.

Table 4 – Approaches to ensuring food security in the United States

Type of approach	Key instruments, level of application, and main objective
Risk management	Involves risk identification, quantitative analysis, and robust optimization models. Applied at state, sectoral, and corporate levels. The main objective is to minimize the impact of disruptions and ensure rapid recovery of food systems.
Inventory-operational	Based on inventory management, supplier diversification, and creation of virtual buffers. Applied at meso- and micro-levels. The main objective is to ensure supply continuity with minimal costs.
Technological-political	Involves the use of digital technologies (IoT, AI, blockchain) combined with government policies. Applied at federal and corporate levels. The main objective is forecasting, transparency, and control over supply chain resilience.
Integrative-risk	Combines technological, managerial, and analytical approaches. Applied at macro and cross-sectoral levels. The main objective is risk ranking and strategic planning of food security.

Note: systematized by the author based on sources [1, 2, 4, 8, 11]

Optimal solutions in the field of food security should be based on the combination of several approaches that encompass financial, agroeconomic, logistical, and political aspects of food system functioning. The scientific literature emphasizes that researchers have long been seeking integrative solutions capable of ensuring production resilience, supply continuity, and management transparency simultaneously.

In particular, I. Medvediev, D. Muzylyov, and J. Montewka [6] proposed a risk management model for agri-industrial supply chains using fuzzy logic, based on the example of the grain route between Ukraine and Poland. Their study demonstrates how integrating logistic and financial factors into a unified risk-analytical system can reduce losses associated with unpredictable events in transportation and export infrastructure. Similarly, A. Profita and D. Kuncoro [7] presented their own methodology of integrated agricultural risk management, which applies the Analytic Network Process (ANP) to assess risks within Indonesia's state grain reserve system, combining elements of planning, production adaptability, and institutional coordination.

In the context of the United States, the author of this study developed the AgriRisk & Supply Continuity methodology, which advances the integrative idea of combining financial analysis, agroeconomic forecasting, logistics management, and public policy. Its architecture consists of four interconnected blocks.

The financial-accounting block ensures the unification of cost assessment based on international standards (IFRS), diagnostics of cost-related risks, and early detection of financial threats for enterprises and public institutions. This approach helps reduce information asymmetry among market participants and creates a foundation for an early warning system.

The agroeconomic block focuses on monitoring seasonal, climatic, and geopolitical factors, modeling scenarios of yield reduction, land resource loss, and assessing the long-term consequences of climate shifts for production. This block serves as a forecasting tool for stress conditions within the food system.

The logistics-export block concentrates on ensuring supply continuity by identifying critical points in supply chains, developing alternative routes in case of geopolitical or climatic threats, and enhancing the flexibility of transport infrastructure.

The politico-strategic block provides for the establishment of national standards for agricultural risk management, integration of corporate data into state analytical systems, and coordination among federal authorities, businesses, and research institutions (Table 5).

Table 5 – Main elements of the AgriRisk & Supply Continuity methodology

System block	Main content and instruments	Purpose / focus of application
Financial-accounting	application of IFRS standards; development of analytical reporting; implementation of early warning systems	ensuring accounting transparency, identifying hidden risks, and building financial stability
Agroeconomic	analysis of seasonal and climatic factors; stress testing for agricultural enterprises; assessment of land resource loss risks	forecasting the effects of climatic and geopolitical fluctuations, supporting production resilience
Logistics-export	modeling of alternative routes; analysis of infrastructural "bottlenecks"; optimization of logistic flows	ensuring supply continuity under emergency conditions
Politico-strategic	development of national risk management standards; integration of business data into state analytical centers	aligning corporate and governmental food security strategies

Note: compiled by the author

The integration of these blocks into a single methodological structure creates an adaptive management system capable of responding to multilevel shocks. When financial risks are identified at an early analytical stage, the agroeconomic and logistics blocks ensure prompt adjustments in production and transportation strategies. Thus, in the context of public administration, the AgriRisk & Supply Continuity methodology facilitates the alignment of corporate risk management approaches with national food security goals, which is a key condition for maintaining the resilience of modern food systems.

Conclusions

The study confirmed that the U.S. food security system is characterized by a multilevel architecture that combines government regulation, research and analytical support, and private sector participation. The main coordinating role belongs to the U.S. Department of Agriculture through its Economic Research Service, which provides key analytical indicators necessary for strategic planning. Statistical analysis showed that despite a high level of domestic production, the United States remains import-dependent, especially for products limited by climatic or economic production constraints. A 41% increase in food imports over the past five years and price growth of up to 75% for certain product categories indicate rising external risks and the need for an adaptive approach to managing food flows.

The theoretical analysis made it possible to systematize the main approaches to food security planning, including risk management, inventory-operational, technological-political, and integrative-risk approaches. The risk management approach focuses on identifying and quantifying risks; the inventory-operational approach aims to stabilize supply through the creation of buffer reserves; the technological-political approach involves the application of digital tools (AI, IoT, blockchain) combined with government regulatory mechanisms. Integrative models that combine these approaches demonstrate the highest level of efficiency, as they provide comprehensive risk management that considers both production and institutional factors.

The author's AgriRisk & Supply Continuity methodology summarizes previous scientific approaches by integrating financial-analytical, agroeconomic, logistic, and politico-strategic blocks into a single system. Its advantage lies in the ability to ensure early detection of financial risks, forecast seasonal and climatic fluctuations, model alternative supply routes, and coordinate public and corporate actions. This methodology creates an adaptive management architecture that enhances the resilience of the food system to multilevel shocks and promotes the alignment of strategic objectives between business and the state in the field of food security.

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