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Food security of Ukraine: National and global level

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Abstract

The aim of this paper is to examine the level of food security in Ukraine in comparison to global regions and European countries in the context of the COVID-19 pandemic and the Russian-Ukrainian war. For this purpose, a variety of indicators were examined including population dynamics, food balance, FAO indicators, and the Global Food Security Index. The results show that in spite of its agricultural potential Ukraine is behind the global and European indicators of food security with the exception of fish products. Barriers to achieving high levels of food security include incomplete legislative reforms, inadequate funding, infrastructure deficiencies, corruption and non-compliance with standards. International cooperation and improved national and regional strategies are needed to overcome the consequences of the war.

Keywords

- food security
- food security indicators
- export
- import
- import dependence
- self-sufficiency
- consumption of food products

JEL codes: Q17, Q18, R11, R58

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Introduction

The food problem has always been in the centre of attention at different stages of society's development as evidenced by the continuous improvement of relevant national programmes primarily in the most developed countries of the world, such as the United States, Japan and EU members. The level of sufficient supply of qualitative food products is a strategically important element of social stability and economic sovereignty and preservation of the nation's health.

Today the optimistic strategies of countries and international organizations regarding the elimination of all forms of malnutrition have turned out to be ineffective. First, the COVID-19 pandemic has had a devastating impact on the global economy and triggered a recession not seen since the Second World War exposing the shortcomings of existing food systems which endangered the lives of people in all regions of the world, especially the least developed countries and exacerbated food insecurity. Thus, in 2020 compared to 2019 the increase in the cost of a healthy diet under the conditions of growing poverty and income inequality caused an increase in the number of people suffering from hunger by 161 million to 811 million people and those who did not have access to a sufficient amount of food—by 320 million people (FAO, 2022).

Despite the pandemic crisis Ukraine as one of the world's largest suppliers of food of animal and vegetable origin (in particular in 2020: 6th place among world exporters of grain crops; 8th place—seeds and fruits of oil plants; 5th place—fats and oils of animal and plant origin) (Melnyk et al., 2021) supplied the countries of the Middle East, Europe, Southeast Asia and North Africa with food. Export of Ukrainian agricultural products to the world market in 2021 accounted for the lion's share of Ukrainian exports (41%) and covered the food needs of 400 million people (Ministry of Agrarian Policy and Food of Ukraine, 2022). The value of production of agriculture and related industries is 20% of Ukraine's GDP and at the same time 70% depends on exports (State Statistics Service of Ukraine, 2022).

The Russian-Ukrainian war for the second time in a short period put humanity in danger of food collapse and deep economic upheavals. Russian aggression and the blockade of Black Sea ports caused interruptions in the supply of food to foreign markets and an increase in world prices because Ukraine and the Russian Federation collectively account for 30% of world wheat exports, 15% of corn and 80% of sunflower oil trade (Ministry of Agrarian Policy and Food of Ukraine, 2022). Each element of the value creation chain of the agricultural sector of Ukraine was negatively affected and its production and export potential weakened. Prolonging the destructive military actions on the territory of Ukraine means a further reduction in food supplies. For Ukraine it prompted a decrease in the liquidity of agricultural producers, an increase

in inflation and unemployment, a decrease in the financing of the healthcare and social protection system which also affects the availability of food and the quality of nutrition.

Therefore, in the context of the aggravation of the global food crisis as a result of the Russian-Ukrainian war there is an urgent need to improve the policy of strengthening food security at national and global levels and to develop effective mechanisms for supporting the agricultural sector based on the application of a comprehensive approach to monitoring the level of food security. This factor indicates the relevance of the chosen research topic.

In general this study addresses the research gap in understanding food security in Ukraine by conducting a comprehensive analysis and comparing the country's key indicators with global and European averages. It also considers the impact of the Russian-Ukrainian war on food security and adds value by providing policy recommendations to strengthen food security in Ukraine.

The article is organised as follows. Section 1 offers an overview of the literature on food security. In Section 2 the comprehensive approach was used. The results of applying this approach are shown in Section 3. Section 4 discusses the impact of the COVID-19 pandemic and the Ukrainian-Russian war on food security and nutrition. The conclusions offer some final remarks, acknowledge the study's limitations and highlight possibilities for future research.

1. Literature review

Many works are devoted to the improvement of methodical approaches for assessing the level of food security. A system of indicators is proposed forecasting by main groups of food products and assessing the state's real needs for resources for their production. Basic indicators of the food strategy as a component of the state's agrarian policy are defined (Nikonenko, 2022). The methodology of the integral assessment of food safety has been improved taking into account the indicators approved by the government as well as an assessment based on the specified indicators of the risks to food safety (Skrypnyk & Starychenko, 2017).

Ukrainian researchers assess the current level of food security in Ukraine and determine the trends in the change of the main indicators according to the national methodology of the CMU which takes in to account the influence of various factors at different levels of management (Babych, 2018). The peculiarities of food security in Ukraine in the conditions of the pandemic were studied and the measures of the economic policy to ensure it were systematized (Tyutyunnikova & Skochko, 2020). In particular the question of minimizing the degree of import dependence of the country's food market is con-

stantly in the field of interest. The commodity and geographical structure of the import of agricultural products in Ukraine was analyzed and the ways of increasing the level of self-sufficiency of the domestic food market and reducing dependence on foreign food supply were assessed (Dukhnytskyi, 2020a).

Scientific research on current global trends in food security deserves special attention. The determinants of the formation of the country's food potential have been identified: conflicts and wars, global pandemics (COVID-19), climate variability and its extreme manifestations, economic slowdowns and economic downturns, and nutrition policy (Pogorelova, 2022).

A significant number of scientific works are devoted to issues of the food security of Ukraine in the context of globalization. Attention is focused on its unsatisfactory level in the global rating and the presence of problems in providing the population with food in view of the growth of threats in the agricultural sector (Horin, 2020). The challenges of the Ukrainian food industry to strengthen global food security in the face of internal and external challenges are substantiated (Pasichnyk, 2020; Sychevskyi, 2019). The dynamics of the geographical structure of food consumption in the last 40 years in the world were analysed, the energy value of the modern diet of a typical inhabitant of the planet was determined, the consumption indicators in the key countries of each geographical region and the differentiation of costs for organic products depending on the purchasing power of buyers in comparison with Ukraine were explored (Dukhnytskyi, 2020b). An assessment of the dynamics of Ukraine's self-sufficiency in basic food products was carried out, the prerequisites and prospects of the national product manufacturer entering the foreign market were analyzed (Samoilyk et al., 2019; United Nations, 2022).

Since the beginning of the large-scale invasion by the Russian Federation on the territory of Ukraine many foreign scientific works have appeared devoted to the analysis of threats to global and regional food security. In particular the most vulnerable regions and countries were identified, the lessons of previous food crises and the necessary measures to protect the most vulnerable countries in the short term were analyzed as well as the long-term directions of the policy of diversification of food, fertilizers, energy, production and trade (Britchenko et al., 2022; Kibrom et al., 2022). The need to unite world governments, donors and other interested parties in order to intensify the protection of future generations from the devastating consequences of malnutrition and prevent food insecurity is justified (Ivashchenko et al., 2018; Osendarp et al., 2022; Sun et al., 2022).

In existing papers the current trends of food security in Ukraine and the regions of the world in the context of their interdependence are touched upon in a fragmentary way. There are no detailed studies which provide a comprehensive assessment over a long period. The recent years have been characterized by crisis changes due to the application of quarantine measures related to COVID-19 and the large-scale invasion of the Russian Federation of

Ukraine as compared to regions of the world and developed European countries. The identification of shortcomings and potential opportunities to ensure a sufficient level of food consumption by the population at national and global levels consitute the purpose of this research.

2. Methodology

In order to study the food security of Ukraine and its factors in comparison with regions of the world and developed European countrie a comprehensive approach that combines international approaches and a modified national approach is applied. It encompasses quantitative indicators which allow such an assessment. Firstly, the level of food security of the state (region) as a whole is considered: population, food balance indicators and FAO food security indicators. Secondly, the focus is put on major food groups (bread and bakery products, potatoes, vegetables, gourds, fruits, berries and grapes, sugar, oil, meat and meat products, milk and dairy products, fish and fish products, eggs): indicator of the sufficiency of consumption of a particular product, the capacity of the domestic market of the product, the share of food imports of the product, the balance index, food self-sufficiency (formulae 1-5). Third, the success of the state in solving internal problems of economic accessibility, physical availability and quality of food is analysed with the use of the Global Food Security Index. The formulae for the abovementioned indicators are as follows:

$$I = \frac{Cf}{Cr} \tag{1}$$

where:

I – an indicator of the adequacy of consumption of a particular product,
Cf – the factual consumption of a particular product per person per year,
Cr – the rational consumption rate of a particular product per person per year, agreed with the Ministry of Health,

$$C_i = F_i P \tag{2}$$

where:

C_i – the domestic market capacity of the i-th product,
i – the type of product,
F_i – the annual average per capita consumption of the i-th product,
P – the average annual population,

$$P_i = \frac{Imi}{Ci} 100\% \quad (3)$$

where:

P_i – the share of food imports of the i-th product,
i – the type of food product,
Im_i – the import of the i-th product,
C_i – the capacity of the domestic market of the i-th product

$$I_{s.b.} = \frac{E}{Im} 100\% \quad (4)$$

where:

$I_{s.b.}$ – the state of balance index (export-import coverage index or import-export coverage ratio),
E – the value of exports,
Im – the value of imports,

$$SS = \frac{Vi}{ICi} 100\% \quad (5)$$

where:

SS – self-sufficiency in food (resource potential of the food security industry),
V_i – the volume of production of the i-th food product,
IC_i – the internal consumption of the i-th product which includes the consumption fund, costs for fodder and seeds.

The study offers also an overview of the effects of the war with Russia on the food security of Ukraine and the world and the measures of institutional international support.

3. Results

The global population growth trend observed during 2000–2020 will continue in all regions of the world (except Europe) over the next 30 years mainly due to African and Asian countries and in 2050 will reach 9,772 million people which will obviously increase food consumption. During 2010–2021 the volume of food production in the world increased as a whole (by 25.2%), as well as by individual product groups (grains, dairy products—by 30%, oil seeds—by 34% among the leaders) (Table 1). At the same time the consumption of

Table 1. Dynamics of the components of food resources of the world in 2010–2021 in million tons

Indicator		2010	2021	Growth, %	
				in 2021 to 2010	in 2021 to 2020
Food, total	Production	3 860.9	4 835.0	25.2	1.4
	Trade	746.6	1 189.3	59.3	–1.6
	Total consumption, incl.	3 164.9	3 896.4	23.1	1.4
	food	1 810.6	2 110.3	16.6	1.9
	feed	898.0	1 222.6	36.1	0.7
	Other consumption	456.3	566.2	24.1	1.2
Grain, incl.	Production	2 241.3	2 799.3	24.9	0.8
	Trade	282.1	473.1	67.7	–1.2
	Total consumption, incl.	2 272.7	2 784.9	22.5	0.9
	food	1 058.0	1 179.2	11.5	1.1
	feed	766.6	1 046.3	36.5	0.7
	Other consumption	448.2	566.2	26.3	1.9
Wheat	Production	655.3	776.6	18.5	0.2
	Trade	125.3	191	52.4	2.6
	Total consumption, incl.	663	765.2	15.4	0.8
	food	468.2	531.3	13.5	1.3
	feed	120.3	149.8	24.5	3.5
	Other consumption	74.4	90.6	21.8	0.6
Meat	Production	294.2	355.5	20.8	5.1
	Trade	26.7	42.1	57.7	1.0
	Total consumption	290	354	21.8	5.3
Oil crops, including	Production	298.6	401.1	34.3	2.1
	Trade	161.7	235.8	45.8	–1.6
	Total consumption	290.8	405.6	39.5	0.9
Vegetable and animal fats	Production	181.3	241.3	33.1	3.0
	Consumption	177	245.3	38.6	1.2
	Trade	92.4	132.7	43.6	–1.6
Sugar	Production	166.3	169.5	1.9	–0.2
	Trade	51.3	60.1	17.2	–1.2
	Consumption	164.1	170.5	3.9	–0.5

Table 1 continued

Indicator		2010	2021	Growth, %	
				in 2021 to 2010	in 2021 to 2020
Milk and dairy products	Production	713.6	927.8	30.0	1.5
	Trade	47	88.1	87.4	2.4
Fish and fish products	Production	146.9	181.8	23.8	4.1
	Trade	55.2	61.4	11.2	–3.0
	Total consumption, incl.	146.9	181.8	23.8	4.1
	food	121.1	161.7	33.5	4.5
	feed	17.6	16	–9.1	–0.6
	Other consumption	8.1	4	–50.6	5.3

Source: calculated by the authors based on FAO data.

food resources increased by 23.1% (grains—by 22.5%, meat—by 21.8%, fish and fish products—by 23.8%, oil crops—by 39.5%). Cereals and in particular wheat play a special role in providing the world's population with food with 68% of its production in 2021 going to food and only 19% to animal feed. The international food market was repidly growing during the period under study. The total trade volume increased by 59.3%, in particular, for grain—by 67.7%, meat—by 57.7%, vegetable and animal fats—by 43.6%, and milk and dairy products—by 87.7%.

The COVID-19 pandemic has had a significant impact on increasing the number of undernourished people worldwide. The pandemic has disrupted global and regional food systems including food production, distribution and access. Containment measures, movement restrictions, and supply chain disruptions have challenged food production and availability. This has resulted in economic shocks including job losses, reduced incomes and increased poverty rates. Many vulnerable populations particularly those in the informal sector or low-income jobs have faced significant financial hardship making it difficult for them to afford nutritious food (Gebeyehu et al., 2022). This economic downturn has exacerbated food insecurity and led to an increase in the number of undernourished people. Restrictions on movement and labour shortages have disrupted agricultural activities including planting, harvesting and transportation. Farmers have faced challenges in accessing markets and investments resulting in lower agricultural productivity and reduced food availability. Together these factors contributed to an increase in the number of undernourished people during the COVID-19 pandemic. Despite an increase in global GDP per capita food system disruptions and social protection challenges have led to an increase in the prevalence of undernourishment.

Addressing the food security and nutrition consequences of the pandemic requires comprehensive strategies that focus on ensuring access to nutritious food, strengthening social protection systems and supporting agricultural activities and livelihoods (Kakaei et al., 2022).

Under the conditions of the COVID-19 pandemic in 2020 the number of undernourished people was 720 million which is 131 million more than in 2010. This is under the conditions of an increase in GDP per capita in the world as a whole (by 16.5 %) and in most regions (Africa by 2.4%, North America by 10.1%, Europe by 7%, Asia by 31.5%) except for South America (decrease of 2.6%). After a period of relative stability in 2014–2019 the prevalence of malnutrition in the world increased from 8.4% in 2019 to 9.9% in 2020 (Table 2).

At the same time the unevenness of the geographical structure of the starving is a cause for concern. In Africa in 2020 21% of people were malnourished which is twice as much as in other regions of the world and three percentage points higher than in 2010. In South America (with 7.8% of malnourished people) this indicator increased during 2010–2020 by 2.1 percentage points, in Oceania (with 6.2% of malnourished people) by 0.6 percentage points. Only in Asia is there a gradual decrease in the number of starving people by 0.5 percentage points with the growth of GDP by 31.5% for the studied period.

The lack of quality nutrition in sufficient quantity is the reason for the steady increase in the percentage of overweight children (primarily in the countries of South and North America in 2020 it was 9.1%, 8.3%, respectively; in Europe 8.2%) and the prevalence of anaemia among women of reproductive age in all regions of the world, primarily in Africa (38.9%) and Asia (32.7%).

Small positive trends in 2010–2020 in the world as a whole include an increase in the percentage of people using safe drinking water (from 65.8% to 74.3%), safely managed sanitation services (from 39.9% to 54%), and a decrease in the percentage of children under five who are stunted (from 27.7% to 22%) (except for North America). In 2020 the highest average levels of food and energy adequacy were achieved in North America (149% or 3769 kcal/capita/day) and Europe (136% or 3395 kcal/capita/day), with the highest average energy requirements for food of 2543 kcal/cap/day and 2498 kcal/cap/day, respectively.

The analysis of Ukraine's food security indicators according to the FAO methodology for 2018–2021 revealed a slight gap in the global and European averages (Table 2) as well as a significant difference in the indicators of developed European partner countries and competitors in the agribusiness market. The nutrition of the population of Ukraine is sufficiently supplied with energy (125%), while the world average is (124%) but lower than in the European level (136%) and the studied EU countries (129–141%) (Table 3). With GDP per capita half the level of Europe the percentage of undernourished people in Ukraine in 2020 was generally at the European average (<2.5%) but severe

Table 2. Food security indicators of world regions in 2010–2020 (according to the FAO methodology)

Indicator	World		Africa		North America		South America		Europe		Asia	
	2010/2009–2011	2020/2018–2020	2010/2009–2011	2020/2018–2020	2010/2009–2011	2020/2018–2020	2010/2009–2011	2020/2018–2020	2010/2009–2011	2020/2018–2020	2010/2009–2011	2020/2018–2020
Average sufficiency of food and energy supply (in percent) (on average over 3 years), %	119	124	112	112	144	149	126	127	134	136	115	123
Food energy supply used to estimate the prevalence of malnutrition (average over 3 years), kcal/capita/day	2831	2950	2531	2566	3662	3769	3003	3046	3378	3395	2718	2908
Gross domestic product per capita, PPP, distribution (constant international $ 2011), I$	13890.5	16194	4605.2	4714.9	53381.8	58764	14921.8	14532.3	33959.7	36342.4	9033.7	11883
Prevalence of malnutrition (average for 3 years), %	9.4	8.9	18.7	19	<2.5	<2.5	5.9	6.3	<2.5	<2.5	9.7	8.2
Number of undernourished people (million, %) (annualized)	636.8 (9.2%)	768 (9.9%)	187.4 (18%)	281.6 (21%)	(<2.5%)	(<2.5%)	22.5 (5.7%)	33.7 (7.8%)	(<2.5%)	(<2.5%)	400.1 (9.5%)	418 (9%)
Percentage of population using safe drinking water services, %	65.8	74.3	–	–	95.5	97.3	76.2	80.1	92.2	93.5	64.7	78.2
Percentage of population using safely managed sanitation services, %	39.9	54	–	–	76.8	81.1	24	33.7	73.6	73	35	55.7
Number of children under five with stunted growth (modelled estimates) (million, %)	180.5 (27.7%)	149.2 (22%)	59.5 (35.9%)	61.4 (30.7%)	0.6 (2.7%)	0.7 (3.2%)	3.6 (10.9%)	2.8 (8.6%)	2.1 (5.4%)	1.8 (4.5%)	110.7 (30.1%)	79 (21.8%)
Number of overweight children under the age of five (modelled estimates, (million, %)	36.4 (5.6%)	38.9 (5.7%)	8.5 (5.1%)	10.6 (5.3%)	2 (8.6%)	2 (9.1%)	2.5 (7.6%)	2.6 (8.2%)	3.9 (9.9%)	3.3 (8.3%)	17.9 (4.9%)	18.7 (5.2%)
Number of women of reproductive age (15-49 years) affected by anaemia (millions, %)	512.7 (28.6%)	570.8 (29.9%)	99.7 (39.9%)	122.7 (38.9%)	7.7 (9.4%)	9.8 (11.7%)	20.8 (19.6%)	19.5 (17.3%)	25.9 (14.5%)	26.5 (16%)	347.5 (31.2%)	380.7 (32.7%)
Minimum energy requirement (kcal/cap/day)	1823	1828	1720	1737	1947	1948	1844	1856	1931	1919	1818	1827

Source: based on FAO data.

Table 3. Food security indicators of Ukraine and selected European countries in 2018–2021

Indicator	Period	Ukraine	Germany	France	The Netherlands	Poland	UK
Average sufficiency of food energy supply (%) (on average over three years)	2018–2020	125	141	141	129	142	133
Food energy intake used to estimate the prevalence of malnutrition (kcal/cap/day) (three year average)	2018–2020	3092	3569	3516	3311	3552	3304
Gross domestic product per capita, PPP, distribution (constant international $ 2011)	2020 (2021)	12377 (12943.6)	50922.4 (52930.8)	42025.6 (45187.4)	54209.6 (56761)	32238.2 (34363)	41627.1 (45839.2)
Prevalence of malnutrition (%) (on average over three years)	2018–2020	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Prevalence of severe food insecurity among the total population (%) (on average over three years)	2018–2020	2.5	0.7	0.7	1.4	<0.5	0.7
Number of people with a serious food insecurity problem (million) (on average over three years)	2018–2020	1.1	0.6	0.4	0.2	0.2	0.5
Political stability and absence of violence/terrorism (index)	2019	–1.52	0.58	0.31	0.86	0.52	0.52
Percentage of the population using safe drinking water services (%)	2020	89	99	99	99	98.3	99
Percentage of population using safely managed sanitation services (%)	2020	72	97.1	78.6	97.5	90.5	98.1
Percentage of children under five with stunted growth (modelled estimates), %	2020	15.9	1.6	–	1.6	2.3	–
Percentage of overweight children under the age of five (modelled estimates), %	2020	17	4.1	–	5	6.7	–
Prevalence of anemia among women of reproductive age (15–49 years), %	2019	17.7	11.7	10.6	12.8	–	11.1

Notes: * <2.5—the proportion of undernourished people less than 2.5%; <0.1—fewer than 100,000 people; "-"—no data available.

Source: (Eurostat, 2022).

food insecurity was characteristic for 2.5% of the population (1.1 million inhabitants) which is five times more than in the reference countries (0.5–1.8%). Problems with political stability and the presence of violence in the state had a negative impact on the food security as evidenced by the negative value of the corresponding index (–1.52).

It is positive that the percentage of the population using at least basic sanitary services (97.7%) is approaching the level of the Netherlands and is higher than the world average (78%) and the European average (96.6%) and only two percentage points lower than in comparable countries. The percentage of the population using at least basic clean drinking water (93.9%) and safely managed sanitation (72%) in Ukraine is significantly lower than in comparable countries especially Germany (99% and 97% respectively) and the UK (99% and 98%).

Although the percentage of children under five years of age with stunted growth, with excess weight and the percentage of women of reproductive age with anaemia in Ukraine is lower than the world average it is 4, 2, and twice higher than in developed EU countries which indicates a threat to the formation of healthy future generations—a critical factor of economic growth and international competitiveness.

The analysis of the dynamics of food security indicators by geographical regions of the world within the main food products during 2010-2019 revealed the general trends of the level of their food security: an increase in the consumption of all main food products as evidenced by the dynamics of indicators of the capacity of food markets; growing import dependence for all basic food products. The indicator of consumption sufficiency the main product which is sufficiently represented in the daily diet of the population of all regions of the world without exception is bread and bread products. Yet the level of import dependence on them in 2019 compared to 2010 increased by eight percentage points and was 38.9% (in Africa 45.3%, South America 68%, North America 40%, Asia 24%, Oceania 83%, Europe 118%). At the same time the studied regions have a high resource potential for food security, with the exception of Africa, where indicators of self-sufficiency in bread products, sugar, vegetable oils, meat products and fish products range from 66% to 93%.[4] The countries of this region have a negative foreign trade balance in most major food groups as evidenced by the import coverage index, primarily for bread, sugar, vegetable oils, meat, eggs and dairy products: 7.2%, 40%, 19%, 9.3%, 48.1%, 46.2% respectively.

In Ukraine the negative trend of insufficient nutrition which is characteristic for the entire period of the state's independence and still persists. The majority of the population is limited in access to high calory, quality food products in sufficient quantities the consumption of which ensures a healthy

[4] The data is available from the authors upon request.

life. Thus, during 2010–2019 for all food groups but vegetable oils, bread and bread products the consumption was lower than the defined rational norm. The consumption of fruits and berries, a source of necessary vitamins, is significantly behind both the norm and the developed EU countries by two to three times. The recommended level for dairy products and meat products and fish was achieved at only 52%, 67% and 60% respectively. At the same time there was a decrease in the capacity of the domestic market for most products (except for meat and dairy products).

In recent years the population's food needs within the limits of its purchasing power have been realized mainly at the expense of domestically produced products. Traditionally the domestic market is highly dependent on imports of fish products (79.6%), fruits and berries (42.6%) and vegetable oils (palm, soybean and rapeseed) (42.9%). In general duringthe period 2010–2019 Ukraine had a high food resource potential in most product groups (even higher than in the UK for all types of food studie, except for bread, dairy products and vegetable oils), primarily for bread and bakery products (1143.5%) and vegetable oils (1279.8%), except for fish products (21.1%), fruits, berries and grapes (82%) as evidenced by the decline in food self-sufficiency rates. However, there is a significant gap behind the achievements of most European countries, such as the Netherlands (self-sufficiency for the whole group ranges from 167 to 669%, except for bread products (12.8%) and fruits and berries (44.9%)), France (108–261%, except for eggs (96%), fish products (28.6%) and vegetables (74.8%), Poland (114–391%, except for fish products (46%)). In addition, the low level of the import coverage index and hence the negative balance of foreign trade in Ukraine is unfortunately characteristic of the mentioned fish and fish products (4.9%), vegetables (80.2%), fruits (57.9%), milk and dairy products (61.9%) as well as potatoes (1.6%). Despite the significant potential for the development of Ukraine's agro-industrial complex the country's food security level according to the GFSI remained almost the same in 2012–2021 and in 2021 amounted to 62 points which corresponds to 58th place among 113 reference countries (Table 4).

The analysis of the components of the general index made it possible to find out the reasons for the unsatisfactory state and potential opportunities for increasing the level of food security in the country (Table 5). According to the accessibility component Ukraine dropped by seven points and took 58th place in the rating which is due to the low level of compliance with food safety programmes as a result of the insufficient level of reforms of national legislation on state control of food quality in accordance with EU standards within the framework of the Association Agreement. According to the availability component Ukraine is in 74th place due to the weak level of state support for research and development in agricultural sciences which in the total volume of 2020 was only 7% of expenditure while for technical sciences it was 57.7% (State Statistics Service of Ukraine, 2021).

Table 4. Global Food Security Index (GFSI) of Ukraine and selected European countries in 2012–2021

Indicator	Ukraine		United Kingdom		The Netherlands (N)		France (F)		Germany (G)		Poland (P)	
Rating*/Rank												
General environment	62.0/58		81.0/3		79.9/6		79.1/9		78.7/11		74.9/22	
1) Accessibility	73.9/58		91.1/4		89.7/13		90.3/9		90.1/10		87.0/25	
2) Availability	51.8/74		72.7/11		73.7/10		67.0/24		69.3/18		65.0/30	
3) Quality and safety	71.9/55		89.6/14		92.2/7		92.1/8		87.8/18		80.5/40	
4) Natural resources and sustainability	49.3/56		69.0/6		61.2/18		67.5/8		66.0/11		65.0/14	
Change in rating/rank in 2021 compared to 2012												
General environment	+4.2	▼1	+6.1	▲14	+2.4	▲3	0	▼4	+1.1	▼3	+4.4	▲3
1) Accessibility	+1.9	▼7	+6.4	▲17	+0.2	▼11	+1.4	▼5	+1.9	▼1	+3.1	▼1
2) Availability	+4.8	▲2	+4.6	▲8	+2.3	▲2	–6.3	▼19	–1.2	▼4	+3.4	▲2
3) Quality and safety	–1.4	▼9	+0.4	▼2	–1.4	▼3	–0.5	▼3	–4.2	▼12	–1.0	▼9
4) Natural resources and sustainability	+13.2	▲50	+14.1	▲12	+10.6	▲11	+9.4	▲3	+9.0	▲3	+13.3	▲13

Rating: 80–100—very good; 60–79.9—good; 40–59.9—moderately; 20–39.9—weak; 0–19.9—very weak.

Source: compiled by the authors based on the Economist Impact.

Table 5. Strengths and weaknesses of Ukraine and selected European countries according to the GFSI in 2021

Indicator	Rating				
	very good (80–100)	good	moderate	weak	very weak
1) Accessibility					
1.1) Change in average food costs	U, UK, N,F	P	–	–	–
1.2) Share of the population below the poverty line	U, UK, N, F, G,P	–	–	–	–
1.3) Inequality-adjusted income index	N, F, G	U, UK, G, P	–	–	–
1.4) Tariffs on imports of agricultural products	–	U, UK, N, F, G, P	–	–	–
1.5) Food security programs	UK, N, F, G, P,	–	U	–	–
1.6) Market access and agricultural financial services	UK, F, G, P	U, N	–	–	–
2) Availability					
2.1) Adequacy of supply	UK, F, N, P	U, N	–	–	–
2.2) Agricultural research and development	–	–	UK, G, P	U, N, F	–
2.3) Agricultural infrastructure	N, F	UK, G	U, P	–	–
2.4) Instability of agricultural production	–	U, UK, N, P	G	F	–
2.5) Political and social barriers of access	UK, N, F, G	P	–	U	–
2.6) Loss of food	U, UK, N, F, N, P	–	–	–	–
2.7) Commitment to food safety and access policy	–	–	B,H	–	U, F, G, P
3) Quality and safety					
3.1) Dietary diversity	N	UK, F, G, P	U		
3.2) Nutritional standards	N, F	UK, G	U, UK, P		

Table 1 continued

Indicator	Rating				
	very good (80–100)	good	moderate	weak	very weak
3.3) Availability of trace elements	U, UK, N, F, G, P	–	–	–	–
3.4) Protein quality	U, UK, N, F, G, P	–	–	–	–
3.5) Safety of food products	U, UK, N, F, G, P	–	–	–	–
4) Natural resources and sustainability					
4.1) Exposition Availability?	G	N, P	U, UK, N	–	–
4.2) Water	–	UK, N	–	F, G	U, P
4.3) Land	N, P	U, UK, N, F	–	–	–
4.4) Oceans, rivers and lakes	–	–	UK	F	U, N, G, P
4.5) Sensitivity	U, UK, F, N, P	–	H	–	–
4.6) Political commitment to adaptation	UK, N, F, G, P	–	U	–	–
4.7) Demographic stress	U, UK, N, F, G, P	–	–	–	–

Notes: grey cells – the level occupied by Ukraine.

U—Ukraine, UK—United Kingdom, N—Netherlands, F—France, G—Germany, P—Poland.

Source: based on data from the Economist Impact.

The agricultural infrastructure is unsatisfactory due to the lack of a fully-fledged agricultural market and an effective network of wholesale markets of agricultural products, an unrealized potential of agricultural service co-operation, insufficient level of technical support by laboratories for product quality control of the process of realization of agricultural products through fairs, underdeveloped channels for realization of agricultural products and an imperfect logistic' infrastructure. The transport infrastructure of Ukraine was sufficient to satisfy the basic needs of the economy. Although during 2019–2021 the amount of investments in road construction projects increased five times (from UAH 21.3 billion to UAH 106 billion respectively) (Gmyrin, 2022; Oliinyk et al., 2021). In 2021 quality and service, transportation efficiency, energy efficiency, safety level, environmental impact did not meet modern

requirements as evidenced by the low integral indicator of the infrastructure index (2.76 points out of 5 possible) (Infrastructure index of the European Business Association, 2021). Port infrastructure is characterized by problems with the concentration of cargo flows, underdevelopment of container and multimodal logistics infrastructure.

In addition, Ukraine has a high level of corruption and risks related to political stability as well as inadequate implementation of food security and access policy commitments. According to the rating component—food quality and safety—Ukraine dropped by nine points and took 55th place in particular due to unsatisfactory levels of diet diversity. This means a significant share of products that contain crumb (except cereals, root crops, and potatoes) and compliance with nutritional standards.

Before the war Ukraine embarked on a path to strengthen national food security: in 2021 it joined the UN Committee on World Food Security. For the first time in history the International Grains Council was headed by a representative of Ukraine. An action plan was developed to transform food systems in Ukraine by 2030.

The military actions of the Russian Federation on the territory of Ukraine have had a negative impact on the functioning of its food systems: integral supply chains of agricultural and food products were disrupted and thus activities related to the creation of added value in the agricultural sector; the sowing campaign was interrupted in the regions where most of the wheat is grown—Kharkiv, Odessa, Zaporizhzhia (30% of the sowing areas). The export of Ukrainian products to foreign markets is complicated due to the blockade of Ukrainian ports. Before the war 60% of agricultural products were exported by sea including up to five million tons of agricultural products through the ports of Odessa and Mykolaiv. Therefore, against the background of limited supply on the world market serious threats have also arisen in global food security with a sharp further increase in food prices and the risk of a global jump in inflation in countries with underdeveloped economies (the Middle East and North Africa). Thus, the average value of the grain price index in March 2022 was 170.1 points which was 17.1% higher than in February (Figure 1) and reached its maximum level since 1990. The average values of the oil and meat price indexes in March 2022 also reached record levels of 248.6 and 120 which are 23% and 4.8% higher than at the beginning of the invasion.

Ukraine is traditionally one of the leaders in the production and export of wheat—the most important universal food and fodder product (Table 6). During the studied period the country's exports increased almost twofold and and amounted to 32.2 million tonnes, i.e. 4.7% of the global trade which allowed the country to take 4th place after the USA (17.9%), the EU (9.8%) and Canada (5.8%). The country's exports of wheat to the international market increased 3.4 times and amounted to 10% of the world's supply while the export quota increased 2.7 times and in 2021 amounted to 59%. Similar dynam-

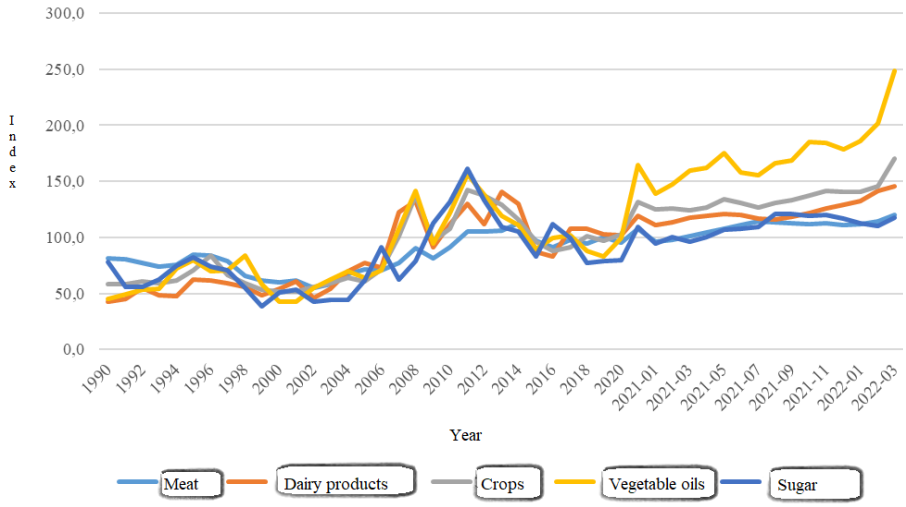

Figure 1. Dynamics of the food price index in the world in 1990–2022 (2014–2016 = 100)

Source: based on FAO data.

ics were observed only in India and Russia who increased their export share in the global market by 26 and 5.3 times and increased their export quota by 22.8 and 4.3 times, respectively (Dutchak et al., 2020).

Countries which are dependent on the import of Ukrainian wheat as evidenced by the share of their imports in the total supply were in critical condition even before the war and the blocking of exports from Ukraine, taking into account their weak positions in the global food security rating, means that they suffer the most from an increase in the world wheat prices (Table 6). The largest competitor of Ukraine in this market is the Russian Federation.

At the beginning of the war the government of Ukraine approved and began implementing the Plan to Ensure Food Security of the State under Martial Law which provides monitoring by the state of food security and agricultural infrastructure in general. Additionally, it provides support to food producers, targets assistance to socially vulnerable categories of the population and exerts centralized control over food prices. Under the conditions of the liquidity crisis in the agricultural sector of Ukraine and as a result of the delay in the export of the harvest in 2021 due to the blocking of the state's maritime transport infrastructure the Ministry of Agrarian Policy and Food of Ukraine introduced the mechanism for providing state guarantees to agricultural producers for the implementation of spring field work (the total need is 100 billion hryvnias). Support is offered primarily for small and medium-sized agricultural producers with a turnover of no more than 20 million euros per year (equivalent to an enterprise which cultivates up to 10,000 hectares). The aid encompasses compensation for the interest rate on loans of up to 50 million

Table 6. Import of wheat from Ukraine and its main competitors in 2020

Importer	GFSI value (rating)	Share of wheat imports by countries in 2020, %							
		Ukraine	Russian Federation	Canada	USA	Australia	Argentina	Kazakhstan	Turkey
Belarus	70.9(36)	7.2	88.4	0.0	0.0	0.0	0.0	0.0	0.0
Egypt	60.8(62)	32.1	64.1	0.4	0.5	3.0	0.0	0.0	0.0
Greece	73.3(27)	8.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Indonesia	59.2(69)	26.4	0.0	22.4	11.7	9.3	22.7	0.0	0.0
Israel	78(12)	18.0	34.8	4.7	0.0	0.0	0.0	0.0	0.0
Jordan	64.6(49)	29.3	38.3	0.0	0.0	0.0	0.0	0.0	0.0
Kazakhstan	69.2(41)	0.0	82.6	0.0	0.0	0.0	0.0	0.0	0.0
Malaysia	70.1(39)	28.4	3.8	11.1	22.5	32.7	0.0	0.0	0.0
Morocco	62.5(37)	17.2	7.7	19.8	0.0	0.0	0.0	0.0	0.3
Myanmar	56.7(72)	10.2	0.0	5.1	24.6	50.9	0.0	0.0	0.0
Pakistan	54.7(75)	50.0	47.1	0.0	0.0	0.0	0.0	0.0	0.0
Philippines	60(64)	9.4	8.2	4.2	49.9	10.9	1.6	0.0	0.0
Qatar	73.6(24)	69.2	39.7	0.0	0.2	11.6	0.0	0.0	0.0
Saudi Arabia	68.1(44)	8.3	31.9	0.0	0.0	9.2	0.0	0.0	0.0
South Africa	57.8(70)	2.7	25.0	6.7	3.4	0.0	0.0	0.0	0.0
Spain	73.6 (24)	9.0	0.5	2.2	0.9	0.0	0.0	0.0	0.0
Sri Lanka	54.1(77)	8.2	29.6	35.3	9.9	3.4	0.0	0.0	–
Switzerland	80.4(5)	2.3	10.2	0.0	0.0	0.0	0.0	0.3	0.0
Thailand	64.5(51)	18.2	10.1	9.2	22.4	11.2	17.4	0.0	0.0
Tunisia	62.7(55)	49.2	5.6	16.3	1.5	0.0	0.0	0.2	–
Turkey	65.1(48)	12.4	21.5	4.7	0.0	0.0	0.0	0.1	0.0
UAE	71(35)	0.6	38.6	17.0	2.4	10.9	0.0	0.0	0.0
Vietnam	61.1(61)	8.5	14.8	8.0	16.9	30.2	6.8	0.0	0.0

Notes: * "-" – no data available.

Source: calculated by the authors on the basis of the State Statistics Service of Ukraine, Economist Impact, UN Cometrade.

UAH and lending for up to six months (for carrying out agricultural activities (sowing) during the period of martial law). The maximum amount of the state guarantee for portfolio loans has been established up to 80% (Cabinet of Ministers of Ukraine, 2022).

In order to simplify the procedures and facilitate the sowing campaign during martial law additional seed certification procedures were cancelled. A producer is allowed to operate agricultural machines without their registration. Online platforms were created to collect the actual needs of agricultural producers during sowing operations and to improve the logistics routes of agrarians under martial law.

The world community quickly reacted to the worsening of the food security crisis in Ukraine as a result of the war. On March 24, 2022 the UN General Assembly adopted the resolution "Humanitarian consequences of the aggression against Ukraine" which expressed concern about the impact of the war on food security on a global scale. The EU as a major producer and net exporter of agricultural products introduced the programme of emergency support for Ukraine's food security and compensation for the consequences of the war to the amount of 330 million euros (AgroPolit, 2022). Assistance was provided for the planting and cultivation of grain and oil crops in order to ensure both domestic needs for food products and maintaining the level of export potential of Ukrainian producers. At the same tim , the EU initiative contributed to the food security of North Africa and the Middle East, Asia and sub-Saharan Africa which depend on Ukrainian grain imports.

In order to overcome obstacles to the export of Ukrainian food, primarily grain and to create "solidarity routes", the European Commission together with interested parties promotes the implementation of the following measures: provision of additional rolling stock, ships and trucks to Ukrainian exporters by EU market participants, the creation of a logistics platform for finding partners ensuring the priority of export of Ukrainian agricultural products by increasing the capacity of transport roads and transshipment terminals, implementation of the agreement on road transport with Ukraine, ensuring maximum flexibility and sufficient staff to speed up customs clearance procedures at checkpoints, increasing capacities for temporary storage of Ukrainian export goods on the territory of the EU, increasing the carrying capacity of the infrastructure of new export corridors and relevant connections in the context of the reconstruction of Ukraine. In order to support the Ukrainian exporters of agricultural products the EU suspended the application of the input price system for fruits and vegetables and cancelled the tariff quotas for these goods for the year starting from June 4, 2022.

Thanks to the signing of the Istanbul Agreement on the export of Ukrainian grain by Ukraine on July 22, 2022 with Turkey and the UN and their mirror agreement with the Russian Federation which identified the ports of Pivdennoho, Odessa and Chornomorsk as key for the export of Ukrainian cargo

22 days after the start of the "grain corridor" (August 1, 2022) 33 ships with 719.5 thousand tons of agricultural products left Ukrainian seaports (Ministry of Agrarian Policy and Food of Ukraine, 2022; Zharykova, 2022).

The FAO in coordination with the Government of Ukraine has developed and is currently implementing a Rapid Response Plan for the deterioration of the food security situation in Ukraine and the limited availability of important agricultural resources (including seeds, fertilizers, pesticides, equipment, fuel and livestock supply) which arose as a result of a combination of material, technical and financial factors. It provided financial assistance to small and medium-sized farms in Ukraine for the period up to December 2022 to the amount of $115.4 million, which is necessary for 376,660 households (979.320 people) (FAO, 2022).

4. Discussion

The study provides an analysis of the impact of the COVID-19 pandemic and the Ukraine–Russia war on food security and nutrition. The global trends in food consumption and production are taken into account. The analysis reveals a significant increase in the number of undernourished people worldwide during the pandemic despite overall economic growth and which has worsened as a result of the war. The disruptions in agricultural activities and the challenges faced by farmers in accessing markets and inputs have contributed to reduced food availability (Nascimento et al., 2019).

The study also highlights the uneven distribution of undernourished people, with Africa experiencing the highest prevalence of malnutrition. It further emphasizes the negative consequences of insufficient nutrition including the increasing prevalence of overweight children and anaemia among women of reproductive age. However, there are positive trends in access to safe drinking water, sanitation services and a decrease in stunted growth among children except for North America. The analysis of Ukraine's food security indicators points to a slight gap with global and European averages as well as significant differences within developed European countries and agribusiness market competitors.

The results indicate that economic growth alone is not sufficient to address food insecurity and malnutrition. Despite an increase in global GDP per capita the COVID-19 pandemic has led to a significant increase in the number of undernourished people worldwide. This is attributed to the disruptions in food systems including production, distribution and access caused by containment measures and supply chain disruptions. The study underscores the importance of comprehensive strategies to address the food security and nutrition con-

sequences of the pandemic. It also highlights the need for efforts to improve self-sufficiency in critical food products, enhance domestic production and address gaps in access to safe drinking water and sanitation services.

The findings have important implications for global food security and public health. The increase in the number of undernourished people during the pandemic poses a significant threat to the well-being of populations and future generations. Insufficient nutrition contributes to health issues such as overweight children and anaemia among women of reproductive age which can impact economic growth and international competitiveness. The uneven distribution of undernourished people, with Africa experiencing the highest prevalence, calls for targeted interventions and support in those regions. The study highlights the urgent need for comprehensive strategies that ensure access to nutritious food, strengthen social protection systems and support agricultural activities and livelihoods to address the food security and nutrition challenges exacerbated by the COVID-19 pandemic.

Conclusions

The results of the analysis for 2010-2021 show the following trends. The population growth in all regions of the world which is expected to continue in the future is accompanied by an increase in food consumption of primarily cereals, meat and vegetable and animal fats primarily used for nutritional purposes. The rise in global malnutrition is due to the intensification of the main negative factors (climate change and slower economic growth) as a result of the global COVID-19 pandemic amid deepening regional food inequality. Growing import dependence primarily on bread and bakery products, vegetable and animal fats ensures that the population of all regions of the world meets the rational daily nutrition standards while eggs, potatoes, meat, and dairy products are consistently in short supply; all regions of the world except Africa have significant resource potential for food security.

Ukraine is behind the world and European averages in some of the indicators of food security. There is also a significant difference with respect to the indicators of food security among the developed European countries. Despite the persistence of a long-term trend of food insecurity except for vegetable oils, bread and bakery products, the food needs of Ukrainian and European population are met mainly through domestic production. Despite the significant export potential of Ukraine's agro-industrial complex the foundation of internal security can be strengthened if the reforms of national legislation in the area of state control over food quality are completed. They include: increased funding for production, research and development in agriculture,

development of agricultural infrastructure, reduction of corruption and risks associated with political stability, fulfilment of food security commitments and access policies.

In order to minimize the manifestations of the global food crisis as a result of the war of the Russian Federation against Ukraine it is necessary to concentrate the efforts of the world community on the long-term effective support and protection of the agro-industrial complex of Ukraine. There is a need to intensify cooperation with international and intergovernmental organizations regarding the restoration of global value chains. It will also contribute to the reliable provision of food to the population of Ukraine.

While the study provides valuable insights into the impact of the COVID-19 pandemic and the Russia-Ukraine war by showing the production trends on food security and nutrition there are limitations to consider. The analysis is based on available data and indicators which may have inherent limitations and potential measurement errors. The study focuses on macro-level trends and may not capture specific local or regional variations in food security and nutrition. Moreover, the analysis does not explore the specific socio-economic and cultural factors that contribute to food insecurity and malnutrition. Further research and data collection efforts are needed to gain a more nuanced understanding of these factors and their impact on food security.

The study highlights several avenues for further studies. First, there is a need for more research on the socio-economic and cultural determinants of food security and nutrition particularly in regions experiencing high levels of malnutrition. Understanding the specific drivers of food insecurity can encourage targeted interventions and policy measures. Second, future studies could explore the long-term impacts of the COVID-19 pandemic on food systems and the effectiveness of various strategies implemented to mitigate these effects. This can provide valuable insights for preparedness and response measures in future crises. Additionally, further analysis is warranted to assess the effectiveness of current efforts to improve access to safe drinking water, sanitation services and to reduce stunted growth among children. Evaluating the impact of these interventions can guide future policies and programmes aimed at improving health outcomes and reducing malnutrition. Prospects for further research encompass also the investigation of internal factors of food security in Ukraine under the influence of the COVID-19 pandemic and the devastating consequences of the large-scale Russian invasion.

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