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RESEARCH ARTICLE

FOOD INSECURITY IN GLOBAL FOOD SUPPLY CHAINS

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Abstract

The introduction of the concept of uncertainty into the analysis of food systems necessitates a reorientation of scientific research towards examining the functioning of food-security systems under conditions characterized by contemporary challenges, threats, hazards, and risks arising from geopolitical conflicts and climatic anomalies. To maintain their homeostasis, such systems must develop adequate and timely mechanisms for response, prevention, signalling, and forecasting. The limited effectiveness of previous strategies, measures, and action plans under relatively stable international conditions necessitates a transition towards a new model for the functioning of global food-supply chains. Following the conflict in Ukraine, the war between Iran and the United States in the Middle East, and the sanctions policies pursued by many NATO member states, the international environment has undergone profound changes that have affected food supply chains in unprecedented ways. These developments have increased the relevance of concepts such as critical food shipments and commodities and have elevated food security to a leading priority within the international security system.

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The study employs modelling and scenario analysis to assess the potential development of various factors affecting the food system and their implications for future situations. A qualitative approach is combined with expert assessments of threats and risks. These assessments can subsequently provide a basis for research employing quantitative methods. Qualitative risk assessment involves the identification of risks, an analysis of their potential consequences, the selection of measures aimed at reducing their impact, and subsequent monitoring. SWOT analysis is employed as one of the effective methods for examining the strengths and weaknesses, opportunities and threats associated with food-supply systems. This qualitative approach is based on the comparative assessment of opposing characteristics of phenomena and processes affecting food-supply chains.

Introduction:-

The current architecture of global food-supply chains, shaped over several decades by trade liberalization and an increasingly deep international division of labour, has experienced unprecedented disruptions in recent years. Geopolitical tensions, expressed through sanctions and trade conflicts, have been compounded by the increasing

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frequency of extreme weather events associated with climate change. Together, these factors have disrupted established logistics networks and contributed to shortages of critical resources (European Commission, 2025).

The exceptionally low level of the Danube River during the summer of 2026 in Serbia, Bulgaria, and Romania virtually interrupted river-based food-supply chains serving the downstream Danube countries. Under such conditions, even countries with relatively diversified economies may face difficulties in ensuring stable access to food. This situation calls into question the sustainability of a previous model based on the concentration of production in a limited number of regions.

These vulnerabilities are particularly pronounced in countries experiencing, or located in close proximity to, low- and medium-intensity military conflicts, including Iran, Oman, Qatar, Saudi Arabia, and Ukraine. Their agri-food sectors remain highly dependent on imports in several strategically important areas. This dependence concerns not only specialized equipment, plant-protection products, and feed additives, but also a fundamental agricultural input—seed material—with the proportion of foreign hybrids for certain crops reaching critical levels (Vrabcheva, 2021; Ben Hassen and El Bilali, 2022). The emergence of new localized conflicts resulting from global geopolitical confrontation, combined with rising prices for essential food resources and increasing logistics costs, creates significant risks of food insecurity. These developments necessitate a reconsideration of traditional approaches to national food security and stimulate the search for alternative solutions.

The concept of food insecurity was used in an address by Swedish diplomat and World Food Programme Chair Carl Skau (Skau, 2026), in connection with the changing geopolitical environment and the emergence of a new form of confrontation involving the United States, China, and Russia, as well as the associated process of regionalization.

In response to these systemic threats, there is an objective need to develop a set of adaptive measures aimed both at diversifying sources of supply and at stimulating domestic production of strategically important food products. Research indicates that simply increasing production volumes does not, in itself, guarantee sustainability. It is also necessary to restructure the agro-industrial complex by moving away from narrow monocultural specialization and developing a technological base capable of reducing sensitivity to external shocks (Grozdanova, 2019).

At the same time, the experience of import substitution following 2014 should be taken into consideration. The introduction of the food embargo stimulated the development of certain sectors but did not resolve dependence on technologically complex products and inputs (Strategicheski, 2024). The purpose of this study is to substantiate strategies capable of reducing dependence on imports of critical groups of goods while simultaneously increasing the overall resilience of food supplies. Addressing this issue is directly related to national priorities concerning food independence. The synchronization of food-security strategies requires an analysis of global risk factors, an assessment of the structure of import dependence, and the formulation of practical recommendations. Taken together, these elements can contribute to a comprehensive approach to strengthening the food sovereignty and resilience of food-supply chains under contemporary geopolitical and climatic challenges.

Results:-

Food insecurity and geopolitical instability:-

Food security, as defined at the World Food Summit in 1996, encompasses physical, social, and economic access to sufficient food to meet human needs. However, in the context of escalating political conflicts, such access may be disrupted, while geopolitical instability increasingly acts as a factor destabilizing global food markets. As noted in the contemporary literature, the export potential of major agricultural regions may be constrained by disruptions to trade routes and infrastructure. Such disruptions can generate cascading effects, including increases in food prices and transportation costs. Panic buying may further contribute to temporary supply shortages (Popov, 2021). In response to food crises resulting from pandemics and armed conflicts, countries have implemented a range of mechanisms, including the accumulation of strategic reserves, subsidies for agricultural production, and price-control measures.

Disruptions to logistics and food-price volatility:-

Increasing geopolitical tensions have been accompanied by disruptions to logistics routes and rising transportation costs. In particular, maritime freight costs have increased substantially in recent years, contributing directly to higher final food prices (Sinclair and Stewart, 2026). Transportation costs constitute an increasingly significant component of overall production and distribution costs, and their increase can have a multiplier effect throughout the supply chain. Exchange-rate volatility represents an additional factor capable of amplifying fluctuations in global food prices.

During periods of uncertainty, consumers may engage in panic buying, artificially increasing short-term demand and generating temporary shortages even when overall production volumes remain sufficient. Such behaviour exacerbates the imbalance between supply and demand that is characteristic of crisis periods. At the same time, infrastructure constraints and underdeveloped domestic logistics systems can impede the rapid redistribution of food. This increases losses and reduces food availability to consumers (Popov, 2011). Consequently, the cascading effects of disrupted trade routes extend well beyond the regions directly affected.

Sanctions and food-market resilience:-

Sanctions and economic confrontation create substantially different conditions for the operation of national food markets. In economies subject to sanctions, opportunities for diversifying food sources may be significantly constrained, leaving domestic production and the accumulation of long-term reserves as the principal mechanisms for maintaining domestic supply. Under such circumstances, ensuring economic access to food for all population groups becomes increasingly important (Todorov, 2025). Continued dependence on imports for certain categories of food, combined with regional disparities in economic accessibility, further increases social risks. Addressing these challenges requires a combination of measures, including targeted support for vulnerable population groups and increased self-sufficiency in strategically important areas.

Climate change as a risk factor for global agriculture and food supplies:-

Climate-related risks, manifested through droughts and other extreme weather events, have a direct negative impact on agricultural enterprises and reduce the stability of primary production (FAO, IFAD, UNICEF, WFP and WHO, 2024). For example, extreme heat affecting France and Italy in 2026 resulted in reduced yields in important grain-producing regions. Such climatic anomalies not only reduce agricultural output but also increase uncertainty for farmers, making long-term planning and investment more difficult. Agri-food systems are inherently exposed to uncertainty and risk, affecting primary production as well as the intermediate and downstream stages of value chains. These risks extend across food-supply chains and affect actors at all stages of their operations. Consequently, a climate shock affecting agricultural production in one region can generate cascading disruptions for processors, distributors, and retailers in other parts of the world. This vulnerability is intensified by the high degree of integration and synchronization characterizing modern supply chains, whereby disruption at one stage can rapidly affect subsequent stages.

The effects of climate-related risks extend beyond production volumes to the quality of agricultural products and the logistics required for their distribution. Extreme weather events, including floods and hurricanes, can damage transport infrastructure, disrupt port operations, and interfere with delivery schedules, further destabilizing global food flows. Agri-food systems therefore demonstrate considerable sensitivity to climate change, increasing uncertainty and risk for market participants. Strengthening resilience requires the integration of mechanisms for prevention, anticipation, coping, adaptation, and transformation (Commission, 2026). Prevention involves the implementation of agricultural technologies capable of reducing dependence on weather conditions. Anticipation includes the development of early-warning and risk-forecasting systems. Coping and adaptation require flexibility in inventory management and diversification of supply chains, while transformation involves restructuring the food system to enhance its long-term resilience to a changing climate (Degaspari et al., 2026).

Economic shocks and food-price volatility:-

Sharp fluctuations in global food prices during periods of macroeconomic and political instability are driven by imbalances between global demand for and supply of agricultural commodities. Inefficiencies within supply chains, both from competitive and regulatory perspectives, together with the mechanisms linking raw-material prices to final consumer prices, can intensify price volatility. The globalization of food markets further complicates these relationships by increasing the sensitivity of prices to external shocks. The COVID-19 pandemic exposed longstanding vulnerabilities within food-supply chains and generated cascading effects. Approximately 75% of food-processing enterprises were affected by supply-chain disruptions. Border restrictions, port closures, and transportation difficulties disrupted distribution networks, reduced operational efficiency, and contributed to sudden increases in food prices (Todorov, 2025). Continuous changes in the external environment therefore require food-supply chains to adapt in order to minimize resource shortages and disruptions in supply.

Distribution costs and food-price formation:-

Approximately half of the final price of food products may be associated with the distribution sector, including distributor margins and transportation and logistics costs. The high resource intensity of food distribution, resulting from substantial logistics and transportation costs and inadequate infrastructure, creates opportunities for reducing

final consumer prices through improvements in distribution efficiency. The distribution sector therefore plays an important role in price formation and may amplify the effects of external shocks on consumer prices. The globalization of supply chains has increased transportation volumes and, consequently, delivery and logistics costs, as well as distributor margins (Sidova, 2023). The COVID-19 pandemic highlighted the vulnerabilities of global production and supply chains and demonstrated the importance of increasing their flexibility. In an environment in which external instability has become a persistent feature of economic development, enhancing supply-chain flexibility, preventing shortages and inefficient resource use, and reducing interruptions and delays in supply constitute important mechanisms for strengthening food-system resilience (Kurshumov et al., 2022).

Conclusion:-

The analysis demonstrates that regional food-supply and logistics systems within the European Union exhibit significant differences, particularly between Western and Eastern European Member States. These differences contribute to uneven physical access to food for substantial segments of the population and therefore represent an important challenge to food security within the Union. The geographical scale of the European Union and the diversity of actors operating within its food sector have resulted in a complex structure of commodity-supply chains. This structure is characterized by extensive geographical coverage, large agricultural holdings, numerous households and small and medium-sized enterprises, intermediaries, processing companies of different scales, and wholesale and retail organizations with varying levels of activity.

Food-supply chains may be short, long, or very long. This diversity encompasses both local markets and agricultural fairs as well as transnational logistics routes, significantly complicating the management of food flows and requiring differentiated approaches to logistics organization (Degaspari et al., 2026). The underdevelopment of logistics infrastructure and insufficient capacity following the transition from socialism to democracy in Eastern European Member States constitute important factors exacerbating regional disparities in food supply. The high resource intensity of distribution systems, driven by substantial transportation and logistics costs, is particularly problematic in areas characterized by poorly developed road networks and limited storage capacity. Consequently, even where production volumes are sufficient in particular regions, physical access to food for consumers in remote settlements may remain limited, thereby creating risks to food security.

Taking regional characteristics into account when developing government support measures for the agro-industrial complex and logistics projects is therefore essential for improving the stability and uniformity of food supplies. Government support for infrastructure development is of crucial importance to these strategies because it can help prevent or mitigate the effects of supply shocks. Producers and other actors in food-supply chains operating in agricultural areas with well-developed infrastructure are better positioned to respond to unforeseen disruptions (Popov, 2011). Therefore, targeted investment in logistics infrastructure—including roads, storage facilities, and wholesale distribution centres—should be regarded as a priority for reducing regional disparities, improving physical access to food, and strengthening the overall resilience of the food system.

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