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MULTIPLICATIVE NATURE OF CONTEMPORARY FOOD CRISES: GEOECONOMIC CONFRONTATION AND THE WEAPONISATION OF MARITIME CHOKEPOINTS

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Abstract. The paper *aims* to substantiate the multiplicative nature of contemporary food crises and demonstrate that the weaponisation of maritime chokepoints is the main way this occurs. Departing from the prevailing analytical convention, which examines each global food shock as a discrete episode with its own trigger, transmission channel and policy response, the study argues that the crises of the 2020s are generated multiplicatively. Instead, it argues that the crises of the 2020s are generated multiplicatively; the drivers of food insecurity not only add up, but also reinforce one another through cross-effects, the magnitude of which is determined by the concentration of export supply and the number of logistical bottlenecks simultaneously exposed to military risk. *Methodology.* The research combines systemic and structural-functional analysis, a comparative case study of three episodes of corridor disruption and a periodisation of global food mega-shocks from 2007 to 2026. It also includes a statistical analysis of the FAO Food Price Index and its commodity sub-indices, as well as the formalisation of driver interaction through additive and multiplicative specifications, complemented by a chokepoint exposure index proposed by the author. The empirical base comprises the Global Report on Food Crises 2026, the World Economic Forum Global Risks Report 2026, publications of FAO, the World Bank, IFPRI, WFP, OECD and CSIS, peer-reviewed literature on food weaponization and wartime grain logistics, and documentary evidence on the July 2026 suspension of shipping in the Ukrainian Black Sea corridor. *Results.* In all three episodes, the decisive mechanism of trade rupture was not the physical impossibility of passage, but rather the repricing of risk. For example, war-risk insurance premiums in the Black Sea increased fivefold in July 2026, while transit through the Strait of Hormuz decreased by over 70 per cent in the same year. The study identifies the depletion of both reserve capacities of the global fertiliser market, as the 2022 shock disabled the Black Sea capacity and the 2026 shock disabled the Gulf capacity that had previously absorbed it. The wheat rally in July 2026 above 7 USD per bushel, which was a three-year high, was driven by attacks on Ukrainian port infrastructure, fertiliser scarcity, and heat stress in key production regions. This is interpreted as direct empirical confirmation of the generation of multiple crises. *Practical implications.* As trade disruption occurs through financial rather than physical channels, instruments such as war-risk insurance and state guarantees for shipowners acquire the status of food policy tools. These should be complemented by keeping trade open, targeted transfers instead of universal price subsidies, regional fertiliser reserves and preventive financing calibrated to agricultural calendars. *Value / Originality.* The paper formally distinguishes between additive and multiplicative crisis generation. It introduces the concepts of dual logistical risk and exhaustion of the world fertiliser market's reserve contours. It also provides the first systematic analysis of the complete suspension of shipping in the Black Sea corridor in July 2026, comparing it with the Hormuz precedent.

Keywords: food security, geoeconomic confrontation, weaponisation of food, maritime chokepoints, Black Sea grain corridor, fertiliser markets, price transmission.

JEL Classification: F51, F52, Q17, Q18, Q34

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1. Introduction

The second quarter of the twenty-first century has confirmed that food security is an inherent aspect of international economic relations, rather than an issue affecting only the least developed economies. According to consensus estimates in the 10th edition of the Global Report on Food Crises, 266 million people in 47 countries and territories experienced acute food insecurity in 2025. However, the report's narrower coverage of 53 countries in 2024 mechanically reduced the aggregate figure, despite no real improvement in the situation (FSIN, 2026). The World Food Programme estimates that 318 million people are experiencing acute hunger, which is twice the number recorded in 2019 (Welsh et al., 2026). These figures coincide with chronic undernourishment, which affects around 673 million, or 8.2 per cent, of the world's population (FAO et al., 2025).

Crucially, this configuration of threats has emerged despite there being no physical shortage of food. World cereal production in 2026 is projected to reach 2,983 million tonnes, the second highest figure on record. Meanwhile, the global stocks-to-use ratio remains at a comfortable 32.0 per cent (FAO, 2026c). Therefore, the contemporary food crisis is a crisis of access, distribution and logistics rather than supply, with its main causes lying in international economic relations. For this reason, the 2026 Global Risks Report identified geo-economic confrontation as the risk most likely to trigger a material global crisis in 2026. This assessment was shared by 18% of respondents to the Global Risk Perception Survey. Interstate armed conflict was the second most likely risk, with 14% of respondents selecting it (WEF, 2026).

Over the past half-century, the theoretical understanding of food security has shifted from a Malthusian emphasis on overall production to multidimensional frameworks that consider agency and sustainability (Clapp et al., 2022). In parallel, a distinct strand of research on the instrumentalisation of food has emerged. The legal boundaries of using starvation as a method of warfare have been systematised (Schmitt, 2022); an analytical typology of the weaponisation of hunger in conflict and post-conflict settings has been proposed (Rodriguez Alvarez, 2024); and the mechanism by which food dependence is converted into a long-range weapon has been described (Mudie-Mantz & Werz, 2025). The empirical dimension of the problem has been explored in various studies. These include investigations into price shocks from a historical perspective (Glauber et al., 2023); the wartime logistics of Ukrainian grain exports (Yanovska et al., 2025); the impact of geopolitical risks on food provision (Zhyvko & Nahirna, 2024); and institutional support for food security amid geopolitical conflict (Kazanishen, 2025).

Nevertheless, a substantial analytical gap persists in this body of work. Traditionally, each global food shock is studied as a separate episode with its own trigger and set of policy responses. This approach implicitly assumes additivity, i.e., the view that the aggregate effect is equal to the sum of the effects of individual drivers. The events of the first half of 2026 render this assumption untenable. For the first time in recent history, two key logistical nodes of the global agri-food system were successively blocked within a single calendar year: the Strait of Hormuz, which historically served as a channel for resources, and the Black Sea grain corridor, which historically served as a channel for food.

First, the novelty of the study lies in the formal distinction between the additive and multiplicative generation of food crises, and the substantiation of the multiplicative specification as being more in line with the current empirical evidence. Second, it introduces the concepts of dual logistical risk and the exhaustion of the reserve capacities of the global fertiliser market. Third, it provides the first systematic analysis of the complete suspension of shipping in the Black Sea corridor in July 2026, comparing it with the precedent of the Strait of Hormuz.

The objective of the present paper is twofold: firstly, to provide substantiated evidence for the multiplicative nature of contemporary food crises; and secondly, to demonstrate that the weaponisation of maritime logistical nodes constitutes the principal channel through which this multiplicativity is realised. To achieve this aim, the following research tasks must be completed: distinguishing between additive and multiplicative mechanisms of crisis generation; formalising the interaction of drivers; systematising the structural preconditions of multiplicativity, particularly the concentration of agri-food markets; conducting a comparative analysis of three episodes of the weaponisation of maritime corridors; tracing the fertiliser channel through which the resource shock is transmitted into food prices; and formulating practical implications for international economic policy.

The study's methodology comprises systemic and structural-functional analysis, treating the global agri-food system as a set of interconnected nodes with nonlinear links. It also includes comparative case analysis of three logistical rupture episodes, application of the periodisation method to mega-shocks between 2007 and 2026, statistical analysis of the FAO Food Price Index, and formal and graphical modelling of driver interaction. The presentation follows a logical sequence of tasks. First, the theoretical model of multiplicativity is substantiated. Then, the weaponisation of maritime corridors is examined empirically as the mechanism of its realisation. Finally, the fertiliser transmission channel is traced and conclusions are formulated.

2. The Multiplicative Model of Food Crises

The methodological basis for the quantitative differentiation of the drivers of food crises is the approach of the Global Network Against Food Crises, which identifies primary, secondary and tertiary drivers for each country, assigning to the basic triad conflict and insecurity, climate extremes and economic shocks. The 2025 distribution clearly shows a hierarchy: the conflict driver was the main cause for 147.4 million people, the climate driver for 87.5 million, and the economic driver for 29.8 million (FSIN, 2026). This statistic is most often interpreted additively, with the sum of the three components approximately reproducing the aggregate figure. Policy recommendations are then constructed on the principle of responding to each driver separately.

The additive logic can be expressed as a linear specification, whereby the increase in acute food insecurity is calculated as a weighted sum of the intensities of individual shocks:

$$\Delta F = \sum_{i=1}^{3} \alpha_i S_i$$

where ΔF is the increment of acute food insecurity; S_i is the intensity of the i-th shock (conflict, climate, economic); and αi is the coefficient of sensitivity of the system to the corresponding shock.

The problem with specification (1) is not its mathematical incorrectness, but its empirical inadequacy. The primary-driver methodology is a classification convention rather than a description of causality; it assigns a country to a single dominant category when, in reality, the drivers operate simultaneously and through shared channels. It is significant that the economic channel – prices, incomes and exchange rates – operates even where it is not formally recognised as the primary driver, since it is this channel that converts local military or climate-related disruptions into global price impulses. Yemen is an emblematic example of the intersection of all three drivers, where conflict-induced import restrictions, currency devaluation and climate shocks have produced a situation in which 63 per cent of households are unable to meet their minimum food requirements (FSIN, 2026).

A multiplicative specification, which supplements the linear terms with cross-effects of interaction, is more adequate:

$$\Delta F = \sum_{i} \alpha_i S_i + \sum_{i<j} \beta_{ij} S_i S_j + \gamma S_1 S_2 S_3$$

where β_{ij} are the coefficients of pairwise interaction of shocks and γ is the coefficient of triple interaction. Multiplicativity in the formal sense means the positivity of the second mixed derivatives, that is $\partial^2 \Delta F / \partial Si \partial S_j > 0$: the marginal damage of a climate shock is higher in an economy already in conflict, and the marginal damage of a price shock is higher where the harvest has already been lost. This property is empirically supported by studies of the impact of economic growth and food inflation on food insecurity. These studies record how household responses to price pressure depend on initial income levels (Bogmans et al., 2024).

The key question is what determines the magnitude of the coefficients β_{ij}. The answer lies in the structure of the global agri-food trade. According to estimates cited by A. Husain and based on data from the United States Department of Agriculture, seven exporters account for around 84 per cent of global wheat exports, six countries account for over 92 per cent of maize exports, and fewer than five states hold between 70 and 90 per cent of global cereal stocks. Meanwhile, China accounts for around a quarter of global fertiliser production (Husain, 2026). With this type of architecture, a local shock to any key node, whether military, climatic or regulatory, almost automatically has a global price impact. Concentration converts an additive system into a multiplicative one: the fewer the independent suppliers, the higher the probability that two shocks affecting different areas will strike the same node.

The second structural amplifier is the small number of maritime logistics nodes through which essential food and resource supplies pass. To formalise this dimension, a chokepoint exposure index is proposed:

$$CRI = \sum_{k} w_k \varphi_k \left(1 - r_k\right)$$

where w_k is the share of world trade in a critical commodity passing through the k-th logistical node; φ_k is the intensity of disruption of that node, normalised between zero and one; and r_k is the substitution coefficient reflecting the capacity of alternative routes to absorb the displaced flow. The structure of the r_k coefficient is of fundamental importance: if two nodes serve as mutual reserve contours, their simultaneous or successive disruption causes r_k to approach zero for both nodes, and the index increases in a stepwise manner rather than additively. Such a configuration precisely emerged in 2026, which is examined in detail below.

A key feature of the multiplicative model is the presence of reinforcing feedback loops. A food crisis not only results from shocks, but also generates conditions that lead to subsequent crises. For example, losses of human capital and GDP increase an economy's vulnerability to future disturbances, while humanitarian financing contracts during the escalation phase of crises, when donor budgets are under pressure from competing priorities. Figure 1 presents a generalised scheme of the multiplicative interaction of drivers.

The categorisation of the global food crises of the last two decades enables the model to be tested against historical events. The five episodes summarised in Table 1 have different triggers and dominant channels of impact. Yet they all share one key structural feature:

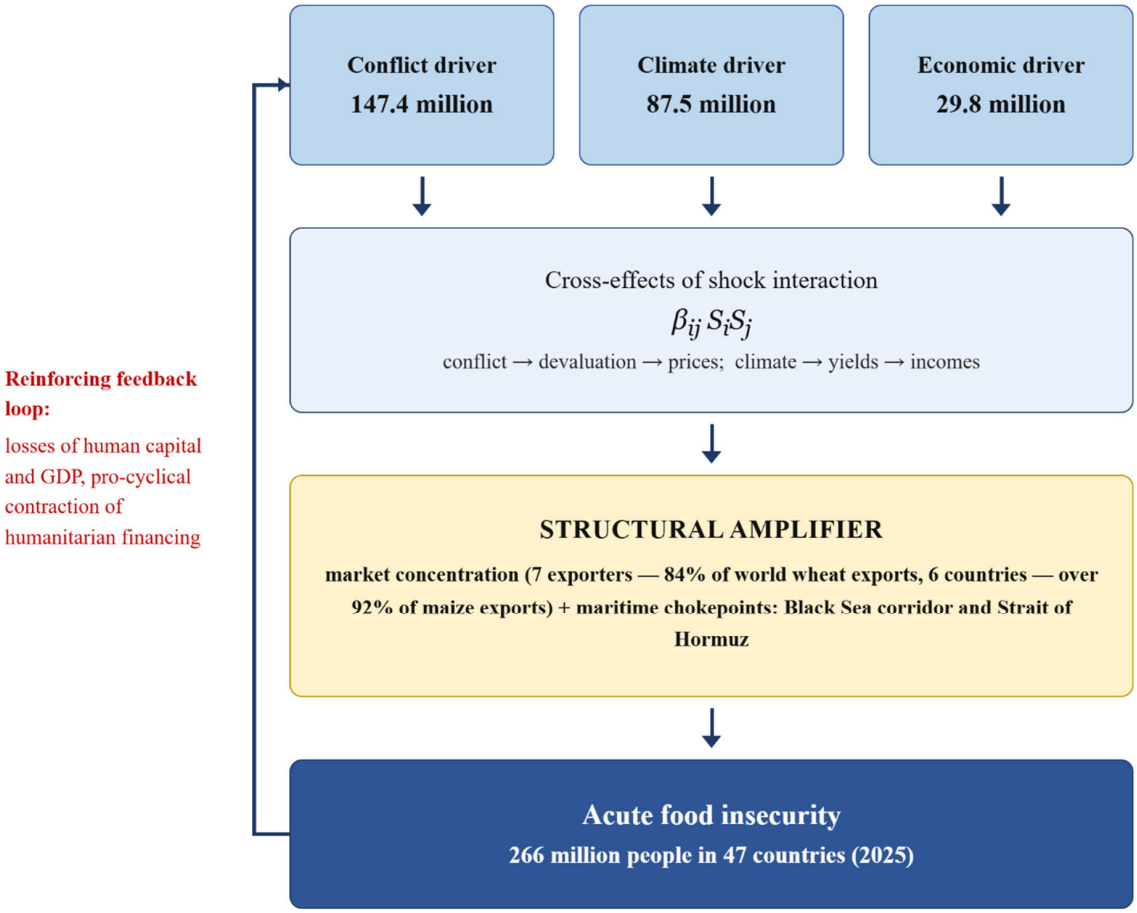


Figure 1. Scheme of the multiplicative interaction of the drivers of food crises

Source: developed by the authors based on (FSIN, 2026; Husain, 2026)

none were caused by a global production deficit. Each was triggered by events in one or two countries or logistical points.

A comparison of the episodes reveals a clear evolutionary tendency. The 2007–2008 and 2010–2011 crises unfolded mainly through the price channel, amplified by waves of export restrictions. The 2020 pandemic shock demonstrated the dominance of the income and logistics channels for the first time under adequate physical supply. The 2022 crisis combined a blow to the food supply with a blow to the resource markets, while the 2026 Middle East conflict is predominantly resource-based, with pronounced lagged consequences. With each successive episode, weight is acquired not by food channels as such, but by infrastructural and resource channels; precisely those that are most susceptible to deliberate weaponisation.

The geopolitical risk index is a quantitative instrument for measuring the geopolitical component of these risks. It is constructed based on the frequency of references to adverse geopolitical events in the world's leading press. Peak values were reached during the two world wars, and the challenges of recent years include the war against Ukraine and the COVD-19 pandemic (Zhyvko & Nahirna, 2024). For this study, this approach is important because it enables geopolitical tensions to be treated as a quantified variable in economic analysis rather than as a background condition. In other words, it allows them to be considered as a fully fledged argument in the function specified by equation (2).

The theoretical part of the study therefore suggests the following interim conclusion: contemporary food crises are generated multiplicatively, and the magnitude of cross-effects is determined by two structural parameters: the concentration of export supply, and the number of logistical nodes that are simultaneously exposed to military risk. The following section tests this proposition against the empirical evidence of 2022–2026.

3. Weaponisation of Maritime Corridors

Using food as a means of exerting pressure is not a new phenomenon, yet the contemporary form of this practice has one key difference: it is not the product itself that is weaponised, but rather the infrastructure

Table 1

Comparative characteristics of global food mega-shocks, 2007–2026

Crisis (period)	Trigger event	Dominant channel of impact	**Key structural lesson**
Food and fuel crisis, 2007–2008	Surge in energy prices, growth of biofuel demand, financial and commodity volatility	Price channel, amplified by a wave of export restrictions	Vulnerability of the system to energy prices, speculative volatility and trade protectionism
Price crisis, 2010–2011	Weather shocks in key exporting countries	Price and trade-policy channels	Food prices are a factor of political stability; the high cost of delayed response
Pandemic shock, 2020	COVID-19 pandemic and global recession	Logistics and income channels	Income is the dominant factor of insecurity; the fragility of global logistics
Crisis of 2022	Full-scale invasion of Ukraine by the Russian Federation, a war against a systemic agri-food exporter	Dual: food supply and resources (fertilisers, energy)	The danger of concentrating grain and fertiliser markets among a limited circle of suppliers
Middle East conflict, 2026	Closure of the Strait of Hormuz (February–April 2026)	Resource channel (energy, fertilisers, sulfur) with a lagged structure	Vulnerability of logistical chokepoints; convergence of energy, resource and food risks

Source: compiled by the authors based on (Husain, 2026; FSIN, 2026; FAO, 2026a; Glauber et al., 2023)

that moves it. Existing literature distinguishes between the direct deprivation of food from civilian populations as a method of warfare and the indirect influence on global markets through blocking trade flows (Schmitt, 2022). It also records the systematic weaponisation of hunger in conflict and post-conflict settings as a means of controlling populations and territories (Rodriguez Alvarez, 2024) and describes food as a long-range weapon whose effects are realised at considerable geographical distances from the theatre of hostilities, impacting countries not involved in the conflict that depend critically on supplies (Mudie-Mantz & Werz, 2025). This last mechanism is the subject of the present section.

The first episode examined is the blockade of Ukrainian Black Sea ports in 2022. Its systemic significance was determined by Ukraine's pre-war weight in world trade: before the full-scale war the country accounted for more than 15 per cent of world maize exports, about 10 per cent of wheat, 15–20 per cent of barley and more than 50 per cent of sunflower oil. The logistical vulnerability of this position was critical. In peacetime, over 70 per cent of Ukrainian grain production was destined for export, with more than 90 per cent of these exports passing through Black Sea ports (Yanovska et al., 2025). The blockade halted maritime supplies effectively, prompting an immediate response from the world market: the FAO Food Price Index reached an all-time high in March 2022, while fertiliser markets entered a crisis of their own.

The institutional response was the Initiative on the Safe Transportation of Grain and Foodstuffs from Ukrainian Ports. This was signed in Istanbul on 22 July 2022, following mediation by the United Nations and Turkey. It established a Joint Coordination Centre to inspect vessels (UN, 2023). During its operation, about 60 per cent of all Ukrainian grain and food exports passed through the maritime corridor, while Africa accounted for over 27 per cent of wheat shipments, with 23 per cent of this going to countries experiencing humanitarian crises (Dankevych, 2022). The Russian Federation's withdrawal from the Initiative on July 17, 2023, and Ukraine's subsequent establishment of its own maritime corridor in September 2023, revealed a key feature of the mechanism: it was not the product that was weaponised, but the shipping security regime itself.

The second episode is the closure of the Strait of Hormuz resulting from the Middle East conflict that unfolded from February 2026 until agreements were reached in early April. This episode's defining feature is its resource-based nature rather than its food-based nature: while no direct grain deficit arose, energy, fertiliser and sulphur markets came under pressure. The logistical aspect of the closure was clearly influenced by insurance considerations: strikes against tankers had made marine insurance premiums in the region prohibitively expensive. Consequently, shipping through the Strait fell by over 70 per cent from the start of the conflict. In early March, the largest container carrier, Maersk, suspended bookings for the Persian Gulf (Glauber, 2026; Abramovych & Mazurenko, 2026). Attempts at external stabilisation, such as the introduction of naval escorts and war-risk insurance programmes, were unable to offset the de facto closure of the strait.

The third episode, which unfolded in July 2026, is of particular significance to this study since it replicates the Hormuz precedent in the Black Sea theatre. The chronology of escalation is as follows: on July 13, a strike on a Togo-flagged vessel unloading mineral fertilisers in the port of Odesa killed five people and injured ten; on July 14, two more people were killed aboard another civilian cargo vessel; on July 19, three cruise missiles struck a Guinea-Bissau-flagged bulk carrier leaving the Black Sea corridor with a cargo of

grain, killing ten people; on July 22, two further bulk carriers were hit by drones in the ports of Odesa and Chornomorsk (Fenbert, 2026). The Odesa regional prosecutor's office reported that 28 commercial vessels were attacked over the course of the month and that 21 seafarers and port workers were killed (The Maritime Executive, 2026).

The market reaction was immediate and echoed the Hormuz precedent. On July 22, 2026, the Danish shipping company Maersk announced the suspension of its Ukrainian service via the port of Chornomorsk. Cargoes were rerouted to Constanța in Romania. On the same day, no vessels passed through Ukraine's Black Sea maritime corridor for the first time since its establishment in 2023 (Fenbert, 2026; Lysenko, 2026a). War-risk insurance rates increased fivefold, and crews began demanding hazard premiums equalling double or triple their wages. Consequently, a call at a Ukrainian port lost its economic rationale (Trachuk, 2026). The mechanism of trade rupture was the same as in the Strait of Hormuz: not physical impossibility of passage, but an increase in the price of risk.

Ukrainian diplomacy characterised the situation in the same way, viewing it as a reproduction of the Hormuz precedent rather than a local episode, and requesting an urgent meeting of the United Nations Security Council on July 27, 2026 (Interfax-Ukraine, 2026; Fenbert, 2026).

Table 2 provides a systematic comparative characterisation of the three episodes of weaponised maritime corridors. The comparison reveals a consistent underlying structure of the mechanism, despite different triggers and commodity flows.

The question of route substitution requires separate consideration, since it is the substitution coefficient r_k in specification (3) that determines whether a logistical rupture becomes a price shock. The experience of 2022–2024 provides a clear answer: over the nineteen months from March 2022 to August 2024, 77.5 per cent of grain exports continued to be shipped through Black Sea ports. Only 5.6 per cent were transported by road and 15.7 per cent by rail. In peacetime, the proportion of exports transported by sea was 90 per cent (Yanovska et al., 2025). In other words, despite years of efforts to develop alternative corridors, the flow was unable to be replaced by land and river routes by more than approximately one fifth.

The substitution constraints in 2026 are even more severe. Danube terminals have limited throughput capacity and channel depth, and the logistical loop still closes at overloaded Constanța. Low water levels and droughts in Europe further complicate river navigation. Delivering a container by road from a European port costs several times more than sea freight, and the rail route encounters limited border crossing capacity (Trachuk, 2026; Yanovska et al., 2025). Another factor is that the flow of imports of equipment, fuel and components is also paralysed, creating a negative feedback loop in the agricultural sector's production costs.

The empirical evidence therefore confirms the model's central proposition: the weaponisation of maritime logistical nodes is not merely a manifestation of the conflict driver, but a mechanism that converts local military shocks into global price impulses by bypassing physical supply and demand balances. The decisive factor is the price of risk rather than the physical capacity of infrastructure, and the key constraint is the low degree to which routes can be substituted.

4. The Fertiliser Channel and Price Transmission

The clearest confirmation of the multiplicative nature of contemporary crises comes from the fertiliser sector. The successive shocks of 2022 and

Table 2
Comparative analysis of episodes of the weaponisation of maritime corridors

Comparison parameter	Black Sea, 2022	Strait of Hormuz, 2026	Black Sea, July 2026
Trigger of rupture	Naval blockade of ports at the outset of the full-scale war	Hostilities and strikes on tankers in the Persian Gulf	Systematic strikes on civilian vessels and port infrastructure
Commodity orientation of the displaced flow	Grain, oils, fertilisers	Energy carriers, fertilisers, sulphur, ammonia	Grain, oils, imports of equipment and fuel
Mechanism of rupture	Physical blockade, subsequently the regime of shipping security	Prohibitive cost of war-risk insurance	Jump in insurance costs and crew hazard premiums
Quantitative indicator	Over 90% of pre-war maritime exports halted	Transit reduced by more than 70%	Insurance rates up fivefold; zero traffic on 22 July
Institutional response	Black Sea Grain Initiative (July 2022), EU Solidarity Lanes	Naval escorts, war-risk insurance programmes	Request for an urgent meeting of the UN Security Council (27 July 2026)
Capacity for route substitution	Low: rail and road absorbed about 21% of the flow	Low: the Red Sea reserve channel weakened	Low: limited Danube capacity and an overloaded Constanța

Source: compiled by the authors based on (UN, 2023; Glauber, 2026; Shamim, 2026; Yanovska et al., 2025; Fenbert, 2026; The Maritime Executive, 2026; Trachuk, 2026)

2026 demonstrated the interdependence of the world market's reserve contours. In 2022, the blockade of Ukrainian ports not only cut off grain exports, but also Ukrainian fertiliser exports. Meanwhile, the Russian Federation, which produces around a quarter of the world's raw materials for mineral fertilisers, immediately restricted shipments, using its control of resources as a lever of pressure. At that time, the world market was significantly compensated for losses through supplies from the Persian Gulf (Glauber et al., 2023; Welsh et al., 2026).

By 2026, the contour that had absorbed the shock of the Black Sea four years earlier was itself blocked. The arithmetic of the world's agricultural dependence on fertilisers from the Persian Gulf is more severe than its dependence on energy from the region: almost half of the global urea trade, the most widely used nitrogen fertiliser, passes through the Strait of Hormuz. The Gulf region accounts for around 20 per cent of global fertiliser exports and 46 per cent of the global urea supply. The Qatari company QAFCO alone provides around 14 per cent of the global urea market. If the closure had persisted, up to one-third of the world's fertiliser trade could have been disrupted (Shamim, 2026). This forms the basis of the thesis on the exhaustion of reserve contours: two successive shocks disabled the world fertiliser market's two main insurance mechanisms, and the substitution coefficient r_k in specification (3) simultaneously approached zero for both nodes.

The shock also propagated along the production chain. Following strikes on gas infrastructure, QatarEnergy, a Qatari company, shut down the world's largest urea plant. India reduced output at three of its own facilities due to a liquefied gas shortage. Bangladesh halted four of its five fertiliser plants. The United States entered the season with a deficit of around a quarter of its seasonal requirements (Shamim, 2026). The price reaction was immediate. As of March 5, 2026, Middle Eastern urea had closed above 590 USD per tonne, marking a 19 per cent increase within a week. Meanwhile, United States DAP had reached 655 USD per tonne. By mid-March, the price of urea had surpassed 700 USD per tonne, representing an increase of around 40 per cent compared to pre-conflict levels and almost 60 per cent compared to the previous year. Following this, prices effectively doubled (Glauber, 2026). Between February and March, the increase amounted to 46 per cent. Fertiliser prices for farmers in various regions increased by 20–60 per cent, and exports of approximately 3.9 million tonnes of fertiliser were suspended. This equates to 30 per cent of the Gulf countries' annual fertiliser exports (Torero, 2026; Vos, 2026).

The geography of dependence determines the geography of vulnerability. Asian countries obtained 35 per cent of their imported urea, 53 per cent of their sulphur and 64 per cent of their ammonia from the Gulf. India imports more than 40 per cent of its urea and phosphates from there, and Brazil imports about half of all its fertilisers (Shamim, 2026). The timing is also crucial: the disruption occurred at the height of the Northern Hemisphere's sowing season, when decisions on fertiliser application are made without the option of postponement. As the largest importers of fertilisers from the Gulf are India, Brazil and China – which are also among the largest producers of food – a reduction in application rates directly creates the risk of a decline in the global supply of staple crops the following year.

A comparison of the marginal effects of the two fertiliser crises is instructive. Even after the 2026 price surge, prices remained below the late 2021 and early 2022 records. At that time, farmers were able to offset the effects of the fertiliser crisis with high grain prices. Now, however, they are facing the crisis with low grain prices, which has had a comparable or even more severe impact on profitability (Glauber, 2026; Shamim, 2026). This directly illustrates multiplicativity: an identical price shock produces different consequences depending on the state of the system's other variables.

The lagged structure of the resource shock determines the timescale of its impact on food security. According to current estimates, the fertiliser market will not return to normal before the end of 2026. Under a pessimistic scenario, imbalances will persist until 2028, meaning the main food consequences are yet to come in subsequent harvest cycles (FAO, 2026a; Vos, 2026). The World Food Programme has estimated that the continuation of the conflict could add up to 45 million people to those in acute hunger as early as mid-2026 (WFP, 2026).

The price transmission in 2026 can be traced through the dynamics of the FAO Food Price Index. After reaching a local maximum in August 2025, the world market entered the Hormuz shock from a comparatively soft price background. The index then declined for five consecutive months, reaching 124.1 points in January 2026. During this period, the cereal sub-index stood at 107.5 points, which was 3.9 per cent below the level recorded a year earlier (FAO, 2026b). The reaction was rapid but uneven across sectors. Between January and April 2026, the composite index rose by 5.6 per cent to reach 131.0 points, its highest level since the beginning of 2023. Almost all of this increase was driven by the vegetable oils sub-index, which surged from 168.6 to 193.9 points – an increase of 15.0 per cent – in response to higher oil prices through the biofuel channel and rising production cost expectations. In contrast, the cereal sub-index rose more modestly to reach 111.3 points. This asymmetry confirms the resource-based rather than food-based nature of the 2026 shock.

The May structure of the index is indicative of the depth of sectoral divergence. The composite indicator

stabilised at 130.8 points, representing a month-on-month decrease of 0.2 per cent and an annual increase of 2.9 per cent. The cereal sub-index rose by 2.6 per cent to 114.3 points. This occurred against the backdrop of lower expected harvests in key exporters and higher fuel and fertiliser costs. Conversely, the oils sub-index declined for the first time since the beginning of the year, by 4.6 per cent to 185.0 points, primarily due to palm and soybean oil. However, sunflower oil continued to appreciate owing to persistent supply tightness. The annual divergence is more pronounced: vegetable oils increased by 21.6 per cent, meat by 6.3 per cent and cereals by 4.9 per cent, whereas dairy products fell by 22.4 per cent and sugar by 13.1 per cent (FAO, 2026b).

June 2026 provided a counterpoint of fundamental importance for the argument of this paper. The composite index declined to 130.3 points, and the cereal sub-index fell by 3.5 per cent. The Black Sea factor was identified as a key influence on these developments, with the rapid progress of the harvest and strong export prospects in the Black Sea region exerting pressure on global wheat prices (FAO, 2026c). To summarise, it can be posited that in June, the Black Sea supply functioned as a price stabiliser for the resource shock; in its absence, it is hypothesised that the fertiliser crisis would have been transmitted into cereal prices with greater rapidity and completeness. The dynamics of the sub-indices for 2026 are presented in Figure 2.

In July 2026, this configuration was reversed, thereby providing, in effect, a natural experiment for testing the multiplicative hypothesis. Following the suspension of shipping in the Black Sea corridor, wheat quotations on the leading exchanges exceeded 7 USD per bushel, reaching the highest level in three years. Analysts attribute this increase to three factors: regular strikes on Ukrainian port infrastructure, which restrict export capacity and reduce world supply; the fertiliser deficit; and unfavourable weather conditions, in particular abnormal heat in key agricultural regions of the world (Lysenko, 2026b). This constitutes direct empirical confirmation of specification (2): three drivers, conflict-related, resource-related and climatic, operated simultaneously, and it was their superposition rather than any one of them separately that pushed the market to a three-year high under comfortable global grain balances.

The distribution of the effect is asymmetric, a fact which is fundamental to understanding the geoeconomic logic of weaponisation. Ukrainian producers did not benefit from the rally in world prices. Complicated logistics and limited export channels mean they are forced to sell their harvest at reduced prices to secure working capital. The gap between domestic and world prices will persist until effective export routes are restored (Lysenko, 2026b). Losses from halting deep-water exports are estimated at around 900 million USD in foregone foreign currency earnings per month

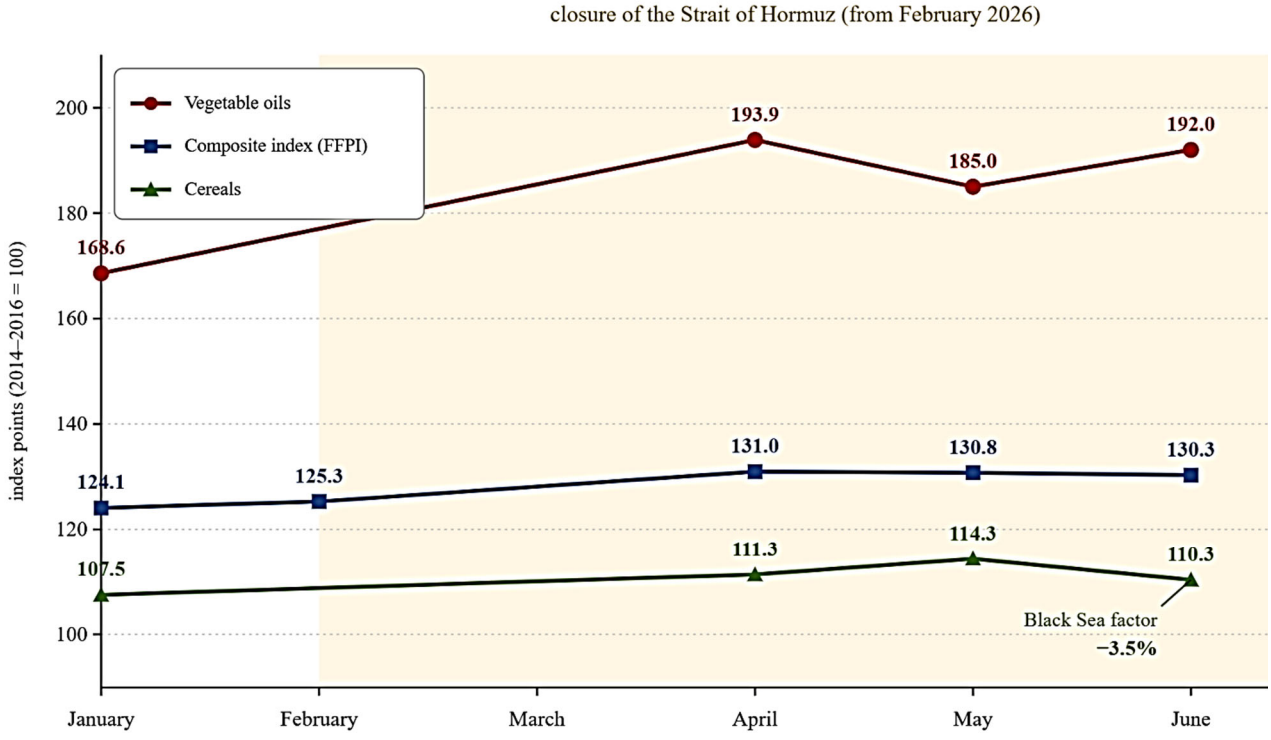


Figure 2. Dynamics of the FAO Food Price Index and its cereal and vegetable oil sub-indices in 2026

Source: compiled by the authors based on (FAO, 2026b; FAO, 2026c)

(Trachuk, 2026). Therefore, the weaponisation of the corridor not only raises world prices, but also redistributes rent from the attacked exporter to its competitors.

The analysis has a number of practical implications. Firstly, the key lesson from the 2007–2008 mega-shock remains highly relevant: the wave of export restrictions that followed the price surge transformed it into a global crisis. Therefore, keeping trade open is a priority (Torero, 2026). Secondly, targeted transfers to vulnerable groups are more effective than universal price subsidies, as the latter exhaust government finances precisely when there is less budgetary room and distort market signals. Thirdly, regional strategic fertiliser reserves should be formed, since the exhaustion of reserve stocks proved to be a critical vulnerability in 2026. Fourthly, mechanisms such as the IMF food shock window should be reoriented towards financing critical fertiliser imports, with recipients prioritised according to agricultural calendars (Vos, 2026).

Fifthly, analysis of the three episodes shows that financial infrastructure is the key instrument for stabilisation, rather than physical infrastructure. Trade disruptions are primarily driven by a sharp increase in the price of risk. Consequently, war-risk insurance schemes and state guarantees for shipowners, as well as cargo buyers, become essential instruments of global food policy. Adopting a medium-term perspective adds a counterpoint: according to projections by the OECD and FAO, real world prices for agricultural products are expected to decline moderately over the next decade as productivity increases (OECD & FAO, 2025). This is not contradictory: a long-term downward trend in real prices can coexist with an increase in the frequency and amplitude of short-term shocks. Therefore, the central problem becomes not the level of prices as such, but their volatility.

5. Conclusions

The study conducted provides grounds for the following conclusions.

Firstly, contemporary food crises are generated multiplicatively rather than additively. The classification methodology, which identified the primary driver as the conflict factor for 147.4 million people, the climate factor for 87.5 million, and the economic factor for 29.8 million, is an accounting convention rather than a description of causality. The formalisation of interaction through the cross-effects $\beta_{ij}S_iS_j$ reflects the empirical evidence more adequately, since the marginal damage of each shock increases in the presence of others.

Secondly, the scale of the cross-effects depends on the concentration of the export supply and the number of logistical nodes that are simultaneously exposed to military risk. For example, an architecture in which seven exporters account for around 84 per cent of global wheat exports and six countries account for over 92 per cent of global maize exports means that any local shock at a key node has global consequences.

Thirdly, a comparative analysis of three episodes – the blockade of the Black Sea in 2022, the closure of the Strait of Hormuz from February to April 2026, and the suspension of the Black Sea corridor in July 2026 – reveals a single mechanism of trade rupture: not the physical impossibility of passage, but an increase in risk premiums. Shipping through the Strait of Hormuz fell by more than 70 per cent and war-risk insurance rates in the Black Sea rose fivefold. On July 22, 2026, no vessel passed through the corridor for the first time since 2023.

Fourthly, the exhaustion of the world fertiliser market's reserve contours has been identified as a phenomenon: the 2022 shock disabled the Black Sea contour, and the 2026 shock disabled the Persian Gulf contour, which had absorbed the consequences of the first shock until then. Since almost half of the world's urea trade passes through Hormuz, the simultaneous disruption of both nodes means that the substitution coefficient approaches zero and systemic risk increases step by step.

Fifthly, the events of June and July 2026 constitute a natural experiment that empirically confirms the multiplicative hypothesis. In June, the supply from the Black Sea acted as a shock absorber for the resource shock, reducing the FAO cereal sub-index by 3.5 per cent. In July, following the suspension of the corridor, wheat quotations exceeded 7 USD per bushel – a three-year high – due to the combined impact of port strikes, a fertiliser shortage and extreme heat. The market reached this level despite comfortable global grain balances, ruling out an explanation based on a supply deficit.

Sixthly, the weaponisation of the corridor has a significant redistributive impact: while global prices increase, Ukrainian producers are forced to sell their produce at a reduced price due to logistical constraints, resulting in an estimated loss of foreign currency earnings of around 900 million USD per month. This combines global price pressure with the displacement of exporters from traditional markets.

Seventhly, the security of trade corridors becomes a global public good. Since trade disruption occurs through financial rather than physical channels, priority policy instruments include war-risk insurance and state guarantees for shipowners to keep trade open; targeted transfers instead of universal subsidies; regional fertiliser reserves; and financing critical imports according to agricultural calendars.

Prospects for further research are associated primarily with the empirical calibration of the cross-interaction coefficients β_{ij} on panel data with an extended time

horizon, which would allow the proposed specification to be moved from the analytical to the predictive plane. Another area of focus is the operationalisation of the chokepoint exposure index for a wider range of logistical nodes, as well as the design of collective war-risk insurance mechanisms for shipping. These mechanisms would provide a global public good on an institutional level.

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