Scientific Journal Warsaw University of Life Sciences – SGGW
Problems of World Agriculture volume 22(XXXVII), number 4, 2022: 47-62
DOI: 10.22630/PRS.2022.22.4.16

Oleksandra Ovchynnykova[1]
Klaipeda University, Lithuania

COVID-19 as a Catalyst of Food Security Crisis. Whether the Existing System of Agriculture Can Remain the Same

Abstract. From 2019 to 2022, since the outbreak of the COVID-19 pandemic, the global percentage of hunger rose by 150 million people, which is 10% of the world population. At the same time, one-third of food is thrown away because it cannot reach the final consumer. Climate change, natural catastrophes, wars leading to humanitarian crises are the main and ongoing causes of hunger. COVID-19 acted as an accelerator of processes that exacerbate the food security crisis, to which import-dependent countries are especially sensitive. Quarantine that was introduced as a tool to combat the spread of the COVID-19 acted as a catalyst of social, economic, political, ecological, and food crisis that is displayed in the global economic system and in agriculture – its subsystem. At first glance, the increase in the percentage of starving populations on the planet is explained by poverty and the inability to purchase basic food products; a rise in prices was caused by breaks in logistics chains, the increase in the price of energy carriers, and economic shifts caused by the lockdown. In practice, despite the constantly growing volumes of global production of agro-industrial products, the balance between demand and supply of products that ensure the world's food security has been disturbed. The research problem lies in the insufficient determination of intangible causes of hunger, other than those caused by poverty and social inequality. The aim of the research is to show the prospects of the aggravation the food security crisis due to excess of food demand over supply, and to propose theoretical ways out of the crisis. The quantitative method of panel data research was used to prepare the article. The visualization method was used to simplify the perception of the proposed array of information. It is possible to overcome such social problems as hunger, poverty, climate and ecology problems caused by the increase in the temperature on the planet's surface, ocean pollution, and soil degradation only through adaptation and achieving synergy between the planet's ecosystems. Agriculture as a main factor of food security should be transformed through implementing principles of climate-optimized agriculture and blue economy (use of ocean resources) as a source of "blue food" to achieve food sustainability.

Key words: COVID-19, food security, agriculture, blue economy, sustainability

JEL Classification: Q010, Q020, O500

Introduction

The world economy is a synergy, its subsystems cannot function separately from each other and require a balanced use of each element of the system. COVID-19 caused a collapse in the health care sector and caused powerful political shifts – it proved the weakness of existing economic systems, demonstrating their inability to respond to destabilizing factors such as a pandemic. As a result of the introduction of lockdowns in cities and countries around the world, which varied in the degree of requirements for social distancing to stop the spread of the virus, 20%–25% of the population remained without work. The social consequences primarily affected the least protected layers of the population. The COVID-19 pandemic caused a deepening of all the problematic issues of

[1] PhD student; e-mail: OvchynnykovaO@gmail.com; https://orcid.org/0000-0002-0624-5549

the world economy. The pandemic, as a catalyst of long-term processes, accelerated and demonstrated the inability of the existing system to meet actual and potential demand on strategic goods of agriculture.

This article is descriptive and provides an overview of the issue. The aim of the research is to show the aggravation of the food security crisis due to an excess of food demand over supply and to propose theoretical ways out of the crisis.

Data and research methods

The quantitative analysis of panel data was applied to statistical information collected from FAO (Food and Agriculture Organization) and USDA (United States Department of Agriculture). Statistical data from FAO was used to highlight and explain changes in food price indexes in the time period from the world financial crisis in 2008. Statistical data from USDA was used to evaluate shifts in supply and demand in production and export from the main producers of cereals and vegetable oils, and in consumption and import for the main consumers of these groups of goods. Data was collected from 2019 for the period at the beginning of the pandemic. The method of calculating standard deviation was used to conduct a statistical analysis of food price index changes in the studied period, and to demonstrate the dynamics of price changes. In addition, the dynamics of price changes are displayed graphically.

Literature review

The role of COVID-19 in disrupting supply chains and its impact on food security is being explored by Rahaman et al. (2021). The relationship between the goals of sustainable development and food security is studied in research by Vågsholm et al. (2020). Potential obstacles on the way to overcoming hunger due to the development of the blue economy are named by Farmery et al. (2021). The problems of hunger and unemployment were spotlighted by Singh et al. (2022). Consequences of COVID-19 on food security in India was researched by Kumar et al. (2021). O'Hara & Toussaint (2021) study food access in crisis caused by COVID-19 and interconnect it with social inequities. Darnhofer (2021) highlights the importance of adapting agricultural systems to potential risk factors of a permanent nature. These papers highlight the influence of the pandemic on agriculture systems, and on the issue of optimization and sustainable development of agriculture. However, the ways to solve the problem of complementation and substitution of strategic products of agriculture and other problems of the world economy through the introduction and use of combination smart-climate agriculture and 'blue food' from the blue economy as an approach to sustainability as a tool of implementation for food security are not raised or offered.

In addition, this article uses statistical reports of the FAO and USDA to obtain a set of data for further analysis, as well as reports from the World Bank, US Global Leadership Coalition, International Institute for Sustainable Development and other organizations to obtain information on existing programs for overcoming the consequences of the food security crisis, solving environmental and climate problems of the planet, and developing agriculture in accordance with the modern needs of society and nature.

Price consequences of the COVID-19 pandemic

To clearly demonstrate the impact of the pandemic on the world product market, the change in the price index calculated by the FAO was analysed. To determine the group of goods that reacted more acutely to COVID-19 in terms of price equivalent, the standard deviation of the indexes of each price group was calculated. The integrated food price index from 2008 to 2022 has a deviation index of 16.95 units, while the deviation for the period 2019-2022 is 24.06 units, and the deviation of vegetable oils and cereal price indices is 53.13 and 27, 27 units in accordance. Therefore, the increase in prices for agricultural products, specifically vegetable oils and cereals, is one of the first tangible consequences of COVID-19 (Table 1).

Table 1. Change in the consumer price index 2008-2022

Year	Food Price Index	Meat Price Index	Dairy Price Index	Cereals Price Index	Oils Price Index	Sugar Price Index
2008	117,5	90,2	132,3	137,6	141,1	79,2
2009	91,7	81,2	91,4	97,2	94,4	112,2
2010	106,7	91,0	111,9	107,5	122,0	131,7
2011	131,9	105,3	129,9	142,2	156,5	160,9
2012	122,8	105,0	111,7	137,4	138,3	133,3
2013	120,1	106,2	140,9	129,1	119,5	109,5
2014	115,0	112,2	130,2	115,8	110,6	105,2
2015	93,0	96,7	87,1	95,9	89,9	83,2
2016	91,9	91,0	82,6	88,3	99,4	111,6
2017	98,0	97,7	108,0	91,0	101,9	99,1
2018	95,9	94,9	107,3	100,8	87,8	77,4
2019	95,1	100,0	102,8	96,6	83,2	78,6
2020	98,1	95,5	101,8	103,1	99,4	79,5
2021	125,7	107,7	119,1	131,2	164,9	109,3
2022	145,8	120,0	143,4	155,9	195,3	114,2
St. Deviation 2008-2022	***16,95***	***9,89***	***18,97***	***21,70***	***32,73***	***24,11***
St. Deviation 2019-2022	***24,06***	***10,70***	***19,41***	***27,27***	***53,13***	***18,99***

Source: FAO data.

Figure 1 and Figure 2 show the growth of prices in the dynamics for vegetable oils and grains with annual intervals for the period 2008–2022 and for the period with monthly intervals from January 2019 to January 2022. (This was before the start of Russia's full-scale invasion in Ukraine, which is an additional negative impact factor of food insecurity.) From 2008 to 2019 food price indexes were downwards, and they increased sharply raised

in 2021. According to FAO data, in 2008 the undernourished population was about 676.3 mln (10% of population), in 2018 – about 590.6 mln (7.7%), in 2021 – 767.9 mln (8.9–10%). Military actions in Ukraine and the Black and Azov seas intensified the processes of food price growth and aggravated the imbalance between demand and supply of strategic food products towards the deficit.

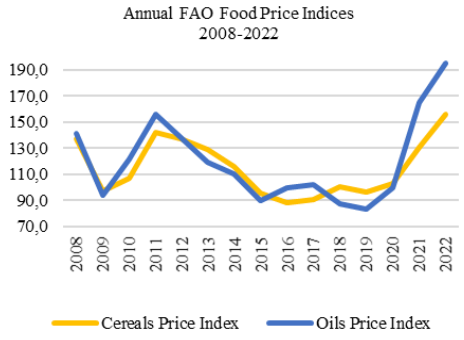

Fig. 1. Change in the consumer price index 2008-2022 (annually)

Source: according to FAO data.

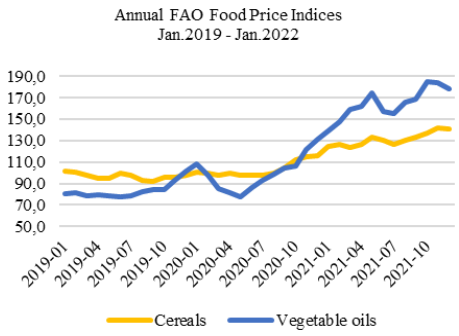

Fig. 2. Change in the consumer price index 2019-2022 (monthly)

Source: according to FAO data.

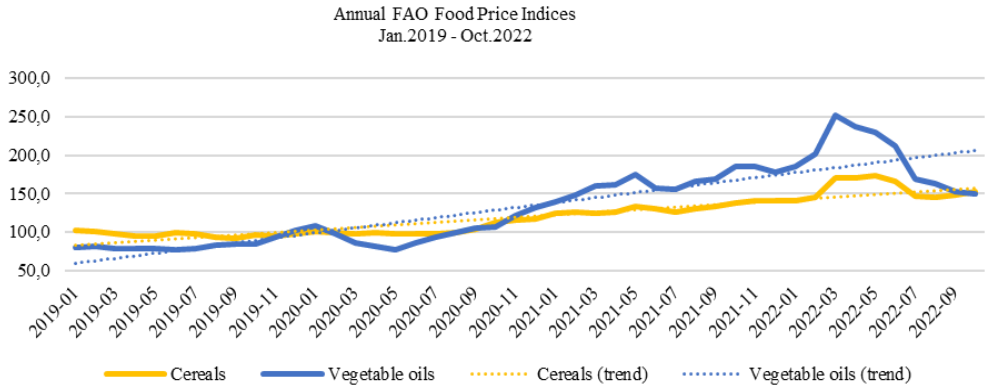

Fig. 3. Change in the consumer price index from January 2019 to October 2022 (monthly)

Source: according to FAO data.

Figure 3 shows the dynamics of prices from January 2019 to October 2022 with a monthly interval, considering the change in prices for the analysed group of goods not only under the influence of COVID-19, but also under the conditions of war in Ukraine. Regardless of the research interval and time limits, price indices for grain crops and vegetable oils tend to show steady growth. COVID-19 did not cause the world food crisis, but accelerated it by creating a "perfect storm". Figure 3 also shows that the price index for vegetable oils decreased in 2022, reaching the value of the change in the index for grain crops. This is explained further in the text of the article.

General factors of COVID-19 influence on economic sectors and food security

To contain the spread of the new virus, governments around the world introduced restrictive measures requiring social distancing. This required business entities around the world to partially or completely stop their activities. A national lockdown was implemented in some countries around the world.

Image 1 schematically shows the number of confirmed cases of COVID-19 over the entire period of the pandemic study. Points with a high concentration of cases are mostly port cities participating in the world market of international trade, where port infrastructure is concentrated.

Image 1. Concentration of confirmed cases of the disease

Source: Center for Systems Science and Engineering at Johns Hopkins University.

When studying the cereal price index, FAO uses price changes for three main commodities — wheat, rice, and feed crops (mainly corn) — to analyse. Therefore, for the study of the world structure of production-consumption and export-import based on USDA statistical reports, data on the balance of world demand and supply were considered specifically for wheat, rice and corn, since these crops are the main ones in the structure of world consumption (Figure 4). The first place in the global structure of cereals production-consumption is occupied by feed grains (53%), wheat (28%), and rice (19%). This percentage ratio is valid for both production and consumption.

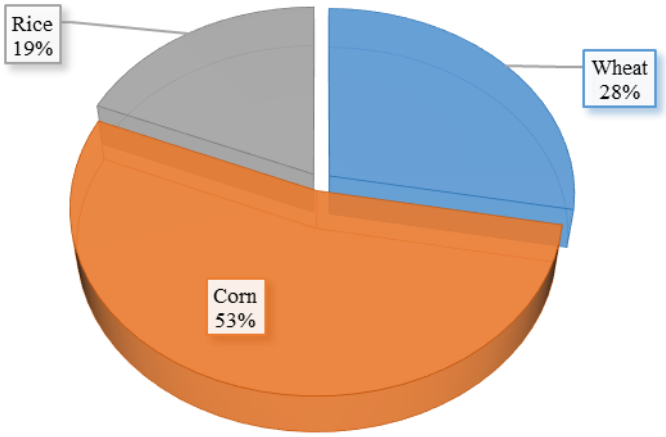

Fig. 4. Structure of world cereals production-consumption
Source: according to FAO data.

Using data from USDA statistical reports, Images 2-5 and Figures 5-8 schematically reproduce the structure of world production and consumption of strategical cereals (wheat, rice, corn) and vegetable oils in what can be understood as a demand and supply structure.

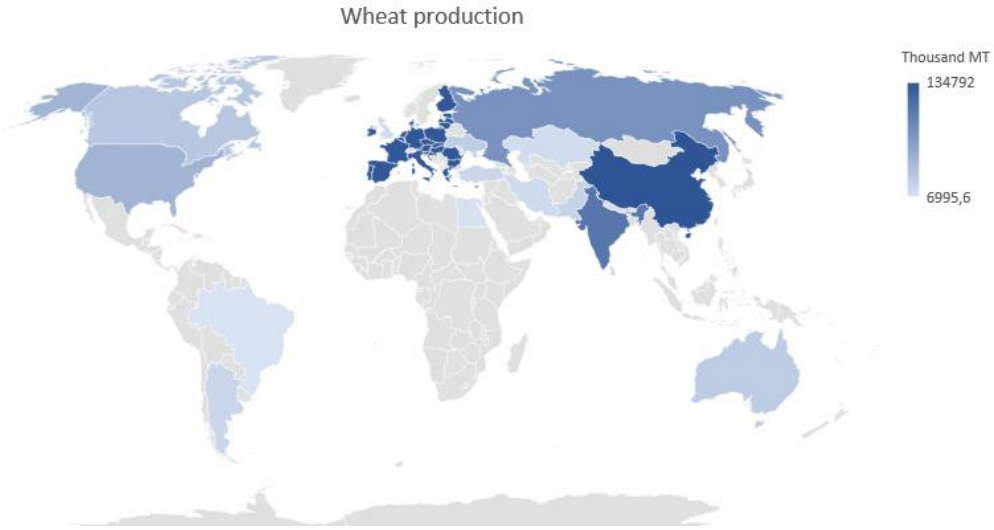

Image. 2. World map of wheat production
Source: according to USDA data.

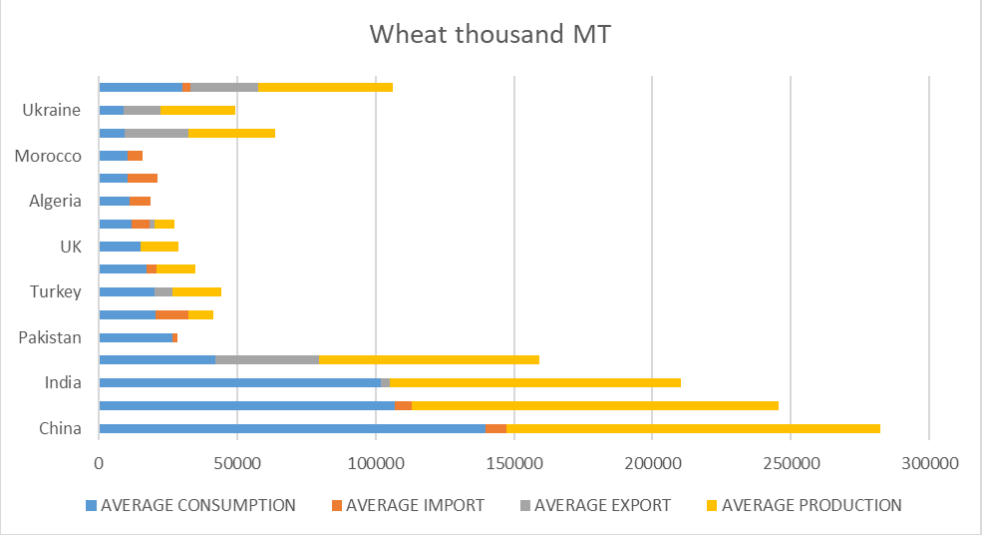

Fig. 5. World structure of wheat supply and demand

Source: according to USDA data.

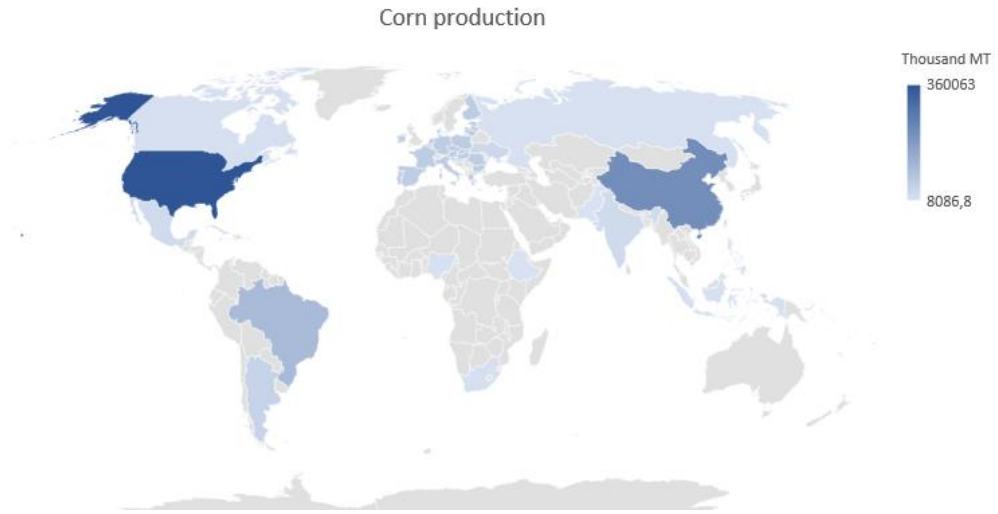

Image 3. World map of corn production

Source: according to USDA data.

China is the biggest producer and country-importer of wheat and simultaneously is a main world consumer. On average, China annually produces about 130 million metric tons of wheat annually. Is important to highlight that China does not export wheat; it makes the region of Southeast Asia one of the biggest importers of wheat, similar to countries on the African continent. Looking at the map of confirmed cases of COVID-19 (Image 1) it is apparent that the majority of confirmed cases were recorded in countries actively participating in export-import operations – in countries that are logistics centers and centers

of world trade. Correspondingly, lockdowns were introduced in these countries, which disrupted the possibility of receiving goods such as food products on time. Therefore, disruption of logistics chains became the first important factor in aggravating the problem of food security.

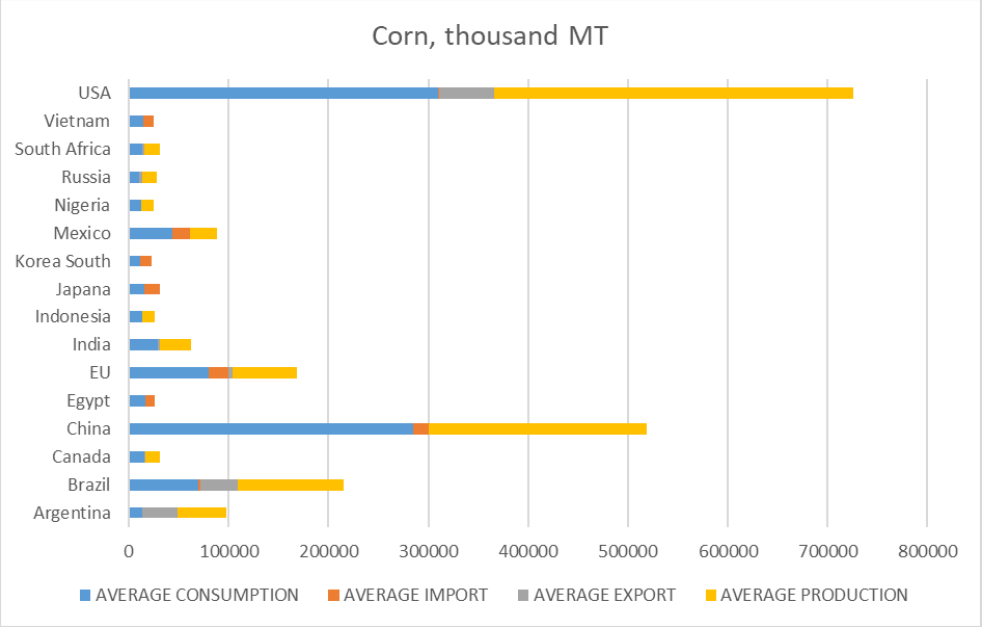

Fig. 6. World structure of corn supply and demand

Source: according to USDA data.

The main importers of corn are South Korea, South Asia, Japan, China, Egypt, Mexico, European Union. China, as in the case of wheat, is a both a large producer and large consumer of corn. According to FAO statistical data, production of coarse grain has been lower or about the consumption since the 2018-2019 marketing year. Due to IGC statistical data, corn production is lower than food, feed, and industrial consumption. The data is presented in Table 2.

Table 2. Production and consumption of coarse grain and corn, mln MT

Marketing year	World coarse grain market		World corn market	
	Production	Consumption	Production	Consumption
2018/19	1 405.3	1 435.1	1132	1149
2019/20	1 450.5	1 462.0	1126	1155
2020/21	1 483.7	1 487.6	1136	1155
2021/22	1 508.7	1 503.5	1220	1217

Source: FAO, IGC.

Exporters and importers of rice are mainly concentrated in the Southern hemisphere. On average, around 505 million metric tons of rice are produced annually around the world

and consumption is about 504 million metric tons. Given the specifics of geographical locations for many countries, good were not able to be delivered by land, and sea transport was limited or prohibited to combat the spread of COVID-19. Food security depends on the critical interdependence of countries on export-import operations and logistics chains – that is, on the physical and geographical location of strategically important food products. The precedent of the lockdowns introduced due to COVID-19 restrictions demonstrated this.

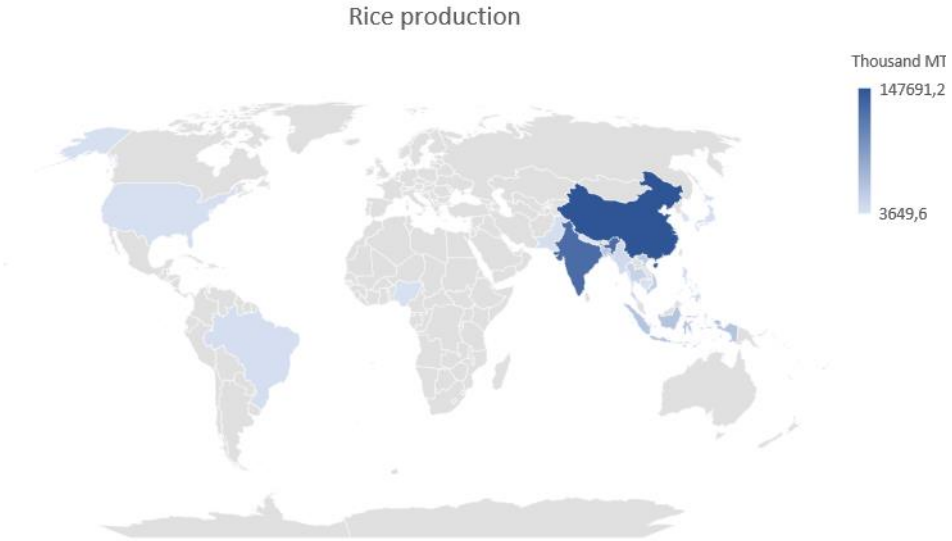

Image 4. World map of rice production

Source: according to USDA data.

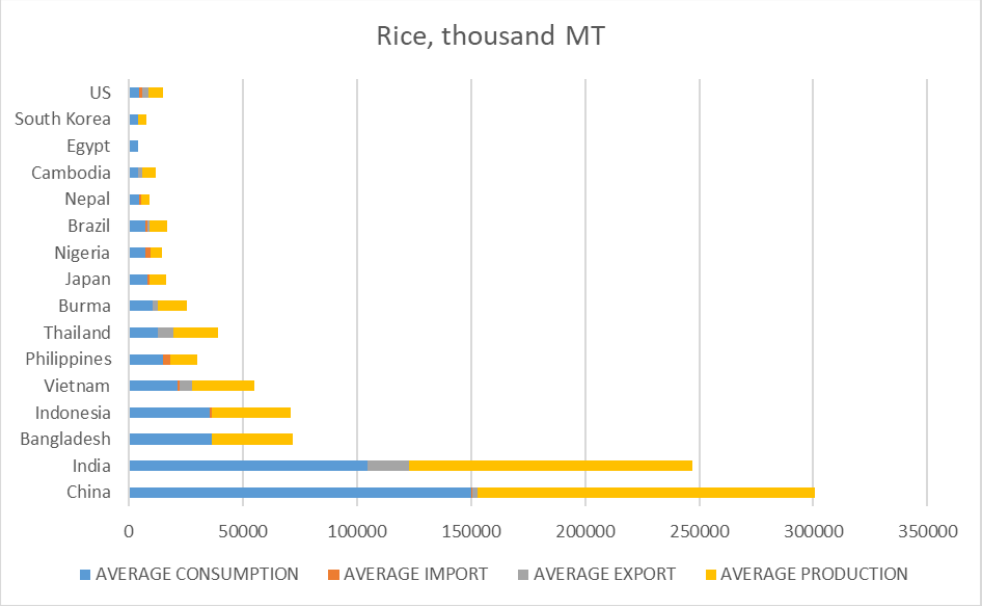

Fig. 7. World structure of rice supply and demand

Source: according to USDA data.

To analyse changes in prices for vegetable oils, FAO uses price dynamics for coconut, cottonseed, olive, palm, palm kernel, rapeseed, peanut, soybean and sunflower oils.

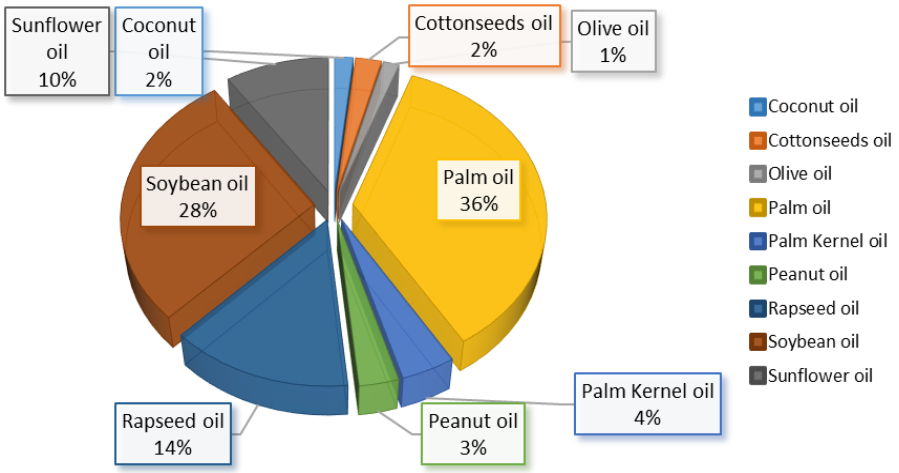

Fig. 8. Structure of world vegetable oils production-consumption

Source: according to USDA data.

It can be seen in Figure 8 that palm oil (36%), soybean oil (28%), rapeseed oil (14%) and sunflower oil (10%) are mainly produced on a global scale. The structure of consumption has a similar distribution. Therefore, in the future, when analysing the cause-

and-effect relationships between the structure of production and consumption, the balance of demand and supply, it is advisable to analyse exactly palm, soybean, rapeseed and sunflower oils.

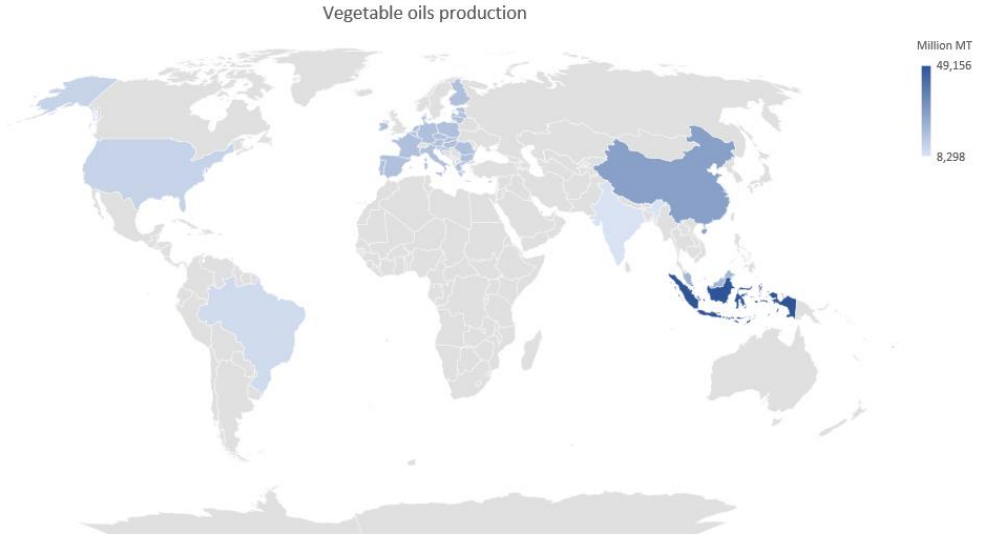

Image 5. World map of vegetable oils production

Source: according to USDA data.

On average, annually all over the world are produced around 209 thousand metric tons of oils and consumption is about 504 million tons annually. Production of palm oil is 74.8 thousand metric tons and consumption of soybean oil 59.0 thousand metric tons, rape oil 29.17 thousand metric tons, sunflower oil 19.9 thousand metric tons and consumption of palm oil – 73.06; soybean oil – 58.04; rapeseed oil – 29.0; sunflower oil –18.3 thousand metric tons in accordance.

During the analysis of the geographical location of the supply and demand of vegetable oils, it can be seen that there are countries that are absolute exporters, the volume of consumption of which is small compared to the volume of export (such as Canada and Ukraine). Importing countries are highly dependent on the movement of goods from the countries of exporters, and therefore critically dependent on the reliability of supply chains.

Due to the Covid-19 restrictions and the implementation of lockdowns, a crisis arose in the logistics industry. In the first quarter of 2020, the volume of logistics transportation fell by 7%. One of the expected consequences of the lockdowns was that ships would not be unloaded at the ports of destination. As a result, ship owners began to remove the volume of transportation from their routes. This caused the accumulation of ships in the ports of departure and unloading, which made it impossible to carry out voyages in a timely manner, and to supply ships for voyage. The result was a physical shortage of vessels for all types of cargo transportation and a rapid increase in freight rates.

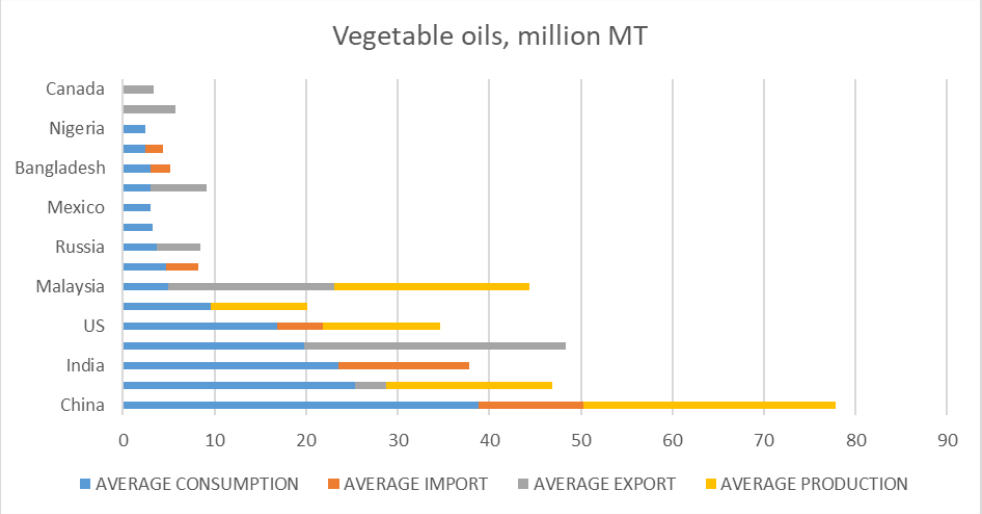

Fig. 9. World structure of vegetable oils supply and demand

Source: according to USDA data.

As a result, exporting countries could not ship products in a timely manner, and import-dependent countries found themselves in conditions of a rapid reduction in stocks, an increase in product shortages, and a rise in domestic prices.

Other factors of COVID-19 influence on economic sectors and food security

In addition to COVID-19 and the implemented lockdowns, the increase in the cost of agricultural products was affected by a decrease in the quality of food indicators of grain products and the loss of part of the expected harvest in 2020/2021 and 2021/2022, caused by the La-Nina phenomenon.

Moreover, as a result of the increase in natural gas prices, the price of mineral fertilizers also increased. This caused additional price increases and wait times for decreased levels of production. On a global scale, there was a domino effect, and a rapid reduction of agricultural product stocks (Figures 10-13). Total consumption growth was higher than total production. In connection to this reduction in stocks of strategic foods, there occurred a further uncontrolled increase in prices, due to a violation of the balance of demand and supply, caused by a number of price and non-price factors. The main problems is that strategically important products that ensure food security have become more and more inaccessible to unprotected layers of society, and the problem of hunger and poverty has become more and more central.

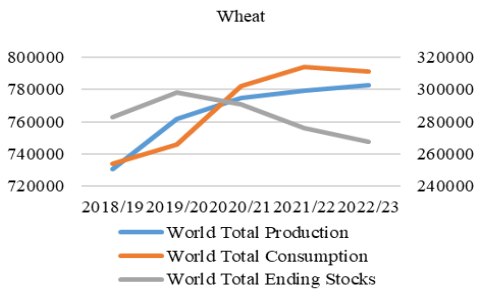

Fig. 10. The volume of wheat production-consumption, ending stocks (thousand metric tons)

Source: according to USDA data.

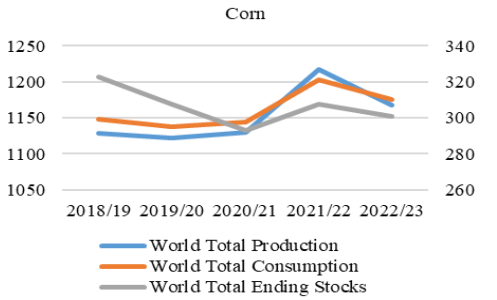

Fig. 11. The volume of corn production-consumption, ending stocks (million metric tons)

Source: according to USDA data.

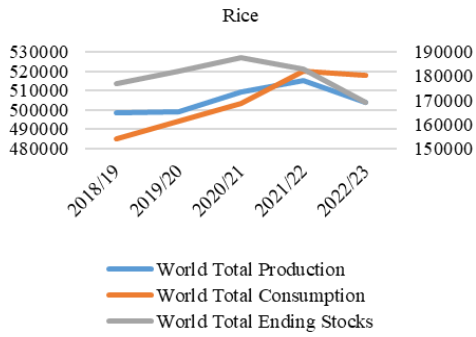

Fig. 12. The volume of rice production-consumption, ending stocks (thousand metric tons)

Source: according to USDA data.

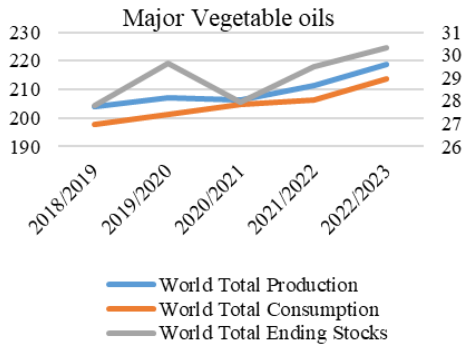

Fig. 13. The volume of vegetable oils production-consumption, ending stocks (million metric tons)

Source: according to USDA data.

It is necessary to consider the prices of oil products as a separate factor influencing the prices of vegetable oils. In April 2020, the price of oil fell to a historic low due to reduced demand for petroleum products. The reason for the decrease in demand was once again the lockdowns, the ban on the movement of people, the cancellation of air flights, the cancellation of sea voyages, etc.

Image 6. Oil prices (USD/Bbl)

Source: according to USDA data.

In Figure 3 and Image 6, the period of falling prices for vegetable oils and crude oil is marked by a circle. This time the falling prices for petroleum products correlates with the falling prices for vegetable oils. The energy sector recovered as a result of the temporary reduction in oil production and the gradual recovery of the movement of people and goods. Vegetable oils have risen in price due to the loss of the palm oil crop, crop failure in soybeans, sunflower and canola in 2019/2020–2020/2021 which are the main oil crops used not only for consumption but also for the production of biofuels. With a potentially sufficient amount of production of oil crops, the uneven placement of production before consumption again caused a rapid increase in prices both in consumer countries and in countries that produce vegetable oils.

A separate but no less important factor in pricing is the panic of consumers and the speculative behaviour of traders, which ensure the movement of goods from the seller to the consumer. In the global aggravation of geopolitical processes, after a significant fall in the reduction of global food reserves, consumers tried to restore stocks and accumulate them to overcome the next potential crises (a new wave of pandemics, crop failures, armed conflicts, etc.).

Discussion

The agricultural market has demonstrated its inability to effectively meet the needs of consumers of agricultural products on a global scale. The grain market is already in a state of growing shortage of products. The market of vegetable oils compensates for the shortage of soft oils by meeting the needs of consumers with palm oil, the production of which exacerbates the environmental problems of the planet. The consequence of such an imbalance is an increase in hunger on the planet, especially in countries dependent on food imports or in underdeveloped agricultural countries in Africa, Asia, and South America.

The constantly growing population of the planet and the increase in demand for food products, the depletion of natural resources — soil, water, biodiversity — all this poses a threat to the food security of the world. According to the forecast of the World Bank, it is necessary to increase food production by 70% by 2050 in order to meet the needs of the global population of 9 billion people.

Climatic changes on the planet, which are accompanied by an increase in temperature, variability of weather conditions, a change in the boundaries of the agricultural ecosystem, invasive processes, and an increase in the frequency of extreme weather conditions lead to a decrease in yield, a deterioration in the nutritional properties of products, and an overall decrease in the productivity of agriculture. In addition, agriculture generates 19%–29% of greenhouse gases emitted into the atmosphere. Given that the industrial sector of the economy is moving towards decarbonization of production, the share of greenhouse gas emissions into the atmosphere from agricultural activities will grow.

The concept of climate-smart (CSA) agriculture combines the management of land cultivation, animal husbandry, forests, and fishing, which together can solve the problem of food security. The main tasks of CSA are to increase the productivity of food production, increase the resistance of agricultural crops to adverse factors of influence and reduce carbon emissions. Considering that land occupies 29.1% of the planet, and the world's oceans 70.9%, and that 40% of the planet's population lives on the shore of water bodies or close to water bodies, it is important to consider the blue economy as a way to ensure the food security of the planet. First, the blue economy involves the development of aquaculture and fishing, which are also considered within the concept of climate-optimized agriculture. Food protein obtained as a result of the development of the blue spheres of the economy is able to ensure the critical absence of vegetable protein. Secondly, the blue economy as an approach to sustainability is an opportunity to ensure economic growth through development of blue economy sectors in underdeveloped countries suffering from poverty and hunger.

Conclusions

COVID-19 demonstrated the inability of existing systems in agriculture to provide the population of the planet with strategically necessary food productions. It highlighted the important need to adapt the existing system of agriculture to ecological, climatic and social issues. To overcome the crisis and balance the system, it is necessary to develop the relationship between agrarian ecosystems and marine and coastal ecosystems, which can provide people with food. This can be a tool to achieve a synergistic effect in ensuring food security, adaptation to climate changes, and ensuring the economic and social development on local and world levels, both for underdeveloped agricultural countries and for developed countries with a diversified production structure.

Literature

Addressing Food Loss and Waste: A Global Problem with Local Solutions. World Bank Group. Available at: https://openknowledge.worldbank.org/bitstream/handle/10986/34521/Addressing-Food-Loss-and-Waste-A-Global-Problem-with-Local-Solutions.pdf?sequence=1&isAllowed=y.

Blue economy development framework. World Bank Group. Available at: https://thedocs.worldbank.org/en/doc/446441473349079068-0010022016/original/AMCOECCBlueEconomyDevelopmentFramework.pdf.

Climate Smart Agriculture Sourcebook. Food and Agriculture Organization for United Nations. Available at: https://www.fao.org/climate-smart-agriculture-sourcebook/concept/module-a1-introducing-csa/chapter-a1-2/en/.

Climate-Smart Agriculture. Food and Agriculture Organization for United Nations. Available at: https://www.fao.org/climate-smart-agriculture/en/.

Climate-smart Agriculture. World Bank Group. Available at: https://www.worldbank.org/en/topic/climate-smart-agriculture.

Darnhofer, I. (2021). Resilience or how do we enable agricultural systems to ride the waves of unexpected change? *Agricultural Systems*, 187, 102997. https://doi.org/10.1016/j.agsy.2020.102997.

FAO Cereal Supply and Demand Brief. Food and Agriculture Organization for United Nations. Available November 2022 at: https://www.fao.org/worldfoodsituation/csdb/en/.

FAO's Food Price Index Revisited. Food and Agriculture Organization for United Nations. Available at: https://www.fao.org/fileadmin/templates/worldfood/Reports_and_docs/FO-Expanded-SF.pdf.

Farmery, A. K., Allison, E. H., Andrew, N. L., Troell, M., Voyer, M., Campbell, B., Eriksson, H., Fabinyi, M., Song, A. M., & Steenbergen, D. (2021). Blind spots in visions of a "blue economy" could undermine the ocean's contribution to eliminating hunger and malnutrition. *One Earth*, 4(1), 28–38. https://doi.org/10.1016/j.oneear.2020.12.002.

Grain: World Markets and Trade. United States Department of Agriculture Foreign Agricultural Service. Available November 2022 at: https://apps.fas.usda.gov/psdonline/circulars/grain.pdf.

Kumar, P., Singh, S. S., Pandey, A. K., Singh, R. K., Srivastava, P. K., Kumar, M., Dubey, S. K., Sah, U., Nandan, R., Singh, S. K., Agrawal, P., Kushwaha, A., Rani, M., Biswas, J. K., & Drews, M. (2021). Multi-level impacts of the COVID-19 lockdown on agricultural systems in India: The case of Uttar Pradesh. *Agricultural Systems*, 187, 103027. https://doi.org/10.1016/j.agsy.2020.103027.

O'Hara, S., & Toussaint, E. C. (2021). Food access in crisis: Food security and COVID-19. *Ecological Economics*, 180, 106859. https://doi.org/10.1016/j.ecolecon.2020.106859.

OECD Employment Outlook 2021 : Navigating the COVID-19 Crisis and Recovery. Available at: https://www.oecd-ilibrary.org/sites/5a700c4b-en/1/3/1/index.html?itemId=/content/publication/5a700c4b-en&_csp_=d31326a7706c58707d6aad05ad9dc5ab&itemIGO=oecd&itemContentType=book.

Oilseeds: World Markets and Trade. United States Department of Agriculture Foreign Agricultural Service. Available May 2018 at: https://uga.ua/wp-content/uploads/oilseeds.pdf.

Oilseeds: World Markets and Trade. United States Department of Agriculture Foreign Agricultural Service. Available November 2022 at: https://apps.fas.usda.gov/psdonline/circulars/oilseeds.pdf.

Rahaman, A., Kumari, A., Zeng, X.-A., Khalifa, I., Farooq, M. A., Singh, N., Ali, S., Alee, M., & Aadil, R. M. (2021). The increasing hunger concern and current need in the development of sustainable food security in the developing countries. *Trends in Food Science & Technology*, 113, 423-429. https://doi.org/10.1016/j.tifs.2021.04.048.

Singh, V., Shirazi, H., & Turetken, J. (2022). COVID-19 and gender disparities: Labour market outcomes. *Research in Economics*, 76(3), 206-217. https://doi.org/10.1016/j.rie.2022.07.011.

Trade and development report 2020. United nations conference on trade and development. Available at: https://unctad.org/system/files/official-document/tdr2020_en.pdf.

Vågsholm, I., Arzoomand, N. S., & Boqvist, S. (2020). Food Security, Safety, and Sustainability—Getting the Trade-Offs Right. *Frontiers in Sustainable Food Systems*, 4, 16. https://doi.org/10.3389/fsufs.2020.00016.

World Agricultural Supply and Demand Estimates. United States Department of Agriculture Foreign Agricultural Service. Available November 2022 at: https://www.usda.gov/oce/commodity/wasde/wasde1122.pdf.

For citation:

Ovchynnykova O. (2022). COVID-19 as a Catalyst of Food Security Crisis. Whether the Existing System of Agriculture Can Remain the Same. *Problems of World Agriculture*, 22(4), 47-62; DOI: 10.22630/PRS.2022.22.4.16