

A critical evaluation of food security based on the GFSI: the case of Poland in comparison with European Union countries

Iwona Szczepaniak, Igor Olech

Abstract

The aim of this article is to assess Poland's position in terms of food security in comparison with European Union (EU) countries over the period 2012–2022, using the Global Food Security Index (GFSI) as the analytical framework. The analysis encompasses both point and ranking data, as well as the dynamics of change, index volatility, and a comparison with the EU average. The findings indicate a moderate yet consistent improvement in Poland's situation, bringing it increasingly closer to the EU average. At the same time, the Polish food system demonstrates above-average stability, and its standing has been further strengthened following the methodological revision of the GFSI in 2020. The article also includes a critical analysis of the indicator, highlighting its conceptual limitations and its disregard for alternative perspectives, such as food sovereignty and food democracy, which, if taken into account, could have a significant impact on Poland's food security position compared to other EU countries. The GFSI thus proves to be a useful tool, yet one that requires supplementation with a broader political and institutional context.

Keywords: food security, Poland, European Union, GFSI.

Iwona Szczepaniak, PhD, DSc, Professor at the Institute of Agricultural and Food Economics – National Research Institute (IERiGŻ PIB), Department of Agribusiness and Bioeconomy Economics, Warsaw;
Igor Olech, MSc, Department of Agribusiness Economics and Bioeconomy, Institute of Agricultural and Food Economics – National Research Institute (IERiGŻ PIB), Warsaw.

Introduction

The pressure for continuous economic growth, which has become a benchmark for development both globally and nationally, leads on the one hand to increased production of goods and services, but on the other hand to excessive consumption. On the one hand, there is a global surplus in food production; on the other, the problem of hunger continues to intensify. In the early 1990s, the number of people suffering from hunger and malnutrition worldwide exceeded one billion. Over nearly 30 years, the number of people suffering from hunger has been significantly reduced, to around 550 million in 2017–2018. Unfortunately, since 2019, it has once again been on the rise¹. The underlying causes of hunger and malnutrition, and consequently of food insecurity, include social inequalities, armed conflicts, extreme weather events, as well as economic downturns triggered by a range of factors. In recent years, these challenges have been further exacerbated by the recession triggered by the COVID-19 pandemic.

As a result, by 2023, more than 733 million people – representing 9.1% of the global population (compared to 7.5% in 2019) – were experiencing hunger. More than half of all people suffering from hunger (385 million, approx. 8% of the population) lived in Asia, and more than one third (298 million, nearly 20% of the population) – in Africa. The lowest numbers of people suffering from hunger were recorded in Central America and the Caribbean (41 million, nearly 18%) as well as in Oceania (3 million, accounting for over 6% of the population). Recently, the most significant increase in the number of undernourished individuals has been observed in Africa. No data are available for North America and Europe; however, it is estimated that the proportion of people suffering from hunger in these regions has not exceeded 2.5%².

In recent years, due to the pandemic, the war in Ukraine and other armed conflicts, as well as the consequences of climate change – including the intensifying water deficit – the issue of ensuring food security has become increasingly prominent. It remains a key challenge for the Member States of the European Union as well. If the current upward trend in the number of people suffering from hunger and malnutrition persists in the near future, it will not be possible to achieve the Sustainable Development Goals (SDGs) by 2030 – including eradicating hunger (SDG 2) and poverty (SDG 1), as well as ensuring good health and quality of life (SDG 3) – as set out by the United

1. FAO, IFAD, UNICEF, WFP, WHO, *The State of Food Security and Nutrition in the World 2024: Financing to the end hunger, food insecurity and malnutrition in all its forms*, Rome, FAO, 2024, p. 3–9, <https://doi.org/10.4060/cd1254en>.

2. Ibidem.

Nations in the 2030 Agenda for Sustainable Development³. Already in 2016, the EU Council expressed concern over the fact that hunger remained one of the most pressing development challenges⁴. Similarly, FAO experts, in reports published even before the COVID-19 health crisis, emphasised that the increasing frequency of armed conflicts, economic downturns, and the intensification of extreme climate events – combined with persistently high food prices and widening income inequalities – are moving humanity further away from achieving SDG 2, Zero Hunger, by 2030.

The issue of ensuring food security therefore remains one of the most pressing global challenges, relevant not only to developing countries but also to highly developed nations, including the EU and its individual Member States. This problem became particularly pronounced during the pandemic, which disrupted food flows within global agri-food supply chains. With Russia's invasion of Ukraine, significant instability has emerged on global agricultural commodity and energy markets. Food producers had to cope with challenges such as rapidly rising raw material prices and the need to ensure continuity of supply chains. At the same time, both globally and across Europe, we continue to witness the consequences of climate change, which adversely affect the natural conditions for agricultural production. All these factors represent economic challenges that threaten food security in EU countries and, as a result, are attracting increased interest among researchers.

The aim of this article is to assess Poland's food security in comparison with the European Union over the period 2012–2022. The analysis uses the Global Food Security Index (GFSI), which allows for the assessment of food security in the different countries, taking into account dimensions such as food affordability, food availability, food quality and safety, as well as natural resources and the resilience of food systems in relation to the EU average. Accordingly, it can be regarded as a continuation, to some extent, of the article written by I. Szczepaniak in 2018⁵. Repeating the study is justified not only by the passage of time, but also by the fact that a revolutionary reform of the GFSI index was introduced shortly after the publication of the previous article. In the article by I. Szczepaniak⁶, three sub-indices were evaluated. Since then, the GFSI has

3. United Nations, *Transforming our world: the 2030 Agenda for Sustainable Development*, Resolution adopted by the General Assembly on 25 September 2015, United Nations A/RES/70/1, <https://www.gov.pl/web/rozwoj-technologie/agenda-2030>.

4. Council of the European Union, *Food Losses and Food Waste – Council Conclusions*, Brussels, 28 June 2016, 10730/16, <https://data.consilium.europa.eu/doc/document/ST-10730-2016-INIT/en/pdf>.

5. I. Szczepaniak, *Assessment of food security and food self-sufficiency of Poland as compared to other European Union countries*, "International Business and Global Economy" 2018, No. 37, p. 168–182, <https://doi.org/10.4467/23539496IB.18.012.9385>.

6. Ibidem.

been expanded to include a fourth sub-index, and the overall number of variables analysed has doubled, which has undoubtedly influenced the ranking results.

The structure of the study is as follows. The first section provides an introduction to the subject matter. The second section is devoted to a theoretical overview of the issue of food security. The third part discusses the GFSI Global Food Safety Index and its constituent pillars. The subsequent section presents the results of the analysis, which covers both point and ranking data, the dynamics of change, index volatility, and a comparison with the EU average. A critical analysis of the GFSI was then conducted, highlighting its conceptual limitations, neglect of alternative perspectives, as well as its practical utility. The study concludes with a summary.

Food security – theoretical considerations

Food security is a contemporary yet complex and multifaceted concept, encompassing economic, political, demographic, social, cultural, and technical dimensions⁷. Most broadly speaking, food security refers to a situation in which all people, at all times, have physical, economic, and social access to sufficient, safe, and nutritious food that meets their dietary needs and preferences in terms of an active and healthy life⁸. On the basis of this definition, four conditions can be identified that must be met simultaneously in order to ensure food security. These are⁹:

1. **Availability of food** – this condition pertains to the actual or potential presence of food, whether from production or reserves; it relates, among other factors, to the functioning of markets and the efficiency of transport systems.
2. **Access to food** – this condition concerns the adequacy of both physical and economic access to food in situations where food is actually or potentially available on the market; access implies that food should be affordable, meaning that its acquisition should not compromise the ability to meet other essential needs, such as education or healthcare; physical access, in turn, requires that food be accessible to all individuals, including those who are physically vulnerable, such as children, the elderly, or persons with disabilities.

7. European Commission, *Food security: understanding and meeting the challenge of poverty*, Brussels, Belgium, Publications Office of the European Union, 2009, p. 7.

8. FAO, *The State of Food Insecurity in the World. Meeting the 2015 international hunger targets: taking stock of uneven progress*, Rome, FAO, IFAD, WFP, 2015, p. 53, <https://www.fao.org/fsnforum/resources/fao-flagships/state-food-insecurity-world-2015-sofi>.

9. FAO, *The State of Food Security and Nutrition in the World 2022: Repurposing food and agricultural policies to make healthy diets more affordable*, Rome, FAO, IFAD, UNICEF, WFP, WHO, 2022, p. 202, <https://doi.org/10.4060/cc0639en>.

3. Food quality and safety (utilisation) – this dimension refers to the assurance of food safety and nutritional quality; that is, food (in the form of a properly balanced and varied diet) should provide adequate energy and contain essential nutrients; combined with appropriate sanitary conditions, access to clean water, and healthcare, these factors determine the nutritional status of individuals.
4. Stability – this dimension refers to the state in which a system remains resilient in terms of food supply, regardless of changing – whether sudden or cyclical – external conditions (such as economic, climatic, social, or political factors); this is a prerequisite for ensuring sustained food security.

Food security can be considered at the global, national, household, and individual levels. Global food security encompasses all elements of the food system, including food production and distribution, food reserves, food aid, information systems relating to production and consumption, as well as programmes aimed at improving population nutrition¹⁰. Ensuring food security at the international level also entails efforts to eliminate stark regional disparities in the satisfaction of hunger. Food aid – both emergency and long-term – plays a significant role in narrowing the food gap in countries affected by chronic food deficits¹¹. At the national level, food security is determined by the food availability and economic access of the entire population to food that meets established quality and safety standards. It is understood as “the supply of food for consumption in the given country equal at least to the biological needs of the society throughout the year”¹². The key determinants of achieving long-term national food security include the continuity of food supply streams, sustainable management of natural resources, environmental, and climatic factors, as well as the administrative and socio-political context¹³. At the household or individual level, food security is defined by a stable supply of food, whether obtained through purchase or own production, that adequately meets the needs of all members of the household. It follows that a country’s food policy can ensure the highest possible degree of household food security only if it takes into account all the factors and processes that influence the nutritional status of each member of the household¹⁴.

10. K. Pawlak, *Problemy światowego i europejskiego bezpieczeństwa żywnościowego* [in:] *Ewolucja światowego i krajowego popytu na żywność w kontekście zmian demograficznych i bezpieczeństwa żywnościowego*, red. K. Świątlik, Monografie Programu Wieloletniego, nr 65, Warszawa, IERiGŻ PIB, 2017, p. 50–89, <http://www.ierigz.waw.pl/publikacje/publikacje-programu-wieloletniego-2015-2019/21786,13,3,0,nr-65-ewolucja-swiatowego-i-krajowego-popytu-na-zywnosc-w-kontekscie-zmian-demograficznych-i-bezpieczenstwa-zywnosciowego.html>.

11. J. Małysz, *Ekonomiczna interpretacja bezpieczeństwa żywnościowego* [in:] *Bezpieczeństwo żywności w erze globalizacji*, red. S. Kowalczyk, Warszawa, Warsaw School of Economics, 2009.

12. N. Ballenger, C. Mabbs-Zeno, *Treating food security and food aid issues at the GATT*, “Food Policy” 1992, Vol. 17(4), p. 264–276.

13. J. Małysz, op. cit.

14. K. Pawlak, op. cit.

During the ongoing war between Russia and Ukraine – two countries that are major producers and exporters of agri-food products – the issue of global food security has become particularly important. There is an ongoing debate concerning the risks to global access to food that is both safe and nutritionally adequate. Trade restrictions imposed in connection with ongoing armed conflicts, inequalities between world regions leading to the deepening of hunger, and advancing climate change are all exacerbating the problem of global food insecurity.

Global Food Security Index

One of the indicators describing the food security of a country or region is the Global Food Security Index (GFSI), published since 2012, calculated for over 110 countries worldwide, including 19 EU Member States and the United Kingdom. A limitation of this method is the absence of the Baltic States, as well as Slovenia, Malta, Luxembourg, and Cyprus from the ranking, which results from the indicator's focus on countries with larger populations¹⁵. Given the EU's population of approximately 450 million, these countries together account for less than 2.5% of the Union's population – around 10.5 million people in total¹⁶. While these countries account for only a small share of the total EU population, their absence from the analysis may lead to an incomplete picture of EU food security, especially considering the EU's geographical and economic diversity.

The GFSI comprises numerous determinants selected by food security experts. These determinants were initially used to construct three sub-indices, capturing the following aspects of food security: affordability, availability, and food quality and safety. Since 2020, a fourth sub-index – natural resources and resilience – has also been included, resulting in a doubling of the number of variables analysed at the aggregate level¹⁷. Each sub-index is based on a set of measurable social, economic, environmental, and infrastructural indicators. The results are recalculated on a scale

15. M. Izraelov, J. Silber, *An assessment of the global food security index*, "Food Security" 2019, Vol. 11(5), p. 1135–1152, <https://doi.org/10.1007/s12571-019-00941-y>.

16. Lithuania: 2.89 million, Latvia: 1.87 million, Estonia: 1.37 million, Slovenia: 2.12 million, Malta: 0.56 million, Luxembourg: 0.93 million, Cyprus: 0.67 million, amounting in total to 10.41 million people.

17. Economist Intelligence Unit, *Global Food Security Index 2017: Measuring Food Security and the Impact of Resource Risks*, 2017, p. 41–44, https://impact.economist.com/sustainability/project/food-security-index/resources/EIU_Global_Food_Security_Index_-_2017_Findings_Methodology.pdf; Economist Impact, *Global Food Security Index 2022: Assessing Food Security Across Four Key Pillars Affordability, Availability, Quality and Safety, and Sustainability and Adaptation*, 2022, <https://impact.economist.com/sustainability/project/food-security-index/download-the-index>.

from 0 to 100, where a higher score indicates a better level of food security. The indices are based on dozens of qualitative and quantitative indicators that assess access, quality, stability, and the systemic resilience of food systems in the countries under study. Since 2017, increasing attention has been paid to the impact of climate change and natural resources on food security. The GFSI is calculated on the basis of both quantitative and qualitative data¹⁸.

The GFSI is the most widely used among indices comparing food security at the national level¹⁹. It was developed by the Economist Intelligence Unit, a research body established by *The Economist*. The index is sponsored by Corteva, one of the world's leading crop protection manufacturers and a company owned by DuPont²⁰. The aim of GFSI-based analyses is to assess which of the countries under study are least and most exposed to food insecurity, taking into account the aforementioned dimensions.

Poland's position in the ranking according to the Global Food Security Index

The average value of the Global Food Security Index for all countries surveyed in 2022 was 62.2, while in the EU it significantly exceeded this level, reaching 74.8. This figure for the EU represents a decrease compared to 2019, when it stood at 75.8. Until 2019, the average GFSI level for all countries surveyed had been rising, but between 2019 and 2021 it declined, reaching 60.9. In recent years, as global food security has become increasingly important, GFSI fluctuations may indicate a lack of stability in this area. The collected data indicate, among other things, that the affordability sub-index declined from 71.9 to 69.0 between 2019 and 2022, a trend driven in particular by the disruptions caused by the COVID-19 pandemic and the war in Ukraine²¹.

In 2022, Poland ranked 21st in terms of its Food Security Index score (Table 1). This means that, compared to 2012, Poland improved its position by three places, while relative to 2021, it fell by one place. Moreover, Poland was among the few countries (alongside France, Belgium, and Bulgaria) that in 2022 achieved a Food Security Index score equal to or higher than in any year from 2012 to 2021. Finland and Ireland consistently ranked as the top two countries with the highest GFSI scores,

18. K. Boratyńska, *Risk Challenges and Their Impact on the Sustainable Food Security System: Lessons Learned from the COVID-19 Pandemic*, "Sustainability" 2025, Vol. 17(1), p. 226. <https://doi.org/10.3390/su17010226>.

19. M. Izraelov, J. Silber, op. cit.

20. A. Nowak et al., *Potencjał polskiego rolnictwa na tle krajów UE w zakresie zapewnienia bezpieczeństwa żywnościowego i energetycznego*, Instytut Naukowo-Wydawniczy "Spatium", 2023.

21. Economist Impact, *Global Food Security Index 2022*, op. cit.

while France and the Netherlands occupied the fourth and fifth positions, respectively. Among the EU Member States analysed, Greece, Hungary, Slovakia, and Romania exhibited the lowest levels of food security²².

An analysis of the partial GFSI indices for 2022 (see Table 1) reveals that Austria, Finland, France, the Netherlands, and Sweden were the only countries where all the sub-indices exceeded the average value in that year. The highest levels of food affordability were recorded in the Netherlands, Ireland, and Belgium, where this indicator exceeded 92. The greatest food availability was observed in Portugal, Finland, Ireland, and the Netherlands. The highest levels of food quality and safety, as measured by the relevant index, were recorded in Denmark, Finland, and Belgium. By contrast, natural resources and resilience were particular strengths of Finland and Ireland. In the case of Poland, two sub-indices – affordability and availability – were below the EU average, while two others – food quality and safety, as well as natural resources and resilience – above the average. The relatively low value of the availability sub-index is attributable to “moderate” scores for its constituents, such as agricultural research and development, farm infrastructure, and agricultural production volatility, as well as a “very weak” score in the category of food safety and access policy commitments²³.

Table 1. Values of the GFSI index and its sub-indices in EU countries in 2022

Ranking	Country	GFSI	Affordability	Availability	Food quality and safety	Natural resources and resilience
1.	Finland	83.7	91.9	70.5	88.4	82.6
2.	Ireland	81.7	92.6	70.5	86.1	75.1
4.	France	80.2	91.3	69.0	87.7	70.3
5.	The Netherlands	80.1	92.7	70.7	84.7	69.2
7.	Sweden	79.1	91.9	68.3	85.0	68.3
10.	Portugal	78.7	90.0	77.0	79.8	64.5
12.	Austria	78.1	91.3	67.1	81.2	69.7
14.	Denmark	77.8	92.1	63.2	89.1	63.8
16.	Czechia	77.7	91.3	69.4	76.3	70.3
17.	Belgium	77.5	92.6	64.6	88.4	61.0
19.	Germany	77.0	87.9	67.0	79.9	70.8
20.	Spain	75.7	89.0	63.1	81.2	66.4

Continued on the next page.

22. Ibidem.

23. Ibidem.

Table 1. Values of the GFSI index and its sub-indices in EU countries in 2022 (cont.)

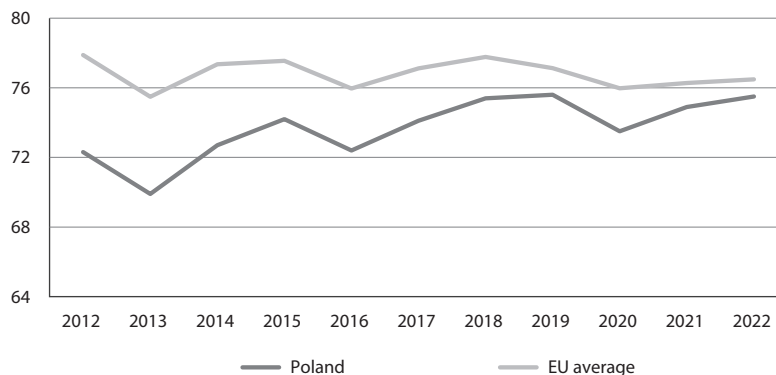
Ranking	Country	GFSI	Affordability	Availability	Food quality and safety	Natural resources and resilience
21.	Poland	75.5	87.4	63.8	81.5	66.7
27.	Italy	74.0	89.5	68.7	75.9	57.3
29.	Bulgaria	73.0	85.8	66.5	79.5	56.6
31.	Greece	72.2	88.5	58.3	80.8	57.3
34.	Hungary	71.4	86.7	63.3	74.4	57.0
36.	Slovakia	71.1	89.1	55.3	77.9	57.6
45.	Romania	68.8	85.1	60.6	77.9	47.1

Source: Source: Own elaboration based on GFSIs.

In the article by I. Szczepaniak²⁴, three GFSI sub-indices were evaluated: affordability, availability, and food quality and safety. Since then, the index has been expanded to include a fourth pillar – natural resources and resilience – and the overall number of variables has been doubled. The changes introduced to the GFSI affected Poland's score (although Poland dropped only one place in the ranking), as illustrated in Figure 1. It should also be noted that 2020 was an exceptional year due to the COVID-19 pandemic – many countries saw a decline in their food security scores in the GFSI during this period. In general, it can be observed that throughout the period 2012–2022, Poland's GFSI scores, despite some fluctuations, exhibited a slight upward trend, indicating an improvement in the country's food security system. Figure 1 further demonstrates that Poland's GFSIs are converging towards the EU average. The only exception is the marked increase in the divergence between Poland's score and the EU average in 2020, which may indicate that Poland was more susceptible to shocks (in this case, COVID-19) than the EU as a whole. It should be borne in mind, however, that by its very nature, the average is more stable than the results for an individual country.

24. I. Szczepaniak, op. cit.

Figure 1. GFSI values for Poland and the EU average in 2012–2022 (points)



Source: Source: Own elaboration based on GFSIs.

During the period under review, Poland's GFSI scores showed consistent improvement. The index increased from approximately 72 points in 2012 to over 75 points in 2022. Poland's ranking compared to other countries generally fluctuated between 25th and 35th place globally, positioning it in the middle of the table – among developed nations. Within the EU Member States, Poland ranked below the average, lagging behind countries such as Germany, France, Ireland, and the Netherlands; however, in recent years, a narrowing of this gap has been observed, which may indicate an improvement in the food security system in Poland. During the period under review, three distinct declines in Poland's performance were recorded – in 2013, 2016, and 2020. Their potential causes are presented below (Table 2).

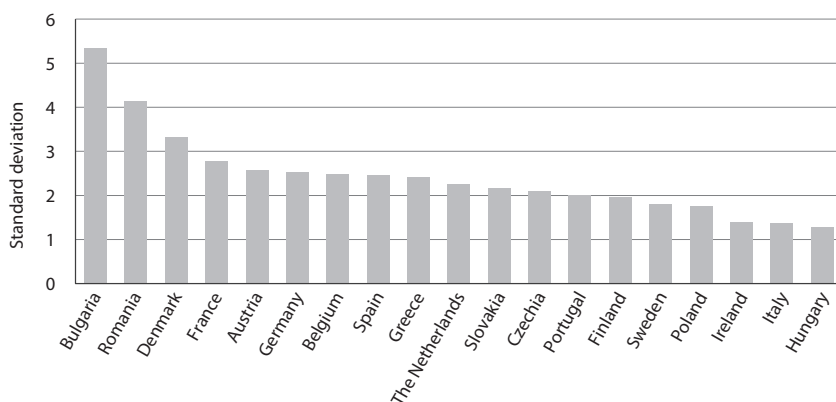
Table 2. Declines in Poland's GFSI scores

Year	Description of the situation	Possible causes
2013	Decline in the global ranking from 24 th place in 2012 to 27 th position	<ul style="list-style-type: none"> – Change in methodology and the inclusion of new countries in the index – namely Ireland and Singapore, both of which surpassed Poland – Weaker indicators of food availability – Infrastructure and food quality challenges
2016	Slight decrease in the index value, with a drop from 28 th place in 2015 to 29 th position	<ul style="list-style-type: none"> – Low resilience of the agricultural sector to climate change – Lack of progress in food quality – Changes in data assessment systems
2020	A pronounced decline in the score (by 2.1 points) was observed during the COVID-19 pandemic, accompanied by a drop from 24 th place in 2019 to 25 th position	<ul style="list-style-type: none"> – Disruptions in supply chains – Declining food affordability – Limited flexibility of the social welfare system

Source: Own elaboration.

To deepen the analysis, the volatility of the GFSI for EU member states was calculated. It was expressed as the standard deviation of GFSI values in each year from 2012 to 2022. This indicator reflects the extent to which a country's score has fluctuated over time – the higher the standard deviation, the greater the instability of food security in that country during the period under review. Figure 2 provides a visual representation of the GFSI variability across EU Member States. The EU average stands at 2.42 points. It is evident that the volatility of Poland's GFSI score was among the lowest and remained below the EU average, which may indicate a relatively high degree of food security stability.

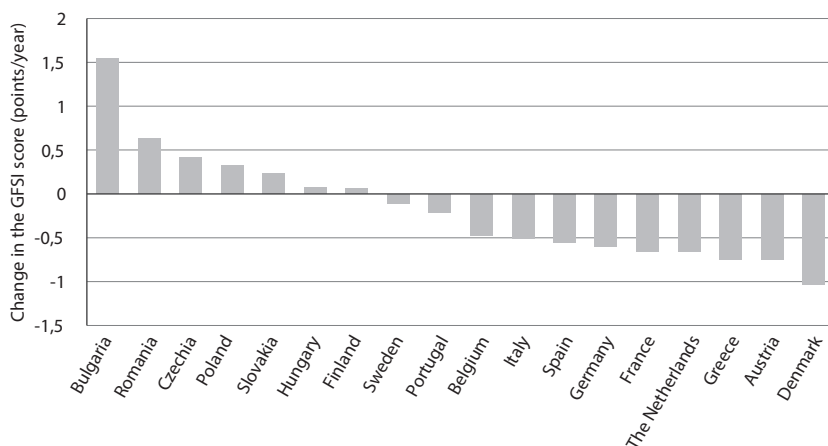
Figure 2. The GFSI variability among EU Member States between 2012 and 2022



Source: Source: Own elaboration based on GFSIs.

Further insights are provided by the analysis of the average rate of change in GFSI scores across the different EU countries between 2012 and 2022 (see Figure 3). It is worth noting that Poland recorded an average annual increase in its GFSI score of approximately 0.32 points, placing it above many EU Member States, yet still trailing behind the fastest-improving countries in the ranking, such as Bulgaria (+1.54 points per year) and Romania (+0.63 points per year). A clear trend towards convergence can be observed – Central and Eastern European countries are improving their GFSI indicators at a faster rate than Western European nations, which are already characterised by a high level of systemic food security saturation. Ireland was excluded from the chart, as its data obscured the variability.

Figure 3. Average annual change in the GFSI score among EU Member States between 2012 and 2022



Source: Source: Own elaboration based on GFSIs.

Subsequently, Z and T standardisations were applied to the GFSI results for EU Member States, with particular attention paid to Poland. It should be noted that both the Z-score and T-score are based on annual standardisation, meaning that the reference point changes from year to year. A high or low score may therefore result not so much from changes within a given country as from developments in its external environment. Moreover, these methods are sensitive to outliers, which may distort the overall picture of relative positioning. Despite these limitations, standardisation allows for a synthetic assessment of Poland's position relative to the EU average. Z-standardisation is an indicator that expresses by how many standard deviations a given observation differs from the mean of the studied population. The T-score, on the other hand, is a normalised measure derived from the Z-score.

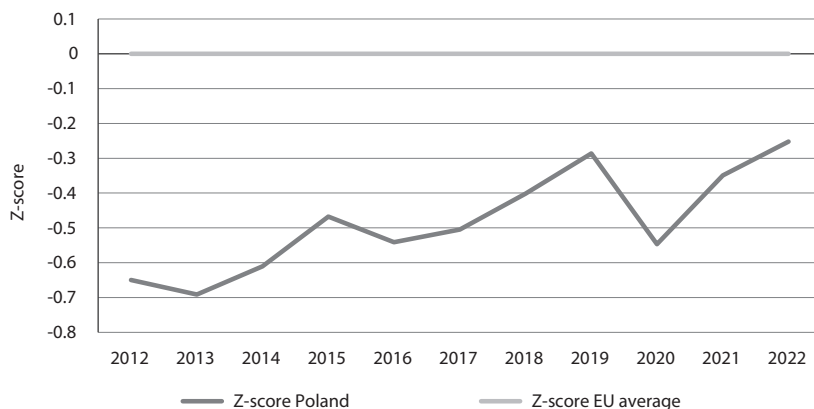
The Z-score is calculated using the following formula:

$$Z = (X - \mu) / \sigma$$

where:

- X represents an individual data point (the GFSI score for a given country and year),
- μ denotes the mean of the dataset (the average GFSI score across all EU countries for a given year),
- σ denotes the standard deviation of the dataset (the dispersion of GFSI scores for a given year).

Figure 4. Z-standardisation of EU Member States in 2012–2022



Source: Own elaboration based on GFSIs.

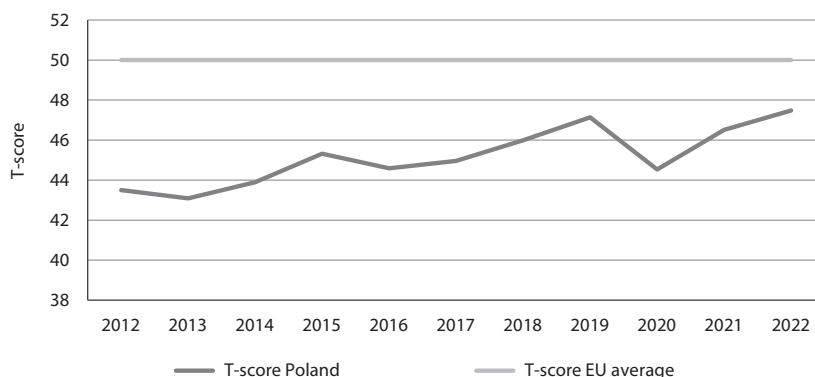
A positive Z-score indicates that a country ranks above the average, while a negative score means it falls below the mean. They enable cross-country comparisons to be made against a shared baseline. By comparing annual results, it is possible to identify emerging trends. Despite improvements in Poland's GFSI scores between 2016 and 2019, Z-score results indicate that the country still remains below the EU average (see Figure 4).

T-score results are a linear transformation of Z-scores, rescaling the values to a distribution with a mean of 50 and a standard deviation of 10. The T-score is calculated using the following formula:

$$T = 50 + 10 * Z$$

A T-score of 50 represents the average for EU Member States. This standardisation facilitates the comparison of results, which are presented on a consistent scale and are easier to interpret than Z-scores. The mean value of 50 serves as a stable reference point, making it straightforward to determine whether a given score lies above or below the average. Because T-scores normalise the data distribution for each year, they are particularly useful for comparisons across years or regions. The results of the standardisation T of Poland also show an increase and development of food security and place Poland below the EU average (Figure 5).

Figure 5. T-standardisation: Poland versus the EU average in 2012–2022



Source: Own elaboration based on GFSIs.

The method of assessing food security based on the GFSI enables comparative analysis of food security at the national level. It is therefore a highly practical tool. Each year, this method is expanded to include additional variables, which, while broadening the scope of food security assessment, also means that results from different years may not be fully comparable. Therefore, the overall GFSI score should be regarded as an indicative variable. In order to conduct precise research based on this indicator, it is advisable to analyse individual variables in relation to one another rather than relying on aggregated cumulative indices.

Critical analysis of the GFSI

Hunger and malnutrition are global challenges. Although they affect the EU population to a much lesser extent than other regions of the world, challenges related to food distribution, losses, waste, and optimal nutrition persist within the Union. As noted by A. Nowak et al.²⁵, based on an analysis of changes in the global GFSI index at the turn of the second and third decades of the 21st century, “global food security remains unstable”; nonetheless, Poland has been classified among the most stable countries in this regard.

25. A. Nowak et al., op. cit.

Since 2017, a fourth component has been incorporated into the GFSI, focusing on natural resources and the resilience of food systems²⁶. According to J. Guo et al.²⁷, the current GFSI, expanded to include resilience to risk factors such as wars and natural disasters, provides a more accurate reflection of the state of food security in individual countries; furthermore, as noted by Ö. Turan et al.²⁸, the annual recalibration of the index enables the dynamic capture of changes occurring within global food systems. However, this may reduce the comparability of the different years and the changes observed between them, and may also mean that countries scoring highly in newly introduced categories benefit more than was the case in years preceding these modifications. Poland may be one such country, as it benefited from these changes (despite a decline in the pandemic year 2020). The evolution of the index over the years is presented in Table 3.

Table 3. Reforms to the GFSI methodology

Year	Types of changes	Description of the methodology
2012	Introduction to the GFSI	Three pillars – Affordability, Availability, and Quality & Safety; a total of 25 variables
2013–2015	Extension of the GFSI	Incorporation of variables relating, among others, to poverty and imports
2016	Update of weights and aggregation	Adjustment of variable weights and aggregation – with increased emphasis on accessibility and policy-related aspects
2017–2018	Further modifications	Modifications to variable definitions, the introduction of new qualitative indicators (such as dietary diversity and nutrition policy)
2019	System-level indicators	The inclusion of variables related to environmental policy, biodiversity, and food system resilience
2020	Structural reform	Addition of the fourth pillar: Natural Resources & Resilience – the number of variables increased to 58; this resulted in a significant change in country scores
2021–2022	Extension of the fourth pillar:	Extension of components related to climate change, water resource availability, and infrastructural resilience

Source: Own elaboration.

26. See V.O. Odhiambo, S.L. Hendriks, E.P. Mutsvangwa-Sammie, *The effect of an objective weighting of the global food security index's natural resources and resilience component on country scores and ranking*, "Food Security" 2021, Vol. 13(6), p. 1343–1357, <https://doi.org/10.1007/s12571-021-01176-6>.

27. J. Guo et al., *Global Food Security Assessment during 1961–2019*, "Sustainability" 2021, Vol. 13(24), p. 14005, <https://doi.org/10.3390/su132414005>.

28. Ö. Turan, S. Gürlük, E. Issi, *Global food security index's reflections to Balkan countries*, "Agriculture for Life Life for Agriculture" Conference Proceedings, 2018, Vol. 1(1), p. 205–211.

Many of the indicators analysed were already included in the first edition of the GFSI; however, in subsequent years, they were subdivided into smaller sub-indices. Some studies have applied Principal Component Analysis (PCA) to test the indicators, as exemplified by the work of O. Odhiambo et al.²⁹ and M. Izraelov and J. Silber³⁰. Both studies concluded that the selected variables are not statistically biased, although according to O. Odhiambo et al.³¹, in order to improve the reliability of the GFSI, weighting should be based on objective statistical measures. This is particularly relevant given that the variables included in the GFSI are selected by a panel of 20 experts. The levels of the GFSI pillars are determined either by assigning them equal weights or by applying weights established by this panel of experts³². Furthermore, as noted by Ö. Turan et al.³³, the individual indicators can be selected and weighted by researchers according to their own methodological assumptions. However, variables not included in the index may also play a significant role. For example, Ö. Turan et al.³⁴ argue that the index should account for differences in country size and be further extended to incorporate the Gini coefficient as a measure of inequality. This latter argument may be particularly pertinent for a country such as Poland, where the number of people living in poverty exceeds two million and, according to recent data, is rising – meaning that approximately 5% of the population may be experiencing food insecurity. In turn, W. Martindale et al.³⁵ highlight the absence of indicators for food storage. S. Łaba et al.³⁶ have observed a lack of appropriate practices for the long-term storage of food – particularly that which is vulnerable to spoilage. Meanwhile, M. Izraelov and J. Silber³⁷ (citing Thomas et al.) argue that the indicator focuses on food security itself, rather than its objectives, such as food consumption or the nutritional status of the population.

Since 2022, the indicator has incorporated the concept of the “first mile,” that is, the shortest possible distance “from farm to fork,” with a particular emphasis on shortening supply chains³⁸. This is particularly important in view of the instability of

29. V.O. Odhiambo, S.L. Hendriks, E.P. Mutsvangwa-Sammie, op. cit.

30. M. Izraelov, J. Silber, op. cit.

31. V.O. Odhiambo, S.L. Hendriks, E.P. Mutsvangwa-Sammie, op. cit.

32. Ibidem; M. Izraelov, J. Silber, op. cit.

33. Ö. Turan, S. Gürlük, E. Issi, op. cit.

34. Ibidem.

35. Zob. W. Martindale et al., *Framing food security and food loss statistics for incisive supply chain improvement and knowledge transfer between Kenyan, Indian and United Kingdom food manufacturers*, “Emerald Open Research” 2020, Vol. 1(6), <https://doi.org/10.35241/emeraldopenres.13414.1>.

36. See S. Łaba, I. Olech, R. Łaba, *A Conceptual Framework for the Long-Term Storage of Unused Food for the Purpose of Creating Food Reserves and Preventing Food Waste in Poland*, “Annals PAAAE” 2024, Vol. XXVI(2), p. 122–137, <https://doi.org/10.5604/01.3001.0054.4638>.

37. M. Izraelov, J. Silber, op. cit.

38. K. Boratyńska, op. cit.

global trade, including food trade. All the more striking, then, amid these changes, is the stability observed in Ireland – a country that, during the pandemic, experienced difficulties in securing supplies of certain food products. Since 2017, the index has also incorporated the gender dimension in agricultural production³⁹, which may distort Poland's scores, as Polish agriculture is predominantly based on family farms where, by tradition, the male is regarded as the head of the household. In such a case, this may have a negative impact on Poland's score.

As noted by Y. Xu et al.⁴⁰ and J. Guo et al.⁴¹, aggregate indices such as the GFSI can serve as a valuable resource for policymakers seeking to strengthen the pillars of food security within their countries and to develop appropriate policy responses. This has become an especially salient issue in recent years⁴². In contrast, O. Odhiambo et al.⁴³ argue that such aggregation may obscure the core challenges related to a given country's food security. Nevertheless, it should be emphasised that the aggregated GFSI score serves primarily as an overview, and the essence of a country's food security should be examined through an analysis of the individual components of the overall index.

The limitations of the GFSI also stem from the very nature of the food security concept, which, following the food crisis of 2007–2008, prioritised increased agricultural production⁴⁴ over alternative approaches. M.B. Carstensen and V.A. Schmidt⁴⁵ identify manifestations of such dominance in the form of ideas, a perspective that was later reflected in research on food systems. Manifestations of ideational power arise when actors seek to shape the beliefs of others by advancing their own ideas at the expense of those of others⁴⁶. In the context of food security, indicators such as the GFSI may embody prevailing ideas promoted by particular groups of actors, such as large corporations⁴⁷, which can result in the marginalisation of alternative perspectives.

One such perspective is food sovereignty, which emphasises the importance of farmers themselves owning the means of production and managing supply chains,

39. Ibidem.

40. Y. Xu et al., *Predicting the potential impact of emergency on global grain security: a case of the Russia – Ukraine conflict*, "Foods" 2023, Vol. 12(13), p. 2557, <https://doi.org/10.3390/foods12132557>.

41. J. Guo et al., op. cit.

42. Ö. Turan, S. Gürlük, E. Issi, op. cit.

43. V.O. Odhiambo, S.L. Hendriks, E.P. Mutsvangwa-Sammie, op. cit.

44. E. Fouilleux, N. Bricas, A. Alpha, *'Feeding 9 billion people': global food security debates and the productionist trap*, "Journal of European Public Policy" 2017, Vol. 24(11), p. 1658–1677. <https://doi.org/10.1080/13501763.2017.1334084>.

45. M.B. Carstensen, V.A. Schmidt, *Power through, over and in ideas: conceptualizing ideational power in discursive institutionalism*, "Journal of European Public Policy" 2016, Vol. 23(3), p. 318–337, <https://doi.org/10.1080/13501763.2015.1115534>.

46. Ibidem.

47. E. Fouilleux, N. Bricas, A. Alpha, op. cit.

rather than these being controlled by transnational corporations. This concept is closely linked to the right of farmers to determine food systems at both local and national levels⁴⁸. Incorporating the issue of food sovereignty into the indicator could potentially improve Poland's ranking, given the extensive land ownership held by Polish farmers, which may be regarded as a factor strengthening resilience and control over the food system, particularly in comparison to countries characterised by highly centralised, large-scale agriculture. Moreover, the dominance of productionism in global food security debates – where a complex issue is reduced to the question of increasing output – may result in indicators such as the GFSI insufficiently accounting for challenges related to food access (e.g., economic or social barriers) and utilisation (e.g., nutritional value, cultural preferences)⁴⁹. While food sovereignty is often presented as diametrically opposed to food security, there are elements of these concepts that overlap⁵⁰, and harnessing these elements can strengthen food systems.

The same applies to agroecology, which focuses on sustainable agricultural practices, often abandoning artificial plant and soil protection. As noted by K.M. Dittmer et al.⁵¹, agroecological practices enhance the resilience of food systems and thereby contribute to improved food security. It should be emphasised, however, that such practices stand in contrast to conventional agriculture, which is predominantly based on monoculture cropping systems. Conversely, A. Baiardi and M.T.M. Pedroso⁵² argue that agroecological practices are not capable of replacing conventional agriculture. The authors contend that, despite its potential environmental benefits, agroecology does not meet the criteria of an agricultural science capable of ensuring food security on the scale required by contemporary society. This is primarily due to the lack of empirical evidence for comparable productivity, the rejection of key tools of modern agriculture – such as genetic engineering – and a predominant focus on ideological and political aspects at the expense of concrete production solutions. It should be noted, however, that Brazilian agriculture – the authors' primary reference point – is even more extensive than its European counterpart and is largely based on genetically modified organisms (with Brazil being the world's second largest producer of such crops after the United States). In contrast, agriculture in the EU is highly restrictive regarding the

48. M. Edelman, *Food sovereignty: forgotten genealogies and future regulatory challenges*, "The Journal of Peasant Studies" 2014, Vol. 41(6), p. 959–978, <https://doi.org/10.1080/03066150.2013.876998>.

49. E. Foulleux, N. Bricas, A. Alpha, op. cit.

50. M. Edelman, op. cit.

51. K.M. Dittmer et al., *Agroecology can promote climate change adaptation outcomes without compromising yield in smallholder systems*, "Environmental Management" 2023, Vol. 72(2), p. 333–342. <https://doi.org/10.1007/s00267-023-01816-x>.

52. A. Baiardi, M.T.M. Pedroso, *Demystifying agroecology in Brazil*, "Ciência Rural" 2020, Vol. 50(11), <https://doi.org/10.1590/0103-8478cr20191019>.

use of GMOs, partly in response to consumer pressure. Consequently, the understanding of food security among EU Member States may differ significantly from that in Brazil (despite the widespread adoption of the FAO definition), which is particularly relevant in the context of the anticipated agreement with MERCOSUR countries and its implications for Polish and European agriculture as well as consumers.

Another concept competing with food security is food democracy, which contrasts with centralised, large-scale, corporate production and focuses on local control and ownership of production chains and on consumer preferences⁵³. J. Behringer and P.H. Feindt⁵⁴ define food democracy as a counterbalance to the “control of food” exercised by concentrated and transnational corporate power within the agri-food system. With its fragmented structure of producers, Poland may be regarded as a country more receptive to the principles of food democracy, which emphasises the strengthening of grassroots public participation in food governance. The concept of radical food democracy (RFD) integrates diverse economic approaches with the notion of civic participation, aiming to establish food systems characterised by more decentralised and collective ownership structures and a higher degree of participatory engagement⁵⁵. This approach necessitates both experimentation with new economic practices that depart from the logic of capital accumulation and the formation of new political actors capable of implementing such practices in reality. Community supported agriculture (CSA) initiatives and local food policy councils (FPCs) exemplify grassroots efforts that can contribute to the development of more democratic food systems for citizens seeking to participate in shaping food policy at the local and regional levels. Such grassroots initiatives may, however, encounter obstacles stemming from traditional political practices, where the interests of powerful lobby groups tend to prevail⁵⁶.

These concepts may be at odds with the interests of DuPont, a company engaged in the production and sale of synthetic crop protection agents. These issues are of such importance from the perspective of food security that they serve to complement it by addressing aspects previously overlooked in its narrow interpretation in favour of mass production⁵⁷, as well as in recognition of the holistic nature of food security – a point frequently raised in the literature⁵⁸ and underscored by research

53. J. Behringer, P.H. Feindt, *Varieties of food democracy: a systematic literature review*, “Critical Policy Studies” 2023, Vol. 18(1), p. 25–51, <https://doi.org/10.1080/19460171.2023.2191859>.

54. Ibidem.

55. S. Leitheiser, R. Vezzoni, *Joining the ideational and the material: transforming food systems toward radical food democracy*, “Frontiers in Sustainable Food Systems” 2024, Vol. 8, p. 1307759, <https://doi.org/10.3389/fsufs.2024.1307759>.

56. Ibidem.

57. E. Fouilleux, N. Bricas, A. Alpha, op. cit.

58. Zob. np. K. Boratyńska, op. cit.

highlighting the growing significance of a broader food policy discourse extending beyond the traditional confines of agricultural policy⁵⁹.

Moreover, indices such as the GFSI may insufficiently account for the long-term sustainability of food systems and their environmental impacts. The concept of multifunctionality in agriculture emphasises the many functions that agriculture has beyond the production of goods, including the provision of environmental and social benefits that may not be fully reflected in indicators focused on quantity and stability of supply⁶⁰. Furthermore, when analysing the limitations of the GFSI, it is important to consider the dynamic nature of food supply chain governance. An important dimension is ideational power, that is, the capacity of actors to shape the normative and cognitive beliefs of others through the use of ideas⁶¹. The GFSI may reflect dominant conceptions of food security advanced by certain groups of actors, which can result in the exclusion of alternative approaches⁶². One example is the intellectual dominance of market-oriented ideas within financial regulation, where expert networks – rooted in shared interests and elite recognition – have limited the participation of actors holding alternative perspectives⁶³.

Conclusions

The COVID-19 pandemic, warfare on various fronts, and climate change have brought to light the weaknesses of food systems and inequalities in different regions of the world, causing a further increase in global hunger and posing a serious threat to food security. Accordingly, guaranteeing both physical and economic access to sufficient, safe, and nutritionally appropriate food for all people has become one of the most significant global challenges of the twenty-first century. Given the vast number of people worldwide suffering from hunger and subsisting below the minimum standard of living, every possible effort must be undertaken to advance food security⁶⁴.

59. M. Coulas, *Discursive institutionalism as an approach for food policy analysis: Insights from the development of Canada's Food Policy*, "Frontiers in Communication" 2021, Vol. 6, p. 749027, <https://doi.org/10.3389/fcomm.2021.749027>.

60. G. Skogstad, *Effecting paradigm change in the Canadian agriculture and food sector: Towards a multifunctionality paradigm*, "Health and sustainability in the Canadian food system: advocacy and opportunity for civil society" 2012, p. 17–38.

61. M.B. Carstensen, V.A. Schmidt, op. cit.

62. E. Fouilleux, N. Bricas, A. Alpha, op. cit.

63. M.B. Carstensen, V.A. Schmidt, op. cit.

64. M. Kwasek, S. Kowalczyk, *Straty i marnotrawstwo żywności w aspekcie bezpieczeństwa żywnościowego*, "Kwartalnik Nauk o Przedsiębiorstwie" 2023, nr 68(2), p. 23–42, <https://doi.org/10.33119/KNoP.2023.68.2.2>.

Despite Poland's lower ranking relative to the EU average, the assessment of its food security based on GFSI dynamics is favourable. Significant progress has been made in terms of both the availability and quality of food, although challenges remain in areas such as strengthening the food system's resilience to crises and improving agricultural infrastructure.

Compared to the findings of I. Szczepaniak's study, over the past five years Poland has increased its overall GFSI score by more than 3 points. Although Poland does not rank among the EU leaders, its position remains stable within the group of countries characterised by moderately high food security. Similarly to the findings of the 2018 study, Poland continues to maintain a high level of food self-sufficiency⁶⁵, which has a positive impact on its GFSI score, particularly in comparison with other EU Member States. According to A. Nowak et al.⁶⁶, Polish agriculture is capable of ensuring food security for the country's population even in the context of relatively low production intensity and limited labour and land productivity.

Nonetheless, Poland's main weaknesses remain its low GDP per capita and, compared to other EU countries, the relatively lower purchasing power of households. An analysis of GFSI volatility between 2012 and 2022 indicates that the Polish food system is moderately stable, with Poland not ranking among the countries most susceptible to GFSI fluctuations. Moreover, Poland's volatility indicator is lower than that of countries with comparable GFSI scores. This means that, although Poland does not rank among the countries with the highest GFSI scores, it demonstrates greater long-term stability than many states with higher GFSI values. The addition of a fourth pillar to the method was beneficial for Poland, raising its position in the ranking by a relatively larger margin than other countries. The developed methodology highlights Poland's geographical and climatic advantages, such as a temperate climate, substantial water retention potential, and a lower risk of flooding.

Poland has been systematically enhancing its food security, both in terms of its overall GFSI level and the structure of its score. After incorporating environmental resilience components, Poland gained an advantage over certain EU countries. Nevertheless, it should continue to enhance economic access to food and the added value of the agri-food sector.

65. P. Szajner, I. Szczepaniak, W. Łopaciuk, *An Assessment of the Production Potential and Food Self-Sufficiency of Ukraine against the Background of the European Union and Poland*, "Sustainability" 2024, Vol. 16(17), p. 7735, <https://doi.org/10.3390/su16177735>.

66. A. Nowak et al., op. cit.

Bibliography

- Baiardi A., Pedroso M.T.M., *Demystifying agroecology in Brazil*, "Ciência Rural" 2020, Vol. 50(11). <https://doi.org/10.1590/0103-8478cr20191019>.
- Ballenger N., Mabbs-Zeno C., *Treating food security and food aid issues at the GATT*, "Food Policy" 1992, Vol. 17(4).
- Behringer J., Feindt P.H., *Varieties of food democracy: a systematic literature review*, "Critical Policy Studies" 2023, Vol. 18(1), <https://doi.org/10.1080/19460171.2023.2191859>.
- Boratynska K., *Risk Challenges and Their Impact on the Sustainable Food Security System: Lessons Learned from the COVID-19 Pandemic*, "Sustainability" 2025, Vol. 17(1), <https://doi.org/10.3390/su17010226>.
- Carstensen M.B., Schmidt V.A., *Power through, over and in ideas: conceptualizing ideational power in discursive institutionalism*, "Journal of European Public Policy" 2016, Vol. 23(3), <https://doi.org/10.1080/13501763.2015.1115534>.
- Coulas M., *Discursive institutionalism as an approach for food policy analysis: Insights from the development of Canada's Food Policy*, "Frontiers in Communication" 2021, Vol. 6, <https://doi.org/10.3389/fcomm.2021.749027>.
- Dittmer K.M. et al., *Agroecology can promote climate change adaptation outcomes without compromising yield in smallholder systems*, "Environmental Management" 2023, Vol. 72(2), <https://doi.org/10.1007/s00267-023-01816-x>.
- Economist Impact, *Global Food Security Index 2021: The 10-year Anniversary*, 2021.
- Economist Impact, *Global Food Security Index 2022: Assessing Food Security Across Four Key Pillars Affordability, Availability, Quality and Safety, and Sustainability and Adaptation*, 2022, <https://impact.economist.com/sustainability/project/food-security-index/download-the-index>.
- Economist Intelligence Unit, *Global Food Security Index 2012: An Assessment of Food Affordability, Availability and Quality*, 2012.
- Economist Intelligence Unit, *Global Food Security Index 2013: An Annual Measure of the State of Global Food Security*, 2013.
- Economist Intelligence Unit, *Global Food Security Index 2014: An Annual Measure of the State of Global Food Security*, 2014.
- Economist Intelligence Unit, *Global Food Security Index 2015: An Annual Measure of the State of Global Food Security*, 2015.
- Economist Intelligence Unit, *Global Food Security Index 2016: Findings & Methodology*, 2016.
- Economist Intelligence Unit, *Global Food Security Index 2017: Measuring Food Security and the Impact of Resource Risks*, 2017, https://impact.economist.com/sustainability/project/food-security-index/resources/EIU_Global_Food_Security_Index_-_2017_Findings_Methodology.pdf.
- Economist Intelligence Unit, *Global Food Security Index 2018: Building Resilience in the Face of Rising Food Security Risks*, 2018.

- Economist Intelligence Unit**, *Global Food Security Index 2019: Strengthening Food Systems and the Environment Through Innovation and Investment*, 2019.
- Economist Intelligence Unit**, *Global Food Security Index 2020: Addressing Structural Inequalities to Build Strong and Sustainable Food Systems*, 2021.
- Edelman M.**, *Food sovereignty: forgotten genealogies and future regulatory challenges*, "The Journal of Peasant Studies" 2014, Vol. 41(6), <https://doi.org/10.1080/03066150.2013.876998>.
- European Commission**, *Food security: understanding and meeting the challenge of poverty*, Brussels, Belgium, Publications Office of the European Union, 2009.
- FAO**, *The State of Food Insecurity in the World. Meeting the 2015 international hunger targets: taking stock of uneven progress*, Rome, FAO, IFAD, WFP, 2015, <https://www.fao.org/fsnforum/resources/fao-flagships/state-food-insecurity-world-2015-sofi>.
- FAO**, *The State of Food Security and Nutrition in the World 2022: Repurposing food and agricultural policies to make healthy diets more affordable*, Rome, FAO, IFAD, UNICEF, WFP, WHO, 2022, <https://doi.org/10.4060/cc0639en>.
- FAO, IFAD, UNICEF, WFP, WHO**, *The State of Food Security and Nutrition in the World 2024: Financing to the end hunger, food insecurity and malnutrition in all its forms*, Rome, FAO, 2024, <https://doi.org/10.4060/cd1254en>.
- Fouilleux E., Bricas N., Alpha A.**, 'Feeding 9 billion people': global food security debates and the productionist trap, "Journal of European Public Policy" 2017, Vol. 24(11), <https://doi.org/10.1080/13501763.2017.1334084>.
- Guo J. et al.**, *Global Food Security Assessment during 1961–2019*, "Sustainability" 2021, Vol. 13(24), <https://doi.org/10.3390/su132414005>.
- Izraelov M., Silber J.**, *An assessment of the global food security index*, "Food Security" 2019, Vol. 11(5), <https://doi.org/10.1007/s12571-019-00941-y>.
- Kwasek M., Kowalczyk S.**, *Straty i marnotrawstwo żywności w aspekcie bezpieczeństwa żywnościowego*, "Kwartalnik Nauk o Przedsiębiorstwie" 2023, nr 68(2), <https://doi.org/10.33119/KNoP.2023.68.2.2>.
- Leitheiser S., Vezzoni R.**, *Joining the ideational and the material: transforming food systems toward radical food democracy*, "Frontiers in Sustainable Food Systems" 2024, Vol. 8, <https://doi.org/10.3389/fsufs.2024.1307759>.
- Łaba S., Olech I., Łaba R.**, *A Conceptual Framework for the Long-Term Storage of Unused Food for the Purpose of Creating Food Reserves and Preventing Food Waste in Poland*, "Annals PAAAE" 2024, Vol. XXVI(2), <https://doi.org/10.5604/01.3001.0054.4638>.
- Małysz J.**, *Ekonomiczna interpretacja bezpieczeństwa żywnościowego* [in:] *Bezpieczeństwo żywności w erze globalizacji*, red. S. Kowalczyk, Warszawa, Warsaw School of Economics, 2009.
- Martindale W. et al.**, *Framing food security and food loss statistics for incisive supply chain improvement and knowledge transfer between Kenyan, Indian and United Kingdom food manufacturers*, "Emerald Open Research" 2020, Vol. 1(6), <https://doi.org/10.35241/emeraldopenres.13414.1>.
- Nowak A., Jarosz-Angowska A., Klikocka H. et al.**, *Potencjał polskiego rolnictwa na tle krajów UE w zakresie zapewnienia bezpieczeństwa żywnościowego i energetycznego*, Instytut Naukowo-Wydawniczy "Spatium", 2023.

- Odhiambho V.O., Hendriks S.L., Mutsvangwa-Sammie E.P.**, *The effect of an objective weighting of the global food security index's natural resources and resilience component on country scores and ranking*, "Food Security" 2021, Vol. 13(6), <https://doi.org/10.1007/s12571-021-01176-6>.
- United Nations**, *Transforming our world: The 2030 Agenda for Sustainable Development*, Resolution adopted by the General Assembly on 25 September 2015, United Nations A/RES/70/1, <https://www.gov.pl/web/rozwoj-technologie/agenda-2030>.
- Pawlak K.**, *Problemy światowego i europejskiego bezpieczeństwa żywnościowego* [in:] *Ewolucja światowego i krajowego popytu na żywność w kontekście zmian demograficznych i bezpieczeństwa żywnościowego*, red. K. Świątlik, Monografie Programu Wieloletniego, nr 65, Warszawa, IERiGŻ-PIB, 2017, <http://www.ierigz.waw.pl/publikacje/publikacje-programu-wieloletniego-2015-2019/21786,13,3,0,nr-65-ewolucja-swiatowego-i-krajowego-popytu-na-zywnosc-w-kontekscie-zmian-demograficznych-i-bezpieczenstwa-zywnosciowego.html>.
- Council of the European Union**, *Food Losses and Food Waste – Council Conclusions*, Brussels, 28 June 2016, 10730/16, <https://data.consilium.europa.eu/doc/document/ST-10730-2016-INIT/pl/pdf>.
- Skogstad G.**, *Effecting paradigm change in the Canadian agriculture and food sector: Towards a multifunctionality paradigm*, "Health and sustainability in the Canadian food system: advocacy and opportunity for civil society" 2012.
- Szajner P., Szczepaniak I., Łopaciuk W.**, *An Assessment of the Production Potential and Food Self-Sufficiency of Ukraine against the Background of the European Union and Poland*, "Sustainability" 2024, Vol. 16(17), <https://doi.org/10.3390/su16177735>.
- Szczepaniak I.**, *Ocena bezpieczeństwa żywnościowego i samowystarczalności żywnościowej Polski na tle państw Unii Europejskiej*, "International Business and Global Economy" 2018, No. 37, <https://doi.org/10.4467/23539496IB.18.012.9385>.
- Turan Ö., Gürlük S., Issi E.**, *Global food security index's reflections to Balkan countries*, "Agriculture for Life, Life for Agriculture" Conference Proceedings, 2018, Vol. 1(1).
- Xu Y. et al.**, *Predicting the potential impact of emergency on global grain security: a case of the Russia–Ukraine conflict*, "Foods" 2023, Vol. 12(13), <https://doi.org/10.3390/foods12132557>.

received: 16.04.2025

accepted: 06.06.2025

