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Stability of food security in EU member states – does the common agricultural policy ensure resilience of food systems during crises?

Stabilność bezpieczeństwa żywnościowego w krajach członkowskich UE – czy wspólna polityka rolna zapewnia odporność systemów żywnościowych w czasie kryzysów?

Abstract

The COVID-19 pandemic and the Russian Invasion of Ukraine caused a global recession, not only by disrupting supply chains, raising inflation, and increasing public indebtedness, but also by destabilising global food markets. The resulting food shortages, along with the negative impact on the economic availability of food products, have made global inequalities more pronounced and exacerbated the problem of food insecurity. This study assesses the level and the stability of food security in the European Union (EU), compared to the rest of the world, and attempts to determine whether the common agricultural policy (CAP) has achieved its stated aim of creating resilient food systems. The stability of the first three dimensions of food security in various countries around the world was assessed based on the Global Food Security Index (GFSI). Research shows that food security in the EU is very good by world standards, as evidenced by the fact that 12 of the top 20 GFSI countries are EU member states. The CAP is shown to improve food security in EU member states and stabilises its already high level.

Keywords: CAP, COVID-19, Food security, Russian Invasion of Ukraine.

JEL: F52, Q18

Streszczenie

Pandemia Covid-19, a następnie inwazja Rosji na Ukrainę spowodowała globalną recesję, zakłócenia łańcuchów dostaw, wysoką inflację, wzrost długu publicznego, ale także niestabilność na rynkach żywności w skali globalnej. Wynikające z tych wydarzeń niedobory żywności, a także pogorszenie dostępności ekonomicznej produktów spożywczych pogłębiły nierówności na świecie i zaostrzyły problem braku bezpieczeństwa żywnościowego. Celem badania była ocena poziomu i stabilności bezpieczeństwa żywnościowego krajów UE na tle innych krajów świata oraz odpowiedź na pytanie, czy wspólna polityka rolna (WPR) spełniła swoją rolę w tworzeniu odpornych systemów żywnościowych. Ocenę stabilności trzech wymiarów bezpieczeństwa żywnościowego w różnych krajach świata dokonano w oparciu o Globalny Indeks Bezpieczeństwa Żywnościowego (GFSI). Badania wykazały, że sytuacja w zakresie bezpieczeństwa żywnościowego w UE jest bardzo dobra na tle świata, o czym świadczy fakt, że wśród 20 krajów o najwyższym wskaźniku GFSI aż 12 to kraje UE. WPR jest czynnikiem zarówno poprawiającym bezpieczeństwo żywnościowe w państwach członkowskich UE, jak i stabilizującym jego i tak już wysoki poziom.

Słowa kluczowe: WPR, Covid-19, bezpieczeństwo żywnościowe, inwazja Rosji na Ukrainę.

JEL: F52, Q18

1. Introduction

The onset of the COVID-19 pandemic, the Russian Invasion of Ukraine, and the subsequent surge in inflation worldwide (the highest in decades), have triggered significant disruptions in the global agricultural market. As a consequence, food security has once again emerged as a focal point on the international agenda and a subject of extensive discourse in the economic literature. The Russian Invasion of Ukraine has not only impacted agricultural commodity markets, but also fuel and fertilizer markets. These shocks compound earlier disruptions in the supply chain attributed to the COVID-19 pandemic, coupled with an unexpectedly robust rebound in global demand and inflationary pressures. The resultant food shortages, along with the negative impact on the economic accessibility of food products, have made global inequality more pronounced and intensified food insecurity, particularly in the most economically vulnerable countries. This has had severe repercussions for households with the lowest incomes. Nevertheless, the magnitude and multifaceted nature of these events have also prompted a reevaluation of the level of food security in developed countries.

These crises naturally raise concerns about the stability of food security in the EU. Europe, particularly the EU member states, is acknowledged as having the highest level of food security in the world. This encompasses both physical and economic access, as well as nutritional quality. The pivotal role in maintaining this status is attributed to the EU CAP. Nevertheless, any comprehensive discourse on food security requires that its first three dimensions (availability, access, and utilisation) be examined in order to ensure stability and resilience against unforeseen disruptions. The present study evaluates the stability of food security in EU member states relative to the rest of the world during the agricultural market shocks experienced between 2019 and 2022. It further seeks to ascertain whether the CAP has effectively fulfilled its role in establishing robust food systems. This paper makes a significant contribution to the existing literature on food security by examining the seldom-explored fourth dimension of food security, i.e. stability. It establishes a causal link between the incorporation of the CAP mechanisms and the stability of food security. This research is particularly pertinent in view of recent crises, and presents a distinctive opportunity to scrutinize the efficacy of the CAP mechanisms.

The subsequent sections of this article are structured as follows. Section 2 elucidates the concept of food security and discusses its dimensions, pointing out the potential threats stemming from contemporary crises, including the COVID-19 pandemic and the Russian Invasion of Ukraine, on the basis of a review of the latest literature on the subject. Section 3 examines food security under the EU CAP, and discusses the challenges raised by the European Green Deal (EGD). Section 4 utilises the GFSI to evaluate the stability of the first three dimensions of food security in various countries around the world. Section 5 presents the conclusions.

2. Contemporary challenges for food security

Food security is defined by the Food and Agriculture Organization (FAO) of the United Nations as 'a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life' (FAO, 2015). Food security has to be guaranteed simultaneously in all its four dimensions, viz. availability, access (economic and physical), utilisation, and the long-term stability of the preceding three.

Food availability refers to the supply side of food security, and is determined by the level of food production, the balance of foreign trade in food, the possibilities of storing and processing food, and food aid programs (Carletto et al., 2013). However, physical availability at the global, national, or even local, levels does not guarantee the economic availability of food, as this is determined by the level of household income, food prices, and the efficiency of markets, including the infrastructure supporting food distribution and the social welfare system.

Another dimension of food security is related to the proper utilisation of food. This dimension results from the fact that food security means not only eliminating of hunger, but also meeting energy and nutritional needs. A balanced and healthy diet requires a knowledge of which foods contain which essential nutrients, an ability to prepare food so that it is fit for human consumption, and the provision of adequate sanitary and hygienic conditions. Food utilisation also refers to socially and culturally accepted food that does not change eating habits and does not negatively impact the natural environment (Poczta-Wajda, 2018).

Full food security prevails when the three previous conditions of food security (availability, access and utilisation) are constantly guaranteed at the general population, household, and individual levels, and is impervious to sudden, unforeseen events (Gulbicka et al., 2015), i.e. it should not be susceptible to adverse natural conditions (e.g. natural disasters, epidemics), political instability (e.g. armed conflicts, trade wars), or economic instability (e.g. unemployment, food price fluctuations). The last four years have seen several events that have constituted a serious challenge for the fourth dimension of food security, viz. stability. Nevertheless, even before the outbreak of the COVID-19 pandemic, the growing number of people facing food insecurity posed a considerable challenge for the international community, while deepening inequalities and climate change seriously threatened the stability of food systems.

The COVID-19 pandemic has had a profound impact on the global economy, disrupting trade flows and causing labour shortages (Alabi & Ngwenyama, 2023). Policy responses, particularly lockdowns and social distancing requirements, have caused major disruptions to supply chains. As a result, real world gross domestic product (GDP) per capita decreased by 3.3% in 2020, while the number of jobs decreased by 114 million (ILO, 2021).

The pandemic has also exposed the fragility of the world's complex food supply chains. The disruptions caused by COVID-19 have been multidimensional and have included labour shortages, input shortages, production interruptions, and trade

restrictions. They have reduced the flow of food from farms and producers to final consumers, and have increased food prices, as well as the amplitude and frequency of their fluctuations (Alabi & Ngwenyama, 2023; Laborde et al., 2020). Although these disruptions have negatively impacted food security globally, some regions have proven more resilient than others. Restrictions on grain exports during the COVID-19 pandemic caused food price spikes and made food security more fragile, especially in low- and middle-income countries (Falkendal et al., 2021; Laborde et al., 2020). As the disruptions caused by COVID-19 have manifested themselves primarily in labour-intensive industries, supply chains in rich countries have proven more resilient, as they rely more on capital and knowledge. One exception to this rule is agricultural production that relies heavily on immigrant labour and/or labour-intensive processing, e.g. meat processing in Europe and the United States (Swinnen & McDermott, 2020). This has resulted in price increases in Europe – primarily for meat, fish and seafood, and vegetables (Akter, 2020).

Countries that were already facing greater food security problems before the pandemic have suffered more (Saboori et al., 2022). However, food systems in the EU have proved to be quite resilient. Apart from occasional shortages during the early days of lockdowns, EU farmers, processors, and retailers have managed to maintain food supplies (Matthews, 2020). The resilience of EU food systems has also been positively assessed by Montanari et al. (2020), although these authors have expressed some concerns as to whether food security in the EU can be maintained in the event of other external crises. In this context, Ranta & Mulrooney (2021) conclude that the decrease in physical food availability in the UK during the pandemic was actually brought about by Brexit and the consequent exclusion of UK food systems from the CAP.

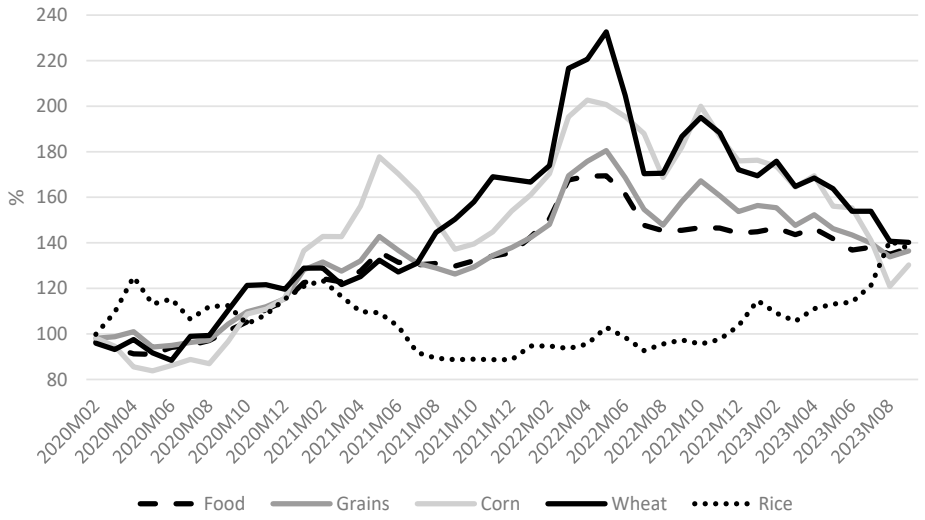
However, just as the global economy began to return to the pre-pandemic status quo, Russia invaded Ukraine on 24 February 2022. Before the war, both countries had been key producers and exporters of wheat, corn, and sunflower seeds, as well as potassium and phosphorus fertilizers. They met 50% of the demand for imported wheat in 26 Asian and African countries, and 30% in another 50 countries (Mottaleb et al., 2022).

The Russian Invasion of Ukraine boosted the upward trend in the prices of agricultural commodities (see Fig. 1). Price increases peaked in mid-2022. Not surprisingly, the prices of products in which Ukraine accounted for a large share of world production increased by far the most (Scuderi, 2022). They started to come down after the shock period, but were still about 40% higher in the second half of 2023 than they had been at the beginning of 2020 (World Bank Group, 2022).

The MENA region is particularly vulnerable to food price fluctuations on account of its high dependence on food imports (Abay et al., 2023). Additionally, it has to be stressed that corn, wheat, and particularly rice, are staples in the diet of this region (as they are in poor Asian countries). Although the price of rice remained relatively stable during this period, while those of other cereals increased rapidly, it nevertheless rose by over 40% to reach its highest level in 12 years in the first half of 2023. This increase in the price of rice was primarily caused by India banning the export of this product, which in turn was a response to the disruption that the Russian invasion of Ukraine had wreaked on food markets. The effects of rising rice

prices could be equally, if not more, damaging to the food security of the world's poorest regions, as it is a staple food for 3 billion people living in poverty.

Figure 1.
Price indexes of agricultural commodities, Jan 2020 = 100

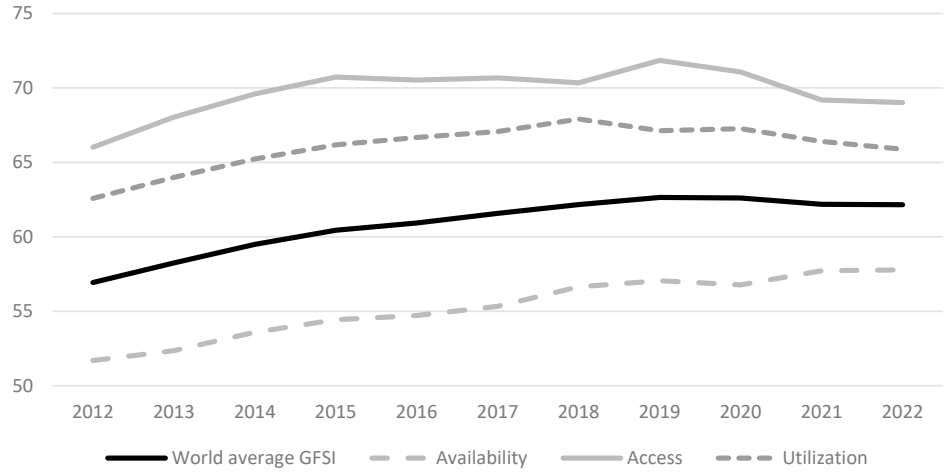


Source: The World Bank (2023a).

An increase in the price of rice is bound to exert demand pressures on substitutes, e.g. wheat, soybeans and corn. Moreover, given the price volatility transfer between agricultural and energy commodity markets (Just & Echaust, 2023), this could have a spill-over effect on demand – and thereby prices – in fuel markets, as well as other food markets. The Russian Invasion of Ukraine has also significantly impacted energy and fertilizer prices (Fig. 2). These price increases, as in the case of agricultural products, peaked in mid-2022. Although they have since come down, they were still much higher in mid-2023 than they had been prior to the pandemic, with fertilizer prices being on average over 200% higher. This, in turn, will not only affect the world's poorest countries (Feng et al., 2023). Studies conducted by Berndt et al. (2022) indicate that a 10% reduction in fertilizer availability in the EU would lead to a decline in net cereal production, while a 10% increase in the global oil price would have a huge impact on the EU's biofuel production. This issue has also been raised by Esonye et al. (2023).

This situation is not expected to improve significantly in the near future, as Ukraine's agricultural assets are being destroyed, and the country is losing labour resources through mass emigration and suffering a significant fall in household income (Melnyk et al., 2023). This means that many low-income countries in North Africa, Southeast Asia and the Middle East now face the risk of widespread malnutrition as a result of reduced supplies from Ukraine and Russia and high prices for staple grains (World Food Programme, 2023).

Figure 2.
Price indexes of crude oil and fertilizers, Jan 2020 = 100



Source: The World Bank (2023a).

The limited food supply, combined with higher food prices, that these recent crises have brought about are clearly detrimental to food security. When it comes to physical availability, this is especially problematic in countries dependent on food imports (Berndt et al., 2022), although economic access to food and diet quality are negatively impacted everywhere. The only countries likely to see any benefits from higher food prices are those that do not need to import food and which earn a significant portion of their foreign currency from food exports, e.g. the US and Canada (Feng et al., 2023). However, energy and fuel prices usually also go up in crises. This causes an increase in agricultural production costs and a decline in agricultural productivity. Thus, while the direct impact of global food price shocks may be limited, the cumulative impact of increases in food, fuel and fertilizer prices on domestic food prices and food security can be significant everywhere (Arndt et al., 2023; Lin et al., 2023; Alexander et al., 2023).

One way to deal with the negative consequences of these shocks may be a policy response, especially a long-term one, that shields agricultural systems against shocks and promotes the stability of food security. An example of such a policy is the EU CAP, which has always prioritised food security. Recent events have tested its effectiveness in maintaining resilient food production systems.

Research on the impact of the Russian Invasion of Ukraine on food and energy security initially found that the countries most affected were poorly developed and had little political clout, e.g. Afghanistan, Pakistan, Algeria, Libya, Oman, Tunisia, and those in Central Asia (Zhou et al., 2023), or were strongly dependent on wheat imports from Ukraine, e.g. Egypt, Turkey, Mongolia, Georgia, and Azerbaijan (Lin et al., 2023).

Few articles on food security in the EU imply that the situation is deteriorating (Abdullaieva et al., 2022; Xu et al., 2024), as the EU has been experiencing both direct (increase of sunflower and rapeseed oil prices) and indirect effects (increase

in the price of maize-based animal feed) (Hellegers, 2022) of the recent crises. On the other hand, some studies (Lin et al., 2023) indicate that large agricultural producers, including France and Germany, can always produce more wheat, and that Eastern and Southern European countries may even act as intermediaries to diffuse shocks in the event of cascading failures (Liu et al., 2023). However, it should be noted that these studies are usually one-dimensional and fail to account for all four dimensions of food security, particularly stability. Moreover, to the best of the present author's knowledge, none of them have formally tested the relationship between CAP and the stability of food security.

3. How is food security addressed in the CAP?

Providing sufficient and adequate food in the aftermath of World War II was one of the primary economic and social motivations for establishing the European Economic Community (EEC). The degree of self-sufficiency of the Community in terms of basic agricultural products was on average around 85%. Additionally, these fears were exacerbated by the prospect of being cut off from supplies of cheap food from former colonies that had become independent countries since the war. The costs of agricultural production in Europe were also much higher than those of other large food producers (USA, Canada, Australia, Argentina), which made Western European agriculture a relatively weak competitor on world markets.

The EEC founding countries accorded agricultural issues special importance in the Treaty of Rome (1957). Article 3 establishes a common agricultural (which included fisheries) policy. Art. 39 specifies the objectives of the common agricultural policy as follows: (i) increasing agricultural productivity by supporting technical progress, and by ensuring the rational development of agricultural production and the optimal utilisation of the factors of production, especially labour; (ii) ensuring a fair standard of living for the agricultural community, in particular by increasing the individual income of those working in agriculture; (iii) stabilising markets; (iv) guaranteeing availability of supply; and (v) ensuring that consumers are supplied with goods at reasonable prices. It was decided that the EU CAP could include any measures deemed necessary to achieve the objectives set out in Article 39, in particular price regulation, subsidies for the production and marketing of various products, the provision of storage and transport systems, and the implementation of common mechanisms to stabilise imports and exports.

Despite several reforms since its introduction in 1962, the CAP's basic objectives and principles have remained unchanged, although some of them are somewhat difficult to reconcile and are even contradictory. For example, on the one hand, the CAP points to the need to utilise the factors of production efficiently and effectively, while on the other, it emphasizes the need to provide farmers with an adequate income. The CAP has attained the latter aim through various support mechanisms, thereby frustrating the former by allowing relatively inefficient and ineffective entities to operate on the EEC/EU market. The main CAP principles have also been reinterpreted. This especially applies to the priority accorded to

EEC/EU agricultural production. The conclusions of the GATT Uruguay Round, WTO regulations, and numerous bilateral and multilateral agreements executed by the EEC/EC/EU have significantly relaxed the rigours of this principle (Drygas & Nurzyńska, 2018). Therefore, although the EU has never ceased implementing the CAP, or waived the requirement of prioritising the production and supply of food for its citizens, the scope of the CAP and the expectations regarding its objectives have changed significantly. The evolution of the priorities for the EU CAP is presented in Table 1. The CAP has proven so effective that for several decades, the availability of food was not directly articulated as a CAP priority. It was only in the 21st century that food security issues, including food safety, were placed back on the CAP agenda.

It is worth noting that food self-sufficiency varies greatly among the EU member states so far as the most important agricultural and food products are concerned. It ranges from values close to zero, which means that almost all domestic demand is satisfied by imports, to values several or even over a dozen times higher than the demand of the respective member state. However, apart from a few cases regarding vegetable fats and fruit (mainly fruit from other climatic zones, e.g. bananas, some citrus fruits), self-sufficiency can be ensured by intra-EU import (Baer-Nawrocka, 2014). Although this is not always able to bring such high comparative benefits as global trade, it guarantees much greater certainty of supplies and their stability.

Table 1.
Food security in the CAP framework

1958–1979 (beginnings of the CAP)	1980–1991	1992 MacSharry Reform	Agenda 2000	2003 Luxemburg Reform	2014–2020	2021–2027
Increased food self-sufficiency Increasing agricultural productivity Stabilization of the agricultural and food market Agricultural income support	Overproduction in the agricultural sector Increase in budget spending on the CAP International pressure (GATT/WTO) The beginnings of the CAP structural policy	Reduction of production surpluses Increasing importance of environmental aspects in the CAP Stabilization of farmers› income Stabilization of the CAP budget	Deepening the CAP reform process Competitiveness of agriculture Rural development stimulated by the CAP	Market orientation of agriculture Caring for the food consumer Rural development Environment Simplifying the CAP rules Compliance with WTO arrangements	Food security Environment Cohesion Protecting the EU›s financial interests	Smart and resilient agriculture Food security Competitiveness and income Environmental protection and climate Social inclusion and local development Food quality and health protection

Source: the authors' elaboration.

None of the EU Member States on its own would be able to ensure an equally high level of food self-sufficiency, and thus an equally high level of physical food security, while still benefiting from the comparative advantages of international

trade (in this case, intra-EU trade) (Marzęda-Młynarska, 2014). Therefore, in the event of turmoil on world markets, the European Union would remain a region with a very high level of food self-sufficiency and consequently high food availability.

The high level of food self-sufficiency and the assured availability of food in the EU suggest that, in principle, EU citizens should have no problem accessing food regardless of supply shortages. However, when accessibility at the individual level is analysed, it is revealed that they do in fact have this problem. Eurostat conducts research, in which it calculates the percentage of people aged 16 and over who cannot afford to eat one meal containing red meat, poultry, or fish (or a vegetarian equivalent) at least every second day. These studies conclude that 11.7% of EU residents aged 16 and over fell into this category in 2022 (Eurostat, 2023). This means that approximately 45 million EU residents cannot afford a nutritious diet. It is worth adding, however, that this situation has been improving for many years, especially for residents of the new member states. In 2013, the problem of access to nutritious food affected almost 2/3 of the population of Bulgaria, over 40% of that of Hungary, about 30% of that of Slovakia, Romania, Lithuania and Latvia, and 20% of that of the Czech Republic, Croatia and Poland. All these countries have since witnessed a significant decrease in the percentage of people unable to afford nutritious food. This problem now only affects over 30% of the population of Bulgaria and over 20% of the population of Romania, Hungary and Slovakia. Nevertheless, it is worth adding that despite these problems, all the EU member states are world leaders in terms of food affordability.

The third dimension of food security, viz. utilisation, is also covered by the CAP and by other EU regulations that encompasses the entire food chain ('from farm to fork') in an integrated manner and by using the 'one health' approach. These regulations cover the safety aspects of primary production, the hygiene conditions in food processing, packaging, labelling, and official controls of compliance with food safety standards. The EU has established control standards for the hygiene of food products, animal health and welfare, plant health, and the elimination of contamination risks from external substances such as pesticides. These standards are based on a strong connection with the environment, they employ advanced production technology, but without unduly exploiting nature and the environment, and they maintain strict quality, environmental and food safety standards (Kowalczyk & Sobiecki, 2011). They ensure that the European consumer receives food of high quality and nutritional value. The fact that agricultural policy is an EU responsibility means that the EU can influence food quality and safety, and EU rules ensure that EU citizens are guaranteed some of the strictest food safety standards in the world.

The agricultural success of the EU has been facilitated by advances in technology, biology, and organisational practices. Much of the increase in agricultural production has been attributed to the widespread use of mineral fertilisers, plant protection products, industrial feed, antibiotics, to the simplification of production structures, and to the scaling up of production. In the 21st century, there are numerous expectations regarding the quality and wholesomeness of food, as well as an awareness of the urgent need to address environmental concerns such as reducing greenhouse gas emissions, minimising the use of industrial inputs (such as mineral fertilisers, pesti-

cides, antibiotics), conserving water resources, enhancing animal welfare standards, and preserving biodiversity. For many years, the CAP has pioneered the concept of sustainable agriculture (Walczak et al., 2022). In response to contemporary challenges, efforts have been made to integrate these challenges into the EGD. The 'Farm to Fork' strategy, central to the EGD, holds particular significance for agriculture. From the perspective of agriculture as a sector, and especially agricultural farms, critical objectives include reducing the use of mineral fertilisers by at least 20% by 2030, cutting the use of chemical pesticides (and the associated risks) by 50% by 2030, halving the sale of antibiotics for animals in farming and aquaculture by 2030, and expanding organic farming to cover 25% of agricultural land by 2030.

Studies on the impact of implementing the EGD in EU agriculture conclude that this could have adverse consequences for the EU agricultural industry, as well as EU food consumers, unless it is thoroughly and carefully prepared (Beckman et al., 2020; Barreiro-Hurle et al., 2021). For example, technological and economic alternatives, such as natural fertilisers, biological methods, and mechanical plant protection, might not provide effective protection or adequate fertilization. This could lead to the proliferation of diseases and pests, and disrupt the nutrient balance in the soil-plant system, posing threats not only to food security, but also to food safety. Therefore, unless the EGD is properly prepared, it risks bringing about both a decrease in yields (ranging from several to several tens of percent) and a deterioration in their quality, including compromised food healthiness (Polityka Insight, 2021). A decline in production is likely to trigger an increase in food prices, which would obviously make consumers worse off financially, particularly those on lower incomes, for whom food purchases account for a significant portion of household expenditure. Consequently, both the physical and economic accessibility of food may deteriorate.

4. Food security stability in different parts of the world

4.1. Data and econometric strategy

The stability of food security in the EU and other regions of the world has been assessed using the GFSI. This indicator was developed by Economist Impact and has been used to assess food security in 113 countries around the world, including 19 EU countries, since 2012. The index is both dynamic and comparative and is constructed from 68 quantitative and qualitative characteristics (factors) of food security. It ranges from 0 to 100, and the higher the value, the better the food security situation (Economist Impact, 2023). The stability assessment was carried out in three key dimensions of food security using the following partial (proxy) indicators: availability (sufficiency of supply); access (affordability); and utilisation (quality and safety).

To assess the causal relationship between the CAP and the stability of food security in the EU, three econometric models were developed and can be represented by the following formula (equation 1):

$$Y = \beta_0 + \beta_1 CAP + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon \quad (1)$$

where: Y – dependent variable; CAP – binary independent variable; X_2, …, X_n – control variables; β_1, …, β_n – regression coefficients; β_0 – intercept; ε – error term.

The dependent variables were: (i) the absolute value of the change in the GFSI between 2022 and 2019, which provides an assessment of food security stability across all three dimensions simultaneously (Model 1); (ii) the absolute value of the change in the sufficiency of supply component of GFSI between 2022 and 2019, which assesses the stability of food availability (Model 2); and (iii) the absolute value of the change in the affordability component of the GFSI between 2022 and 2019, which evaluates the stability of food access (Model 3). The model for the utilisation dimension did not meet the assumptions of a correct econometric model.

Table 2.
Dependent variables, independent variable, and control variables used in the regression model (No. of observations = 110)

Variable	Description	Source	Mean	SD	Min.	Max.
GFSI stability – model 1	The absolute value of the change in the GFSI index in 2022 vs 2019.	Economist Impact, 2023	1.9	1.7	0.0	10.9
Avail. stability – model 2	The absolute value of the change in the sufficiency of supply component of GFSI in 2022 vs 2019.	Economist Impact, 2023	20.2	23.0	0.0	52.2
Access stability – model 3	The absolute value of the change in the affordability component of GFSI in 2022 vs 2019.	Economist Impact, 2023	4.5	4.6	0.2	19.7
CAP	Binary variable, where 1 indicates that the country is covered by the CAP, 0 indicates that the country is not covered by the CAP.	European Commission, 2023	0.2	0.4	0.0	1.0
GNI pc PPP	Gross national income per capita expressed in current international dollars converted by purchasing power parity conversion factor.	The World Bank, 2023c	35324.3	81790.0	1280.0	840840.0
Food CPI	Annual change in consumer prices, Food Indices (2015 = 100).	FAO, 2023	7.8	21.3	-4.3	214.7
Agricultural tariffs	Average MFN tariff applied on agricultural import (%).	WTO, 2023	15.1	9.5	0.1	65.1
Agricultural PPI	Annual change in the selling prices received by farmers (2014–2016 = 100).	FAO, 2023	3.5	5.9	-14.4	29.3
Agricultural R&D	Agriculture share of government expenditure on R&D (%) / Agriculture value added share of GDP (%)	FAO, 2023	0.6	1.4	0.0	14.2

Variable	Description	Source	Mean	SD	Min.	Max.
Agricultural TFP	The total factor productivity of agriculture, captured by annual growth in agricultural output (%) minus annual growth in agricultural inputs (%).	ERS USDA, 2023	0.02	0.05	-0.18	0.22
Irrigation	Cultivated agricultural area equipped for irrigation (%).	FAO, 2023	11.0	16.2	0.0	99.7
Food loss	Post-harvest and pre-consumer food loss as a ratio of the domestic supply (%).	FAO, 2023	5.4	3.1	1.0	20.3
Transport	National transport and logistics performance, Logistics Performance Index, score 1–5.	The World Bank, 2023b	3.0	0.6	2.1	4.2
Food security strategy	Binary variable, where 1 indicates that there is food security strategy in the country, 0 indicates that there is no food security strategy.	Economist Impact, 2023	0.6	0.5	0.0	1.0
Food safety mechanisms	Efficacy of food safety mechanisms, as captured by a WHO-assigned score. Scores are provided on a 0–100 scale.	WHO, 2023	69.1	25.7	0.0	100.0
Drinking water	Population with access to at least basic drinking water services (%).	The World Bank, 2023c	88.3	16.0	46.0	100.0

Source: based on Economist Impact, European Commission, The World Bank, FAO, WTO and ERS USDA databases.
Note: No. of observations = 110.

The main explanatory variable is a binary variable, where a value of 1 denotes that the country is under the influence of the CAP, while a value of 0 signifies the absence of such policy. A series of control variables was incorporated to isolate the impact of the CAP on food security stability and account for any other factors associated with EU membership that might affect food security. The selection of these variables was guided by a review of the relevant literature (Kaur & Kaur, 2015; Sassi, 2018; Warr, 2014) and the availability of data. Ultimately, a comprehensive set of 12 control variables, pertaining to specific dimensions of food security, was gathered and included in the estimation process. Table 2 provides a detailed list of all variables and their sources.

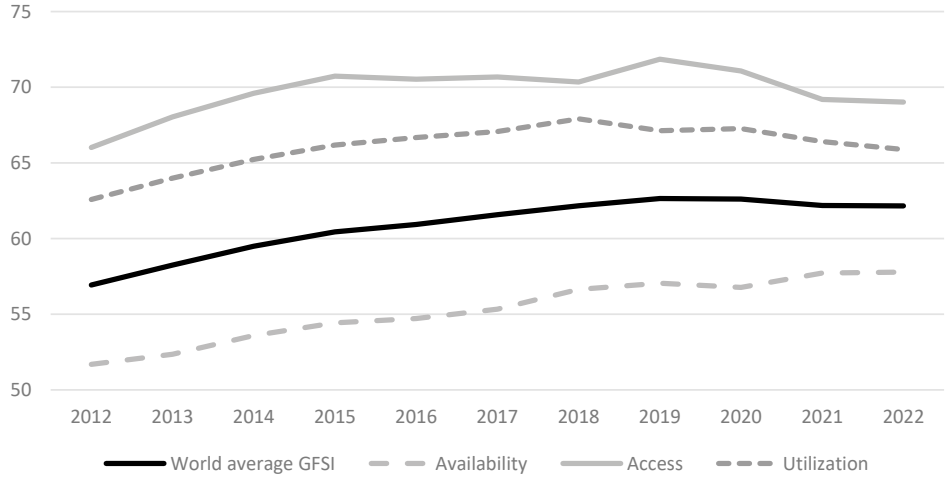
Given the multidimensional nature of food security, an effort was made to incorporate as many collected control variables as possible into the models. However, it is crucial to note that an excessive number of variables can diminish the quality of estimators and increase the risk of multicollinearity, potentially worsening the model fit. The forward stepwise regression method was applied to help select the optimal control variables. The models were subsequently assessed for compliance with linear model assumptions using the Shapiro-Wilk test and the VIF test. Robust standard errors were calculated to address heteroscedasticity.

4.2. Research results

From 2012 to 2019, there was a steady global increase in the GFSI. However, between 2019 and 2022, the GFSI decreased to 62.2. This index dropped the most in

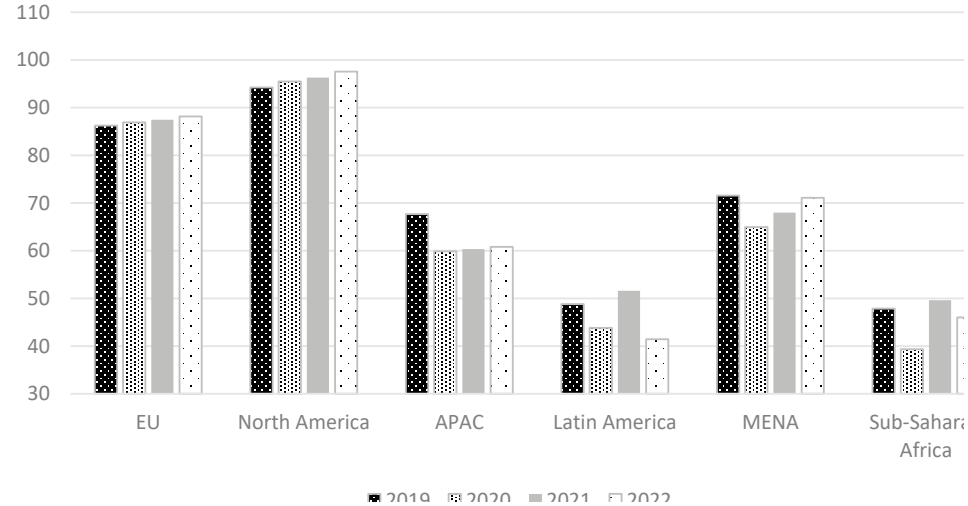
the areas of access and utilization (Figure 3). The intensity of this process varied in different regions of the world.

Figure 3.
World average Global Food Security Index and its main components (2012–2022)



Source: Economist Impact (2023).

Figure 4.
Availability (sufficiency of supply) in different regions in recent crisis years



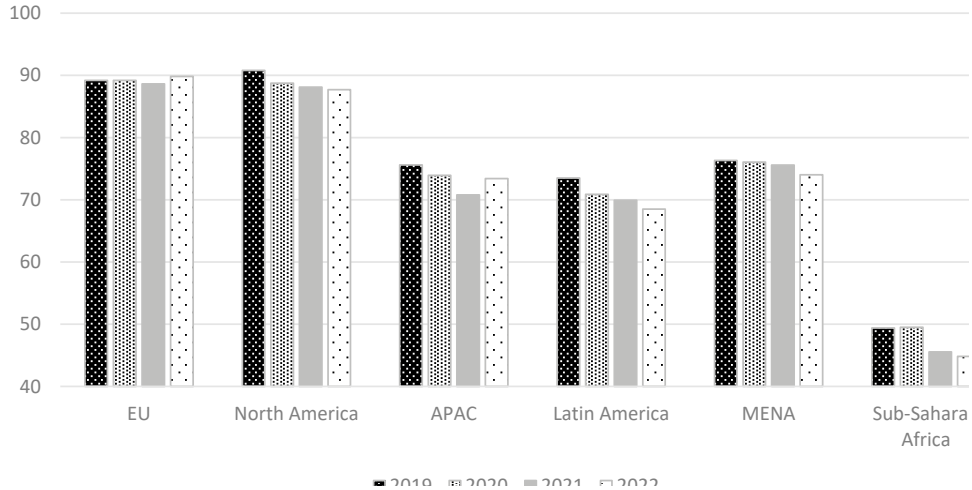
Source: Economist Impact (2023).

The availability dimension of food security, as assessed through the supply sufficiency partial GFSI indicator, actually improved in the EU and North America during the crisis years of 2019-2020 (Figure 4). This indicator varied considerably in other regions of the world, although the trend was downward. The detailed data included in Table A.1 in the Appendix confirm that the physical availability of food did not deteriorate any of the EU countries in the GFSI database in 2019–2020. On the contrary, availability improved in most countries (most notably in Poland, Romania, Spain and Slovakia). At the same time, the EU countries continued to occupy the top positions in the supply sufficiency index ranking. However, in 38 countries, mostly in sub-Saharan Africa, physical food availability worsened during this period. This situation is particularly disturbing given that these countries had occupied the bottom positions in the availability ranking even before the outbreak of the COVID-19 pandemic and the Russian Invasion of Ukraine. These crises have also shown that this dimension of food security is highly unstable.

As for the next dimension of food security, viz. economic access, the EU was the only region not to experience a reduction in the average value of the affordability index (Figure 5). The affordability index decreased in 71 of the countries in the GFSI database. The detailed data in Table A.2 in the Appendix indicate that there were only 5 EU countries among them, and the reductions they experienced were not significant. It is worth noting that the affordability index has decreased in many non-EU developed countries, including the United States, South Korea, Canada, Australia, New Zealand, Japan and Singapore. As a result, the EU countries still occupy leading positions in the economic food security ranking and this situation is stable.

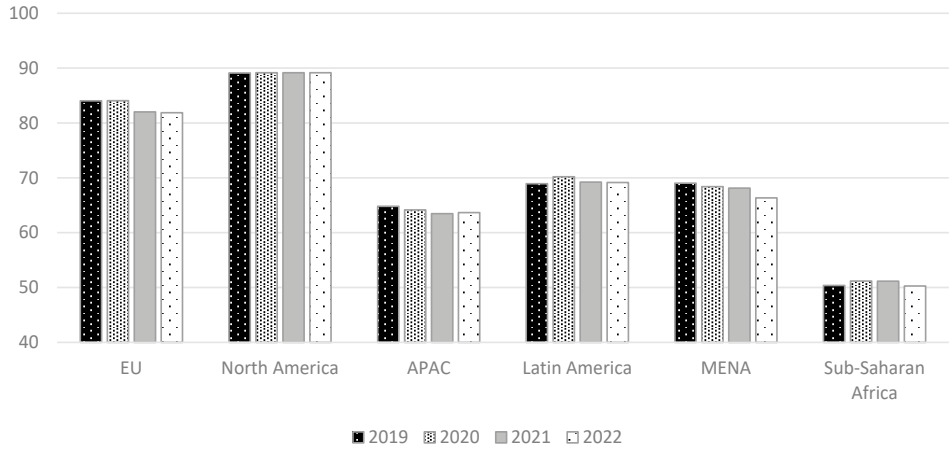
As for the third dimension of food security, the indicator being a proxy for food utilization (i.e. quality and safety) deteriorated in the EU to a greater extent than in other regions (Figure 6). Apart from the EU, the average value of the quality and safety indicator also decreased in the APAC and MENA regions. Fourteen of the 19 EU countries in the GFSI database were among the 70 countries that recorded a decline in the value of this indicator in 2019–2022 (Table A.3 in the Appendix). These declines, however, did not dislodge EU countries from their top positions in the food quality and safety ranking. It should be added that lowering the quality of food is a basic strategy for maintaining economic access to it and can occur mainly in countries where the quality of nutrition is already relatively high (Butcher et al., 2021; Mitchell et al., 2022). Therefore, it can be concluded that while the EU has fallen short of absolute stability in this dimension, it is still in a much more advantageous position than other regions.

Figure 5.
Economic access (affordability) in different regions in the crisis years



Source: Economist Impact (2023).

Figure 6.
Utilisation (quality and safety) in different regions in the crisis years



Source: Economist Impact (2023).

The preceding analysis concerning the influence of the CAP on the stability of specific dimensions of food security was substantiated by an econometric examination (Table 3). It was assumed that the stability of food security is reflected in maintaining it at a consistent level. Neither significant increases nor sharp declines are preferred. Therefore, the absolute value of the change in the index of a specific dimension was adopted as a measure of its stability.

Table 3.
Parameter estimates of forward stepwise regression model for the determinants of food security stability

Dependent variable	Model 1	Model 2	Model 3
	GFSI stability	Avail. stability	Access stability
Explanatory variables			
CAP	-0.538 (0.489)	-11.030*** (3.494)	-2.260*** (0.556)
GNI pc ppp			0.000 (0.000)
Food CPI		-0.152 (0.080)	
Agricultural R&D		-1.648** (0.725)	
Food loss	0.067 (0.059)	0.991 (0.853)	
Drinking water	-0.031** (0.014)	-0.300* (0.165)	
Agricultural TFP		-54.840* (31.839)	
Transport	-0.758* (0.406)	-5.600 (4.662)	-2.089*** (0.609)
Agricultural PPI	-0.015 (0.013)		0.170** (0.076)
Irrigation	-0.018* (0.009)		
Food security strategy	-0.555 (0.410)		
Intercept	1.877* (1.103)	62.994*** (18.882)	10.287*** (1.990)
R^2	0.118	0.294	0.224
test F	2.84 p = 0.009	13.53 p < 0.000	13.26 p < 0.000

Note: Robust standard errors of the parameters are reported in parentheses; *** indicates significance at the p < 0.01 level; ** indicates significance at the p < 0.05 level; * indicates significance at the p < 0.1 level.

Source: based on Economist Impact, European Commission, The World Bank, FAO, WTO and ERS USDA databases.

In models 2 and 3, which correspond to the stability of availability and access, the CAP variable is significant at the p < 0.01 level. The negative coefficient sign of this variable implies that the CAP contributed to a reduction in the absolute value of the change in availability/access between 2022 and 2019, thereby enhancing the stability of these dimensions. Hence, the present research supports the findings of Matthews (2020) and refutes the concerns expressed by Montanari et al. (2020).

The stability of food availability (model 2) was found to depend on several control variables, including increased public R&D expenditure, the total factor productivity (TFP) of agriculture, and access to drinking water. These findings align

with those of existing studies. Public R&D expenditure has been identified as one of the key factors that enhance food availability, both in developing (Hertel et al., 2020; Orr et al., 2022; Chandio et al., 2023) and developed countries (Baldos et al., 2020; Fuglie et al., 2022). Moreover, these studies suggest that public spending on R&D can boost agricultural productivity while addressing environmental concerns (Barrett, 2021). This is particularly significant as increases in agricultural productivity (measured by TFP) play a crucial role in promoting food security stability (Sunge & Ngepah, 2022) – a finding corroborated by the present research. The significant and negative coefficient of the drinking water variable reaffirms previous studies (Stoler et al., 2020; Nounkeu et al., 2022; Wemakor et al., 2023) on the impact of access to drinking water on food security availability and the total GFSI index (model 1).

Transport and logistics performance are statistically significant to the stability of the access dimension of food security (model 3) and the overall GFSI index (model 1). These results are consistent with the findings of an analysis of the impact of logistics on the four dimensions of food security conducted by Subramaniam et al. (2023). Conversely, the coefficient of the agricultural PPI was found to be statistically significant and positive (model 3), indicating that a larger increase in the prices received by farmers drove up the absolute value of changes in the access dimension of food security, thereby reducing its stability. These results are in line with discussions held by Kwaw-Nimeson & Tian (2021).

The demonstrated insignificance of the CAP's impact on the stability of the total GFSI corresponds to expectations (model 1). This is attributed to the GFSI encapsulating the utilisation dimension (quality and safety), which underwent a more pronounced deterioration in the EU than elsewhere. This is noted in the discussion of data depicted in Figure 6, and mentioned in Table A.3 in the Appendix. The stability of the GFSI was nevertheless influenced by access to drinking water, transport and logistics performance, and the proportion of agricultural area equipped for irrigation. Regrettably, a model for the utilisation dimension could not be estimated due to the failure to adhere to the assumptions that are necessary for a valid econometric model.

5. Conclusions

The CAP, and the European agricultural model it has shaped, have been put to the test in recent years. First, the COVID-19 pandemic, and then the Russian Invasion of Ukraine, sparked a global recession, disrupted supply chains, caused inflation, drove up public debt, and made global food markets more unstable. This article has found that, despite the grim prognoses presented in some of the reviewed literature (Montanari et al., 2020; Abdullaieva et al., 2022; Xu et al., 2024), food security in the EU has proven to be very stable. On the contrary, the EU food security is very high by world standards, as evidenced by the fact that 12 EU member states are among the 20 countries with the highest GFSI index, and 15 are among the top 30, including Poland, which is in 21st place. However, a comprehensive assessment of

the stability of food security in the EU requires that the stability of its individual dimensions be taken into account. The results obtained here suggest that the situation in the EU in either the availability or access dimensions, did not deteriorate, which cannot be said of other developed nations, let alone developing ones. Both availability and access have either remained consistently high or have shown slight improvements, underscoring their stability. The estimated econometric models confirm that in the case of the availability dimension, in addition to public R&D expenditure, agricultural TFP, and access to drinking water, implementing the CAP also supports the stability of food systems. Implementing the CAP has also proved to be significant in ensuring the stability of the access dimension by supporting the control variables of change in the selling prices received by farmers and transport and logistic performance.

These results prove that the EU CAP improves food security in the EU and stabilises its already high level. This is well reflected in the opinion of the European Economic and Social Committee, which states that the European food supply chain proved exceptionally resilient during the COVID-19 pandemic. Consumers had constant access to almost all food products (Ravnik & Schmidt, 2021). Although COVID-19 and the Russian Invasion of Ukraine contributed to rising food prices in the EU and its citizens felt the impact of inflation, the economic access to food and the stability of food supplies, although slightly deteriorating at times, remained high. This confirms that the EU is not only an economic community, but also a community that ensures security for its citizens, including the very important food security, which is primarily underwritten by the agricultural sectors of the individual member states.

Unfortunately, the same cannot be said for other regions of the world. The present results corroborate those of Falkendal et al. (2021) and Laborde et al. (2020) that low- and middle-income countries have the least stable food security. At a time when global food security is of the utmost importance, the GFSI components show that global food systems are fragile and unstable. Since peaking in 2019, the GFSI has been declining, which, given the current rice market turmoil and the spreading conflict in the Middle East, heralds a further deepening of food security problems, particularly in those countries already struggling.

The economic environment does not promise to be any more stable in the short-to-medium term. On the contrary, the tense geopolitical situation in various regions of the world and the deepening climate crisis portend more frequent shocks to food systems. The food security challenge also encompasses meeting the UN Sustainable Development Goals (SDGs). While the second SDG 'to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture by 2030', directly targets food security, the interplay between food security and the broader SDGs is nuanced. Unsustainable short-term interventions to alleviate hunger, if undertaken globally, pose a severe environmental threat, as they would release excessive carbon dioxide into the atmosphere, promote deforestation, contaminate water bodies and the water table, deplete livestock and fisheries, and cause desertification. Moreover, the degradation and disruption of natural ecosystems are consequential hazards to crop diversity and the stability of worldwide food systems. Consequently,

the preservation of environmental sustainability is a formidable challenge to both planetary and human wellbeing, underscoring the imperative for prompt intervention. Research and development can improve food security and environmental sustainability by helping to contain food price increases and slowing the expansion of cropland (Baldos et al., 2020).

The architects of the CAP are now faced with additional challenges, both significant and formidable. The EU will have to raise its agricultural productivity if it is going to play a role in addressing global food security issues in addition to maintaining a high level of food security for its own citizens. Moreover, this will have to be achieved without clearing and cultivating any more land, and in the face of pressing environmental and climate-related concerns that will necessitate minimizing the use of many traditional production inputs, such as mineral fertilizers, pesticides, and antibiotics. The EGD was designed in response to these challenges. However, the stability of food security in Europe may be compromised unless farmers accept its initiatives before it is implemented.

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References

Abay, K. A., Breisinger, C., Glauber, J., Kurdi, S., Laborde, D., & Siddig, K. (2023). The Russia-Ukraine war: Implications for global and regional food security and potential policy responses. *Global Food Security*, *36*. https://doi.org/10.1016/j.gfs.2023.100675

Abdullaieva, A., Andrusenko, N., Hromova, O., Martynova, L., Prutska, O., & Yurchyk, I. (2022). The Impact of the Russian-Ukrainian War on EU Food Security. *Economic Affairs (New Delhi)*, *67*(4), 859–867. https://doi.org/10.46852/0424-2513.4s.2022.19

Akter, S. (2020). The impact of COVID-19 related 'stay-at-home' restrictions on food prices in Europe: findings from a preliminary analysis. *Food Security*, *12*(4), 719–725. https://doi.org/10.1007/s12571-020-01082-3

Alabi, M. O., & Ngwenyama, O. (2023). Food security and disruptions of the global food supply chains during COVID-19: building smarter food supply chains for post COVID-19 era. *British Food Journal*, *125*(1), 167–185. https://doi.org/10.1108/BFJ-03-2021-0333

Alexander, P., Arneth, A., Henry, R., Maire, J., Rabin, S., & Rounsevell, M. D. A. (2023). High energy and fertilizer prices are more damaging than food export curtailment from Ukraine and Russia for food prices, health and the environment. *Nature Food*, *4*(1), 84–95. https://doi.org/10.1038/s43016-022-00659-9

Arndt, C., Diao, X., Dorosh, P., Pauw, K., & Thurlow, J. (2023). The Ukraine war and rising commodity prices: Implications for developing countries. *Global Food Security*, *36*. https://doi.org/10.1016/j.gfs.2023.100680

Baer-Nawrocka, A. (2014). Zmiany w spożyciu i stopniu samowystarczalności żywnościowej w Unii Europejskiej. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *360,* 19–27. https://doi.org/10.15611/pn.2014.360.02

Baldos, U. L. C., Fuglie, K. O., & Hertel, T. W. (2020). The research cost of adapting agriculture to climate change: A global analysis to 2050. *Agricultural Economics (United Kingdom)*, *51*(2), 207–220. https://doi.org/10.1111/agec.12550

Barreiro-Hurle, J., Bogonos, M., Himics, M., Hristov, J., Pérez Domínguez, I., Sahoo, A., Salputra, G., Weiss, F., Baldoni, E., & Elleby, C. (2021). *Modelling environmental and climatic ambition in the agricultural sector with the CAPRI model*. Publications Office of the European Union.

Beckman, J., Ivanic, M., Jelliffe, J., Baquedano, F., & Scott, S. (2020). Economic and food security impacts of agricultural input reduction under the European Union Green Deal's farm to fork and biodiversity strategies. *U.S. Department of Agriculture, Economic Research Service*, *EB-30*, 1–59.

Berndt, M., Boysen-Urban, K., Ehjeij, S., Espey, A., Feuerbacher, A., Flaig, D., Heimann, T., Hess, S., Kempen, M., Schünemann, F., & Wieck, C. (2022). Implications of Russia's War in Ukraine for the Global Agri-Food Sector – An Ex-Ante Assessment using Different Simulation Models. *German Journal of Agricultural Economics*, *71*(3), 134–149. https://doi.org/10.30430/gjae.2022.0310

Butcher, L. M., O'Sullivan, T. A., Ryan, M. M., Lo, J., Nyanjom, J., Wilkins, H. C., & Devine, A. (2021). To dine in or not to dine in: A comparison of food selection and preparation behaviours in those with and without food security. *Health Promotion Journal of Australia*, *32*(S2), 267–282. https://doi.org/10.1002/hpja.427

Carletto, C., Zezza, A., & Banerjee, R. (2013). Towards better measurement of household food security: Harmonizing indicators and the role of household surveys. *Global Food Security*, *2(1),* 30–40. https://doi.org/10.1016/j.gfs.2012.11.006

Drygas, M., & Nurzyńska, I. (2018). Uwarunkowania dyskusji nad kształtem Wspólnej Polityki Rolnej po 2020 roku. *Zeszyty Naukowe SGGW w Warszawie – Problemy Rolnictwa Światowego*, *18*(2), 57–69. https://doi.org/10.22630/prs.2018.18.2.34

Economist Impact. (2023). *Global Food Security Index*. https://impact.economist.com/sustainability/project/food-security-index/download-the-index

ERS USDA. (2023). *International Agricultural Productivity*. https://www.ers.usda.gov/data-products/international-agricultural-productivity/

Esonye, C., Esonye, C. O., Agha, E. O., Ume, C. S., Njemanze, C. V., Eyisi, C. E., & Adepoju, T. F. (2023). The 2022 Russia invasion on Ukraine: The biofuel energy security challenge on Ukraine and some related countries. *Heliyon*, *9*(11). https://doi.org/10.1016/j.heliyon.2023.e21483

European Commission. (2023). *Common Agricultural Policy*. https://ec.europa.eu/agriculture/index_en

Eurostat. (2023). *Inability to afford a meal with meat, chicken, fish (or vegetarian equivalent) every second day – EU-SILC survey*. https://ec.europa.eu/eurostat/databrowser/view/ilc_mdes03/default/table?lang=en

Falkendal, T., Otto, C., Schewe, J., Jägermeyr, J., Konar, M., Kummu, M., Watkins, B., & Puma, M. J. (2021). Grain export restrictions during COVID-19 risk food insecurity in many low- and middle-income countries. *Nature Food*, *2*(1), 11–14. https://doi.org/10.1038/s43016-020-00211-7

FAO. (2015). *State of Food Insecurity in the World*. FAO Publications.

FAO. (2023). *Food and Agriculture Data*. https://www.fao.org/faostat/en/#home

Feng, F., Jia, N., & Lin, F. (2023). Quantifying the impact of Russia-Ukraine crisis on food security and trade pattern: evidence from a structural general equilibrium trade model. *China Agricultural Economic Review*, *15*(2), 241–258. https://doi.org/10.1108/CAER-07-2022-0156

Gulbicka, B., Kwasek, M., & Obiedzińska, A. (2015). *Z badań nad rolnictwem społecznie zrównoważonym (33). Analiza bezpieczeństwa żywnościowego Polski*. IERiGŻ.

Hellegers, P. (2022). Food security vulnerability due to trade dependencies on Russia and Ukraine. *Food Security*, *14*(6), 1503–1510. https://doi.org/10.1007/s12571-022-01306-8

ILO (2021). *ILO Monitor: COVID-19 and the world of work. Seventh edition. Updated estimates and analysis*.

Just, M., & Echaust, K. (2023). Przenoszenie zmienności cen pomiędzy rynkami towarów rolnych i energetycznych – perspektywa rynków europejskich w czasie pandemii COVID-19 i wojny rosyjsko-ukraińskiej. *Wieś i Rolnictwo*, *2*(199), 41–66. https://doi.org/10.53098/wir022023/02

Kaur, S., & Kaur, H. (2015). Determinants of food security in Sub-Saharan Africa, South Asia and Latin America. In *Global Economic Cooperation: Views from G20 Countries* (pp. 81–102). https://doi.org/10.1007/978-81-322-2698-7_6

Kowalczyk, S., & Sobiecki, R. (2011). Europejski model rolnictwa – uwarunkowania ewolucji. *Roczniki Nauk Rolniczych, Seria G*, *98*(3), 9–20.

Laborde, D., Martin, W., Swinnen, J., & Vos, R. (2020). COVID-19 risks to global food security. *Science, 369*(6503), 500–502. https://doi.org/10.1126/science.abc4765

Lin, F., Li, X., Jia, N., Feng, F., Huang, H., Huang, J., Fan, S., Ciais, P., & Song, X. P. (2023). The impact of Russia-Ukraine conflict on global food security. *Global Food Security*, *36*. https://doi.org/10.1016/j.gfs.2022.100661

Liu, L., Wang, W., Yan, X., Shen, M., & Chen, H. (2023). The cascade influence of grain trade shocks on countries in the context of the Russia-Ukraine conflict. *Humanities and Social Sciences Communications*, *10*(1), 449. https://doi.org/10.1057/s41599-023-01944-z

Marzęda-Młynarska, K. (2014). *Globalne zarządzanie bezpieczeństwem żywnościowym na przełomie XX I XXI wieku*. Wydawnictwo UMCS.

Matthews, A. (2020). EU Food System Strengths and Vulnerabilities during Covid-19. *EuroChoices*, *19*(3), 4–12. https://doi.org/10.1111/1746-692X.12300

Melnyk, T., Tunitska, Y., & Banas, D. (2023). Food security of Ukraine: National and global level. *Economics and Business Review*, *9*(3), 181–220. https://doi.org/https://doi.org/10.18559/ebr.2023.3.927

Mitchell, A., Ellison, B., & Bruening, M. (2022). Persistent and Episodic Food Insecurity and Associated Coping Strategies Among College Students. *Journal of Nutrition Education and Behavior*, *54*(11), 972–981. https://doi.org/10.1016/j.jneb.2022.06.003

Montanari, F., Arayess, S., Barbarasa, T., Clavarino, A., Ferreira, I., Mahy, A., Margaritis, S., Michałowska, A., Schröck, C., Servé, A., Wesolowska, A. S., Varallo, C., & González, P. V. (2020). The response of the EU Agri-food chain to the COVID-19 pandemic: Chronicles from the EU and selected member states. *European Food and Feed Law Review*, *15*(4), 336–356. https://www.jstor.org/stable/26998516

Mottaleb, K. A., Kruseman, G., & Snapp, S. (2022). Potential impacts of Ukraine-Russia armed conflict on global wheat food security: A quantitative exploration. *Global Food Security*, *35*. https://doi.org/10.1016/j.gfs.2022.100659

Poczta-Wajda, A. (2018). Miary i wymiary bezpieczeństwa żywnościowego. *Zeszyty Naukowe SGGW w Warszawie – Problemy Rolnictwa Światowego*, *18*(1), 203–213. https://doi.org/10.22630/prs.2018.18.1.19

Polityka Insight. (2021). *Wpływ Europejskiego Zielonego Ładu na polskie rolnictwo*.

Ranta, R., & Mulrooney, H. (2021). Pandemics, food (in)security, and leaving the EU: What does the Covid-19 pandemic tell us about food insecurity and Brexit. *Social Sciences and Humanities Open*, *3*(1). https://doi.org/10.1016/j.ssaho.2021.100125

Ravnik, B., & Schmidt, P. (2021). *Towards a Fair Food Supply Chain*. European Economic and Social Committe.

Saboori, B., Radmehr, R., Zhang, Y. Y., & Zekri, S. (2022). A new face of food security: A global perspective of the COVID-19 pandemic. *Progress in Disaster Science*, *16*. https://doi.org/10.1016/j.pdisas.2022.100252

Sassi, M. (2017). Understanding food insecurity: Key features, indicators, and response design. In *Understanding Food Insecurity: Key Features, Indicators, and Response Design*. https://doi.org/10.1007/978-3-319-70362-6

Scuderi, R. (2022). The Impact of the War in Ukraine on Commodity Markets. In *Commodity Markets Outlook*. World Bank Group.

Swinnen, J., & McDermott, J. (2020). Covid-19 and Global Food Security. *EuroChoices*, *19*(3), 26–33. https://doi.org/10.1111/1746-692X.12288

The World Bank. (2023a). *Commodity Markets*. https://www.worldbank.org/en/research/commodity-markets

The World Bank. (2023b). *Logistics Performance Index*. https://lpi.worldbank.org/

The World Bank. (2023c). *World Development Indicators*. https://databank.worldbank.org/source/world-development-indicators

Walczak, J., Frątczak, W., Izydorczy, K., Skowrońska, M., Poczta, W., Szymańska, M., Pomianek, B., Sadowski, A., & Brodziak, G. (2022). *Środowiskowe i klimatyczne konsekwencje intensyfikacji, skali i koncentracji produkcji rolniczej*. Wydawnictwo Naukowe Scholar.

Warr, P. (2014). Food insecurity and its determinants. *Australian Journal of Agricultural and Resource Economics*, *58*(4), 519–537. https://doi.org/10.1111/1467-8489.12073

WHO. (2023). *Global Health Observatory indicator views*. https://apps.who.int/gho/data/node.imr#ndx-S

World Bank Group. (2022). The Impact of the War in Ukraine on Commodity Markets. In *Commodity Markets Outlook*. https://www.worldbank.org/en/research/commodity-markets

World Food Programme. (2023). *Annual Review 2022*.

WTO. (2023). *World Tariff Profiles*. https://www.wto.org/english/res_e/reser_e/tariff_profiles_e.htm

Xu, Y., Chou, J., Wang, Z., & Dong, W. (2024). Predicting the differences in food security with and without the Russia–Ukraine conflict scenarios over different regions of the world. *Agricultural and Food Economics*, *12*(1), 5. https://doi.org/10.1186/s40100-024-00296-9

Zhou, X. Y., Lu, G., Xu, Z., Yan, X., Khu, S. T., Yang, J., & Zhao, J. (2023). Influence of Russia-Ukraine War on the Global Energy and Food Security. *Resources, Conservation and Recycling*, *188*. https://doi.org/10.1016/j.resconrec.2022.106657

Appendix

Table A.1.
Availability (sufficiency of supply) component of GFSI – value in 2022 and change compared to 2019

European Union				Top 1–19 decrease				Top 20–38 decrease				Top 39–57 decrease/lowest increase			
World rank	Country	2022 Value	Change 2022 vs 2019	World rank	Country	2022 Value	Change 2022 vs 2019	World rank	Country	2022 Value	Change 2022 vs 2019	World rank	Country	2022 Value	Change 2022 vs 2019
1	Ireland	100.0	0.0	82	Mali	37.1	-52.2	97	Paraguay	24.7	-47.3	77	Argentina	40.4	0
5	Belgium	99.2	0.0	76	Egypt	44.5	-51.4	91	Peru	28.0	-47.3	5	Belgium	99.2	0
7	Austria	97.5	+2.4	90	Colombia	28.8	-49.8	86	Panama	30.5	-46.4	44	Chile	78.6	0
9	Romania	95.9	+3.3	86	Burkina Faso	30.5	-48.9	102	India	20.6	-45.6	12	France	92.6	0
11	Poland	93.4	+4.1	108	Chad	14.0	-48.9	92	Cambodia	27.2	-44.8	1	Ireland	100.0	0
12	France	92.6	0.0	102	Nicaragua	20.6	-48.9	89	Philippines	29.7	-43.1	1	Israel	100.0	0
12	Germany	92.6	+0.8	92	South Africa	27.2	-48.9	110	Venezuela	5.8	-7.4	24	Kazakhstan	86.8	0
15	Italy	91.8	+1.7	99	Angola	23.9	-48.1	56	Jordan	72.0	-3.3	40	Nepal	81.9	0
15	Portugal	91.8	+2.5	85	Indonesia	32.1	-48.1	96	Nigeria	25.5	-2.5	55	Oman	72.8	0
22	Greece	87.6	+0.8	81	Mexico	37.9	-48.1	28	United Kingdom	86.0	-2.5	20	Saudi Arabia	88.5	0
24	Denmark	86.8	+1.6	77	Uzbekistan	40.4	-48.1	34	Switzerland	83.5	-1.7	67	Sierra Leone	62.9	0
24	Spain	86.8	+3.3	105	Zambia	18.1	-48.1	44	UAE	78.6	-1.6	56	Sudan	72.0	0
30	Finland	85.2	+0.9	92	Malaysia	27.2	-48.1	113	Congo	2.5	-0.8	111	Syria	4.1	0
30	Hungary	85.2	+3.3	92	Niger	27.2	-48.1	20	Australia	88.5	-0.8	7	Tunisia	97.5	0
34	Czech Republic	83.5	+2.5	109	Botswana	12.4	-48.0	36	Bahrain	82.7	-0.8	111	Yemen	4.1	0
36	Netherlands	82.7	+2.5	79	Tajikistan	39.6	-48.0	102	Ecuador	20.6	-0.8	1	Algeria	100.0	+0.8

European Union				Top 1–19 decrease				Top 20–38 decrease				Top 39–57 decrease/lowest increase			
41	Sweden	81.0	+0.8	84	Côte d›Ivoire	34.6	-47.3	50	Malawi	75.3	-0.8	12	Germany	92.6	+0.8
59	Bulgaria	71.2	+2.5	105	Togo	18.1	-47.3	30	Norway	85.2	-0.8	22	Greece	87.6	+0.8
62	Slovakia	70.3	+3.3	97	Honduras	24.7	-47.3	36	Qatar	82.7	-0.8	99	Guatemala	23.9	+0.8

Source: (Economist Impact, 2023).

Table A.2.
Access (affordability) component of GFSI – value in 2022 and change compared to 2019

European Union				Top 1–19 decrease				Top 20–38 decrease				Top 39–57 decrease			
World rank	Country	2022 Value	Change 2022 vs 2019	World rank	Country	2022 Value	Change 2022 vs 2019	World rank	Country	2022 Value	Change 2022 vs 2019	World rank	Country	2022 Value	Change 2022 vs 2019
3	Netherlands	92.7	+1.0	111	Syria	32.0	-23.4	98	Niger	42.8	-8.2	59	Bolivia	71.6	-3.4
4	Belgium	92.6	+2.5	71	Brazil	63.0	-19.7	47	Peru	79.7	-8.2	49	Kazakhstan	78.0	-3.4
4	Ireland	92.6	+0.5	68	Colombia	64.6	-17.8	85	Nepal	52.7	-8.2	52	Mexico	76.0	-3.4
6	Denmark	92.1	-0.6	63	Belarus	67.8	-17.4	57	Dominican Rep.	73.4	-8.2	81	Turkey	58.4	-3.2
7	Finland	91.9	+1.3	113	Nigeria	25.0	-17.4	79	Laos	59.7	-7.5	9	New Zealand	91.6	-3.0
7	Sweden	91.9	+2.2	74	Sri Lanka	61.0	-15.9	61	Ecuador	70.8	-7.2	89	Cameroon	50.4	-2.9
11	Austria	91.3	+0.9	112	Zambia	26.8	-15.5	80	India	59.3	-6.8	83	Côte d›Ivoire	54.2	-2.5
11	Czech Republic	91.3	+0.4	101	Kenya	41.7	-14.6	105	Angola	35.5	-6.4	58	El Salvador	72.5	-2.5
11	France	91.3	+2.4	110	Burundi	32.5	-14.2	109	Haiti	32.8	-6.0	60	Philippines	71.5	-2.5
15	Portugal	90.0	+0.2	99	Mozambique	42.6	-13.8	55	Paraguay	74.3	-6.0	41	Costa Rica	83.0	-2.1
17	Italy	89.5	+0.3	45	Kuwait	80.0	-11.7	97	Togo	45.7	-5.9	25	Canada	88.3	-1.9
19	Slovakia	89.1	+2.3	50	Russia	77.8	-10.2	93	Uganda	48.3	-4.6	37	Panama	84.4	-1.9
20	Spain	89.0	+0.4	75	Pakistan	59.9	-10.2	29	United States	87.1	-4.3	21	Oman	88.6	-1.8
24	Greece	88.5	-0.4	108	Ethiopia	32.9	-9.8	51	South Korea	76.8	-4.3	39	Thailand	83.7	-1.7

European Union				Top 1–19 decrease				Top 20–38 decrease				Top 39–57 decrease			
26	Germany	87.9	-1.6	70	South Africa	63.4	-9.7	77	Tajikistan	59.8	-4.3	73	Argentina	62.0	-1.6
27	Poland	87.4	-0.4	64	Algeria	66.8	-9.3	87	Bangladesh	52.1	-4.0	100	Venezuela	41.8	-1.6
31	Hungary	86.7	+0.5	62	Botswana	69.0	-9.1	42	Chile	82.4	-3.9	26	Germany	87.9	-1.6
34	Bulgaria	85.8	-0.4	48	Azerbaijan	78.1	-8.5	21	Qatar	88.6	-3.8	43	Serbia	81.5	-1.3
36	Romania	85.1	+0.6	75	Ghana	59.9	-8.3	69	Nicaragua	64.4	-3.8	82	Senegal	57.9	-1.2

Source: (Economist Impact, 2023).

Table A.3.
Utilization (quality and safety) component of FSGI – value in 2022 and change compared to 2019

European Union				Top 1–19 decrease				Top 20–38 decrease				Top 39–57 decrease			
World rank	Country	2022 Value	Change 2022 vs 2019	World rank	Country	2022 Value	Change 2022 vs 2019	World rank	Country	2022 Value	Change 2022 vs 2019	World rank	Country	2022 Value	Change 2022 vs 2019
2	Denmark	89.1	+8.3	57	Belarus	69.0	-15.2	54	Singapore	69.7	-5.7	32	Kazakhstan	76.3	-3.0
4	Belgium	88.4	+0.3	92	Venezuela	51.5	-12.4	106	Angola	43.9	-5.6	109	Sierra Leone	41.8	-3.0
4	Finland	88.4	+0.1	59	Kuwait	67.8	-10.7	111	Guinea	39.8	-5.3	12	Netherlands	84.7	-2.8
6	France	87.7	+0.3	66	Colombia	63.3	-10.0	54	Panama	69.7	-5.2	46	China	72.0	-2.6
9	Ireland	86.1	-0.2	94	Ghana	50.5	-8.3	60	South Africa	66.1	-5.2	29	United Kingdom	77.6	-2.4
11	Sweden	85.0	-2.2	21	Portugal	79.8	-8.1	82	Algeria	54.7	-5.2	47	Bolivia	71.7	-2.4
12	Netherlands	84.7	-2.8	19	Greece	80.8	-7.8	85	Cambodia	54.0	-4.9	99	Benin	48.1	-2.3
15	Poland	81.5	-1.3	45	Serbia	72.6	-7.3	70	Tunisia	58.8	-4.8	8	Norway	86.8	-2.2
17	Austria	81.2	-4.5	101	Egypt	45.9	-6.8	27	Romania	77.9	-4.8	11	Sweden	85.0	-2.2
17	Spain	81.2	-5.7	40	Uruguay	73.8	-6.6	17	Austria	81.2	-4.5	68	Guatemala	61.3	-2.2
19	Greece	80.8	-7.8	41	Switzerland	73.5	-6.6	36	Italy	75.9	-4.5	79	Nigeria	55.6	-2.1
20	Germany	79.9	-6.1	47	Qatar	71.7	-6.5	93	Syria	50.8	-4.4	50	South Korea	71.5	-1.9

European Union				Top 1–19 decrease				Top 20–38 decrease				Top 39–57 decrease			
21	Portugal	79.8	-8.1	39	Hungary	74.4	-6.4	78	Indonesia	56.2	-4.3	76	Cameroon	56.5	-1.6
22	Bulgaria	79.5	+8.7	107	Congo	43.5	-6.3	83	Azerbaijan	54.5	-4.3	43	New Zealand	73.1	-1.5
27	Romania	77.9	-4.8	105	Côte d›Ivoire	44.1	-6.2	81	Sri Lanka	55.0	-4.0	61	Philippines	65.3	-1.5
27	Slovakia	77.9	-0.2	102	Thailand	45.3	-6.1	32	Czech Republic	76.3	-3.9	88	Burkina Faso	52.8	-1.4
32	Czech Republic	76.3	-3.9	20	Germany	79.9	-6.1	42	Oman	73.2	-3.7	109	Mozambique	41.8	-1.3
36	Italy	75.9	-4.5	108	Togo	42.3	-5.8	80	Jordan	55.4	-3.7	15	Poland	81.5	-1.3
39	Hungary	74.4	-6.4	17	Spain	81.2	-5.7	32	Bahrain	76.3	-3.1	76	Tajikistan	56.5	-1.3

Source: Economist Impact (2023).