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# ARMED CONFLICT IN UKRAINE: FOOD SECURITY AND ENVIRONMENTAL IMPLICATIONS

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## ABSTRACT

The ongoing conflict has far-reaching consequences, not only for the citizens of Ukraine and Russia but for societies and economies worldwide. This paper examines specific geopolitical, economic, and environmental impacts of the war – both direct and indirect consequences on food security, including rising prices, as well as short-term and long-term implications on the environment, including the impact on agricultural land and loss of biodiversity. It is concluded that the conflict is likely to have a greater impact on the environment than on the economy.

## Introduction

The conflict in Ukraine has had a dramatic impact on the global economy, geopolitics, and food security. The dynamic and unpredictable situation has reduced revenues and caused disruptions in the food system, eroding all dimensions of food security, particularly food availability and access. The conflict has resulted in population displacement, damages to civil and agricultural infrastructure, restrictions on the movement of people and goods, increased disruptions in public services (transportation, banking, water, and energy supply), and the formation of bottlenecks in input supplies (especially fertilizers). Furthermore, the armed conflict emerged at a time when food prices were already high due to drought, poor harvests in South America, and the impact of the COVID-19 pandemic (Rice et al., 2022).

It is realistic to expect that the current conflict will also cause an ecological disaster (Pereira et al., 2022). There is already evidence of severe air pollution and greenhouse gas emissions released during intense fighting. The war will have a negative impact on soil degradation and landscape morphology. Considering that Ukraine possesses some of the most fertile soil in

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the world (chernozem), soil degradation will affect food production. Intensive deforestation and habitat destruction will seriously disrupt biodiversity, with significant implications for wildlife. Due to the destruction of infrastructure and the transportation of pollutants into water reservoirs, the availability and quality of water will be jeopardized. Finally, the war activities near Europe's largest nuclear power plant, the Zaporizhzhia Power Plant, and Chernobyl have the potential for unforeseen consequences such as radiation leaks.

The very nature of the problem addressed in this paper gives rise to the basic hypothesis of the research itself: the conflict causes numerous economic and environmental consequences. The research conducted in this paper is based on the application of desk research methodology, including analysis and synthesis, deduction and induction, as well as descriptive analysis. Relevant sources, such as publications from international organizations primarily from the United Nations (UN) system and referenced scientific papers, were utilized in the study. The significance of this research lies in providing theoretical and analytical insights into the consequences related to food security, agricultural trade, and the environment, which are triggered by the ongoing conflict.

### **Impact on food security and agricultural trade**

Seismic hunger is raging through the world - 828 million people are experiencing hunger, with a significant increase since 2019 in the number facing acute food shortages, rising from 135 million to 345 million. In 45 countries, 50 million people are on the brink of famine, while the gap between the need and the possibility (desire) for funding has never been greater (WFP, 2022). There are numerous causes contributing to this catastrophic situation, including climate shocks, the economic consequences of the COVID-19 pandemic, the cost of living, and conflicts. Conflicts are the primary drivers of hunger, with 60% of the hungry living in war-affected areas of violence. In this regard, in May 2018, the UN Security Council adopted Resolution 2417, which addresses the link between armed conflict and violence, as well as conflict-induced food insecurity and the threat of famine (UN, 2018). Resolution 2417 calls upon all parties to armed conflict to fully comply with international humanitarian law and to protect the civilian infrastructure essential for the proper functioning of food systems.

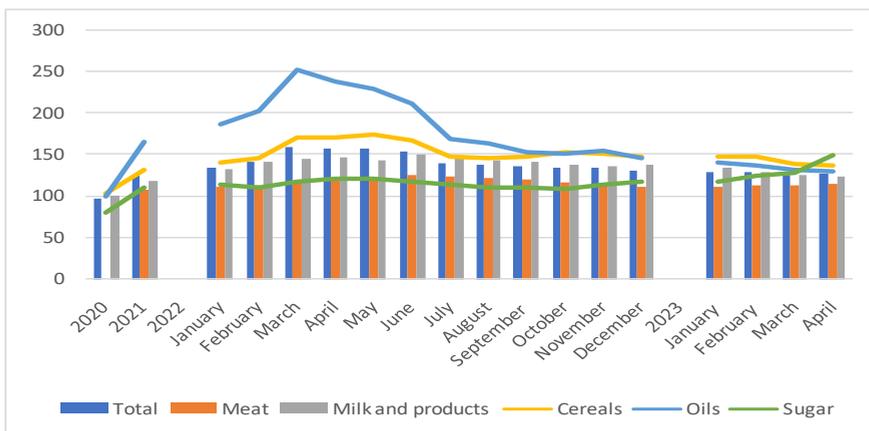
The Ukrainian conflict serves as an additional example of how conflicts fuel hunger, displace people from their homes, and destroy sources of income. The ongoing conflict has resulted in the fastest-growing refugee crisis in Europe since World War II, with approximately 7.7 million registered Ukrainian refugees across Europe (UNHCR, 2022). The war has prevented farmers from cultivating the land, with 20-30% of winter crops remaining unharvested, and spring crop areas reduced by around 20% compared to the previous year. Access to inputs such as seeds, fertilizers, fuel, and pesticides is limited, resulting in a significant overall decline in yields and a decrease in cereal production of approximately 40% compared to expected results (FAO, 2022). Additionally, Ukraine is facing a shortage of storage capacity as existing facilities cannot absorb all the produce from the above-average harvests in 2021 and 2022, which was halted due to the sudden closure of maritime export channels.

According to the recent FAO report (2023), which includes agricultural enterprises, it is evident that those cultivating up to 250 hectares of land are responsible for producing more than 70% of the crop output. However, the report also reveals that 90% of crop producers are experiencing a decline in revenue, 40% are making changes in their farm operations, and 93% are facing increases in production costs compared with the same period of the previous year. The situation is somewhat better in the livestock sector, with 60% experiencing a decline in revenue. The overall assessment is that the total losses in agriculture amount to 3.8 billion dollars, with approximately 70% attributed to crop production.

Overall, the conflict in Ukraine has immediate and indirect consequences on food security (Ben Hassen & El Bilali, 2022). The most significant immediate consequences include logistical blockades, export restrictions, price increases (energy, gas, fertilizers, food), inflation, reduced production, and damage to storage facilities. The indirect consequences of the war include panic buying, delayed sowing, reduced yields, economic recession, decreased purchasing power of the population, political instability and protests, increased hunger and malnutrition, and consumption of lower-quality food (Ben Hassen & El Bilali, 2022).

The Ukrainian conflict, in the first months after its beginning, posed a threat to food security by reducing economic access to food through price increases. The FAO Food Price Index, which monitors monthly fluctuations in the prices of globally traded food commodities, reached 136.3 in September 2022, indicating a 5.5% increase compared to the same month the previous year (Figure 1). However, it is important to note that the conflict, which commenced on February 24, 2022, cannot be solely attributed as the exclusive cause for high food prices. As shown in Figure 1, the price of total food in April 2023 is actually lower by 6.19% compared to January 2022, before the war. During the same period, grain prices have decreased by 3.2%, dairy product prices by 6.04%, and vegetable oils prices by as much as 30.07% (World Bank, 2023).

**Figure 1.** FAO food price index (2020-2022)



Source: Authors' composition based on FAO (2023)

Despite the food price index consecutive monthly decrease, domestic food price inflation remained high in almost all countries, regardless of their income levels, during the period of April 2022 to March 2023. For instance, in the low-income country of Burundi, food price inflation increased from 19.3% to 48.9%. In lower-middle-income countries like Egypt, it rose from 26% to 63%, and in Tanzania, it increased from 6.6% to 9.7%. In upper-middle-income countries, Serbia saw an increase from 16.1% to 27.0%, and Albania from 10.4% to 11.5%. Even in high-income Germany, food price inflation went up from 8.6% to 22.3%. However, during the same period, domestic food price inflation in Russia decreased from 20.5% to 2.6%, and in the United States, it decreased from 9.4% to 8.5% (World Bank, 2023).

Bombing and shelling result in the creation of craters in the soil, erosion, and pollution, forcing to exclude such lands from agricultural production. Damage to irrigation systems negatively affects soil fertility and the biocapacity of arable land (Pathak, 2020). Ukraine is one of the most significant grain producers in Europe, and according to available data, large agricultural areas have been affected. In July 2022, fires covered approximately 70,000 hectares of agricultural land, resulting in the equivalent loss of 317,000 tons of grain (Forbes, 2022). A study based on the FAO model has shown that the damage (until June 2022) to physical assets, land, and machinery used in the production of wheat, corn, barley, and vegetable oils amounts to around \$4.3 billion (AgPulse, 2022; KSE, 2022) (Table 1). Soil damage has occurred due to mining pollution and direct physical damage (mines). Physical damage to fertile soil has been caused by craters from shelling and rocket attacks, as well as damage inflicted by tank tracks and other military vehicles. It is estimated that due to restricted access to farms and thus a lack of care, 42,000 sheep, 92,000 cattle, 258,000 pigs, and over 5.7 million poultry have died. More than 7,800 hectares of perennial crops located in affected areas have been partially or completely destroyed.

**Table 1.** Damage in agriculture by categories

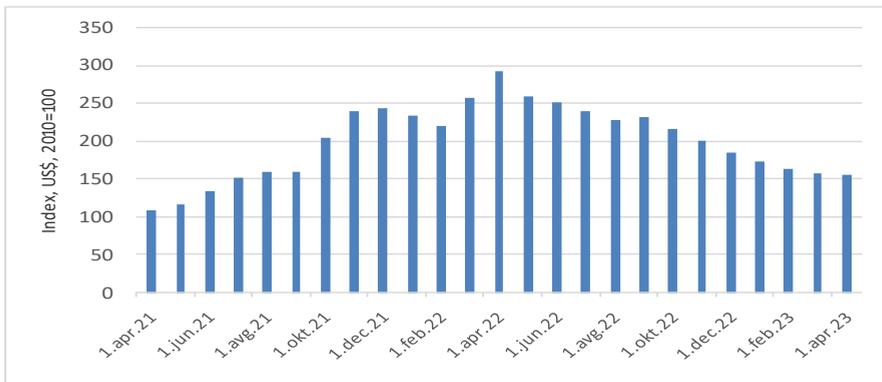
Category	Total value (million US\$)
Soil&non-harvest winter crops	2.135
Agricultural machinery and equipment	926,1
Storage capacity	272,4
Livestock inventory	136,4
Perennial crops	89,1
Inputs (fertilizers, fuel...)	119,6
Stored products	613,0
TOTAL	4292.3

Source: KSE, 2022

Russia and Ukraine are net exporters of agricultural products and leading suppliers to the global food and fertilizer markets. One-third of the world's grains originate from these two countries. They are ranked among the top three global exporters of wheat, barley, corn, rapeseed and oil, as well as sunflower and oil. Russia is the largest global exporter of nitrogen fertilizers, the second-largest exporter of potassium fertilizers, and the third-largest exporter of phosphate fertilizers (FAO, 2022a).

Of particular concern is the increase in the prices of essential inputs, such as fertilizers. For example, in the Eastern Africa region, fertilizer prices have more than doubled in just two months since the start of the conflict in Ukraine compared to the previous year, which will reduce cereal production by at least 16% (Reliefweb, 2022). The price of natural gas, a raw material in the production of nitrogen fertilizers, has risen in Europe by 127.6% six months after the start of the conflict, following sanctions imposed on Russia (Anadolu Agency, 2022). The sharp increase of fertilizers prices can be caused by Russia's temporary export restrictions (Glauben et al., 2022). Nevertheless, similar to food prices, fertilizer prices were already high before the conflict began (Figure 2). The fertilizers price index was at 240.01 points in November 2021, rose by 22.4% in April 2022, reaching 293.73 points. However, it has continuously declined for the following 12 months, reaching 155.97 points in April 2023. (World Bank, 2023a).

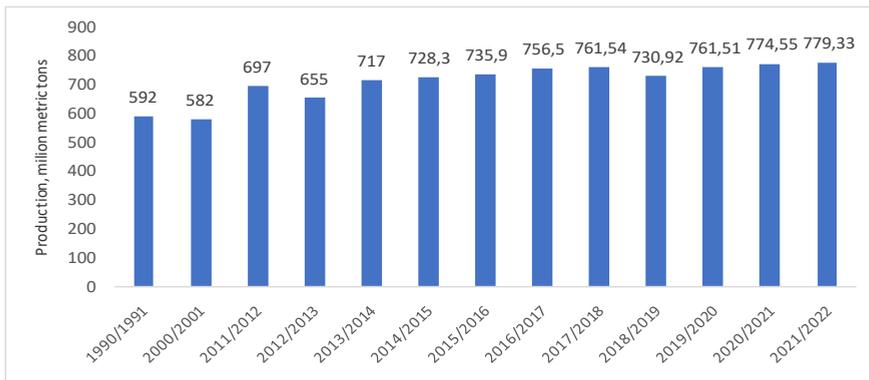
**Figure 2.** Fertilizers Price Index



Source: World Bank (2023a)

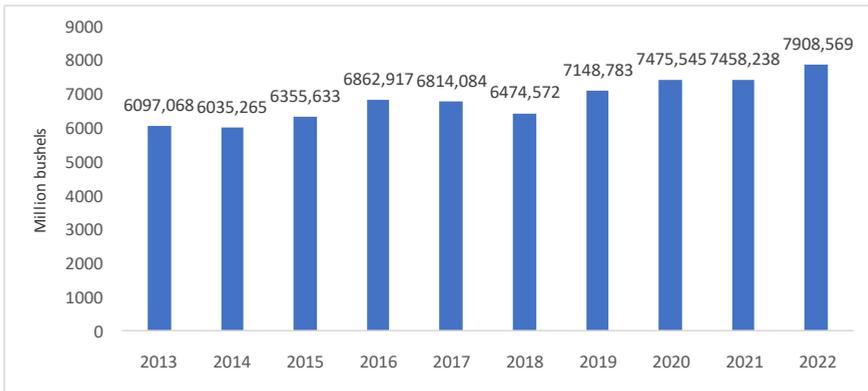
Despite tensions in the world wheat market, there was no shortage either on the supply side (Figure 3) or in terms of exports (Figure 4).

**Figure 3.** Global wheat production volume, million metric tons



Source: Authors' composition based on USDA (2023)

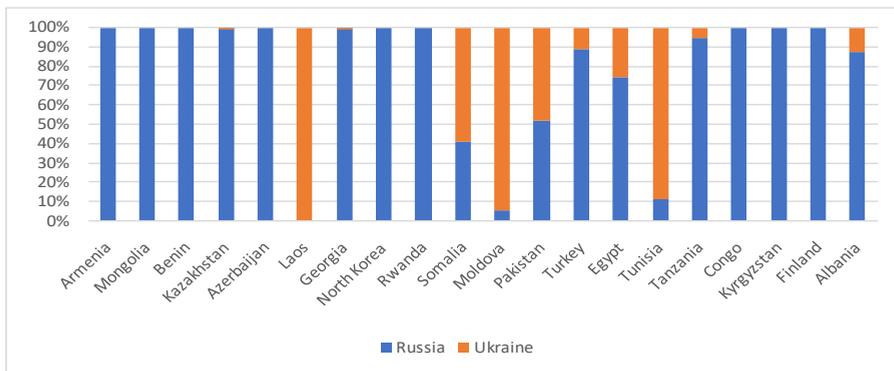
**Figure 4.** World wheat export, 2013-2022



Source: Authors' composition based on USDA (2023)

Nevertheless, the situation remains precarious for economically disadvantaged regions heavily reliant on imports, particularly in Africa and Southeast Asia, which adopt a relatively neutral stance towards the conflict (Glauben et al., 2022) (Figure 5). Under the current circumstances, significant benefits are expected for major wheat suppliers in the EU and North America. Consequently, it appears highly unlikely that Russia would enforce extensive export restrictions with the intention of provoking food insecurity in import-dependent regions.

**Figure 5.** Wheat import dependence on Russia and Ukraine 2022, by country (%)



Source: Authors' composition based on OECD (2022)

### Environmental consequences

Military activities have caused serious consequences for the environment that future generations will also experience. It will take decades to restore the landscapes and natural resources of Ukraine (Fernandez-Lopez et al., 2022; Sikorsky et al., 2022; Jacobo, 2022). The potential short-term and long-term negative effects of war on the environment are presented in Table 2.

**Table 2.** Short-term and long-term impacts of the conflict in Ukraine

Short-term	Long-term
Water pollution and contamination of water resources	Chronic respiratory diseases and shortened lifespan
Acute water scarcity	Contamination of cities (remediation is a lengthy process)
Deterioration of air quality causing respiratory issues	Permanent changes in soil profiles and land use leading to decreased agricultural production
Increased greenhouse gas emissions	Lower quality of life due to pollution effects
Soil pollution through toxic substance leaching	Loss of biodiversity
Changes in soil profiles and land use, soil erosion	Reduction in ecosystem services
Acute impact of radiation	Impact on efforts to achieve climate change goals and sustainable development objectives
Deforestation and forest fires	Collapse of environmental management systems
Death of wildlife	
Habitat destruction and temporary species migration	

Source: Rawtani et al. (2022)

Damage to infrastructure, particularly in eastern Ukraine, which is heavily industrialized, can lead to the release of toxins into natural water sources. Toxins from closed mines without adequate drainage systems can contaminate groundwater, and worsening water supply and sanitation conditions can lead to an increase in food and waterborne diseases (Anthes, 2022; Jacobo, 2022; Rawtani et al., 2022). It has already been proven that after damage to fertilizer reservoirs, the concentration of ammonia increased 163 times, and the concentration of nitrates increased 50 times in river water samples east of Lviv (Subbaraman, 2022). The consequences of air pollution will be dramatic, especially since air quality in Ukraine was below European standards even before the war (Pehchevski, 2020). Research in Ukraine has shown that concentrations of NO<sub>2</sub> and PM<sub>2.5</sub> are most strongly correlated with wartime activities (Zalakeviciute et al., 2022).

Ukraine is one of the most significant European centers of biodiversity, with 35% of the species inhabiting the continent found within its borders (WWF, 2022). Among the 70,000 plant and animal species, many are rare and endemic. These include European bison, brown bears, lynx, wolves, and sturgeons—the most endangered species in the world. Ukraine, which encompasses part of the Danube Delta, belongs to the “Green Heart of Europe” and is home to rare steppe ecosystems (in the central-eastern part of the country), coastal wetlands, alpine meadows, ancient beech forests, and vast peat lands. In the Polissya region in the north, immense pine, oak, and birch forests can be found, while the Carpathian Mountains in the west host ancient beech forests and alpine meadows. Many habitats within and outside protected areas have been endangered by previous military interventions, and forest management certificates in war zones have been suspended. According to preliminary data, 30% of Ukraine’s protected areas have been threatened by shelling, bombing, oil pollution, and military maneuvers. At

least 14 zones (in the Dnieper Delta, Black Sea lagoons and islands, Karkinitiski and Dzharylgatsky bays, areas along the Desna River in the Sumy region) recognized under the Ramsar Convention on wetlands are at risk of complete destruction (WWF, 2022). There have been 254 cases of environmental crimes and 1,500 cases of ecosystem destruction recorded, while forest fires have affected over 250,000 hectares (Rawtani et al., 2022).

### **Discussion and conclusions**

Currently, there are six active armed conflicts taking place globally, namely in Afghanistan, Ethiopia, South Sudan, Syria, Yemen, and Ukraine. According to data from the World Food Programme (WFP, 2022), over half of Afghanistan's population is experiencing acute food insecurity, with 5.5 million people facing severe hunger in Northern Ethiopia. In South Sudan, approximately 60% of the entire population lives under constant risk of hunger, while 60% or 12.4 million Syrians are suffering from hunger. Additionally, a staggering 16.2 million Yemenis are grappling with food insecurity.

Similar to other conflicts worldwide, the armed conflict in Ukraine has the potential to directly and indirectly affect food security. As of 16 May 2023, approximately 20% of the Ukrainian population, totaling 8,240,289 individuals, have become refugees dispersed across Europe, according to the UNHCR (2023), while 11 million are food insecure (WFP, 2023). Due to the ongoing armed conflict in Ukraine, farmers are sowing fewer crops, leading to a decline in both production and export of agricultural goods (EU, 2023). The armed conflict in Ukraine has resulted in various detrimental impacts on the agricultural sector. One of the consequences is the decline in soil fertility, as damaged lands are excluded from production. The destruction of agricultural infrastructure has further exacerbated the challenges faced by farmers. Additionally, the conflict has had devastating consequences for biodiversity in the affected areas. Furthermore, the conflict has contributed to increased air pollution in Ukraine. These combined factors pose significant challenges to the agricultural industry and have far-reaching effects on the environment and overall food security in the region.

The consequences of the ongoing conflict in Ukraine are not limited to the domestic market but have unwanted effects on a global scale. Indeed, the timing of the conflict in Ukraine, coinciding with existing challenges such as the COVID-19 pandemic, climate change, and high food demand, has further exacerbated the increase in food prices. The conflict adds another layer of disruption to the already strained global food supply chain, leading to heightened market volatility and potential supply disruptions. This, in turn, puts additional pressure on food prices, making them more susceptible to upward price movements. The combined impact of these factors creates a challenging environment for food security and affordability, particularly for vulnerable populations.

The conflict in Ukraine cannot be solely blamed for the increase in food prices. This is evident from the fact that while food price inflation is growing in most countries, the overall food price index is decreasing. Various factors, including global supply and demand dynamics,

weather conditions, transportation costs, trade policies, and other geopolitical events, as well as localized factors contribute to fluctuations in food prices. Localized factors that can contribute to high food prices can include corruption or the influence of lobby groups. Corruption within the food system can lead to inefficiencies, rent-seeking behavior, and price manipulation, which can drive up prices for consumers. Lobby groups representing specific agricultural sectors may also exert influence on government policies, regulations, and subsidies that can distort market dynamics and contribute to higher food prices. These factors can undermine fair competition, limit market access for smaller producers, and create barriers that impact the affordability and availability of food for consumers.

Due to the escalating fertilizer prices, it is anticipated that farmers worldwide will likely make adjustments in their agricultural practices. They may choose to reduce fertilizer usage, which could lead to reduced crop yields. Alternatively, farmers, following the example of American farmers (Reuters, 2022), may opt to decrease the areas dedicated to crops like corn and wheat while increasing the areas dedicated to soybeans that typically require less fertilizer compared to other crops. These strategic shifts may also contribute to a further increase in food prices. Additionally, soybean producers may potentially gain more benefits compared to producers of other crops.

To summarize, as long as major grain suppliers do not impose significant export restrictions, the conflict in Ukraine is not expected to have a substantial impact on global trade volume, assuming other factors remain unchanged (*ceteris paribus*). Additionally, until now, the conflict has not significantly affected wheat production or export volumes. However, it is crucial to note that the conflict in Ukraine could have more significant negative environmental consequences than its economic impact. The long-term environmental repercussions may necessitate substantial resources and time for mitigation, potentially surpassing the immediate economic consequences.

### Conflict of interests

The authors declare no conflict of interest.

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