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Manuscript ID:  
IJWGAFES-2025-020505

DOI: [10.5281/zenodo.17679848](https://doi.org/10.5281/zenodo.17679848)

DOI Link:  
<https://doi.org/10.5281/zenodo.17679848>

Volume: 2  
Issue: 5  
Month: May  
Year: 2025  
E-ISSN: 3066-1552

Submitted: 06 Apr 2025  
Revised: 15 Apr 2025  
Accepted: 05 May 2025  
Published: 31 May 2025

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**How to cite this article:**  
Kumar, R. (2025). What Role Does Ukraine's "Black Earth" (Chernozem) Region Play in Global Grain Security, and How Are Changing Climatic and Geopolitical Conditions Altering Its Agricultural Geography?. *International Journal of World Geology, Geography, Agriculture, Forestry and Environment Sciences*, 2(5), 21–25.  
<https://doi.org/10.5281/zenodo.17679848>

# What Role Does Ukraine's "Black Earth" (Chernozem) Region Play in Global Grain Security, and How Are Changing Climatic and Geopolitical Conditions Altering Its Agricultural Geography?

Rakesh Kumar

## Abstract

The Ukrainian Black Earth region is an extensive area of particularly high-quality soil, found mostly in Ukraine's center and east. These exceptionally fertile soils have enabled Ukraine to be a major player in world grain production for many years. The region can produce large amounts of essential commodities like wheat, maize, and sunflower oil, both domestically and internationally. However, this important agricultural region is currently facing serious threats to its ability to fulfill this role through increasing climate related changes (such as extreme temperatures and drought) and the effects of the current war between Russia and Ukraine. The Russian invasion of Ukraine has made much of Ukraine's agricultural lands uninhabitable because of mines and chemical contamination; it has also severely restricted Ukraine's ability to transport grains out of the country to meet the demands of international markets. This research project analyzes the changing dynamics in Ukraine's agricultural regions using recent data from 2025 to provide a more contemporary look at what is happening. Using the most up-to-date available information from recent studies, the results demonstrate that there is an approximately 16-30 percent reduction in the amount of land being used for cultivation, which can be attributed to the disruption caused by the war. The losses will be further exacerbated by the negative effects of climate change on crop yields. As a result, the geographical landscape of Ukraine's agricultural activity is undergoing a significant transformation. Agriculture is beginning to shift to the west in response to the threat to the Black Earth region, and the need for new trade routes to circumvent blockages in the Black Sea is becoming increasingly important. To mitigate the numerous challenges created by these crises and to ensure the long-term sustainability of global food systems, this research proposes a multi-faceted strategy that includes developing climate-resilient farming practices (climate smart agriculture) throughout Ukraine's agricultural sector. In addition to developing resilient farming practices, the research suggests that Ukraine will require significant international assistance and investments to address the multitude of problems associated with the loss of Ukraine's agricultural productivity.

**Keywords:** Food Security, Agriculture Geography, Black Earth, Chernozem, Geopolitics, Ukraine

## Introduction

Ukraine's fertile chernozem belt, with its nutrient-rich dark soils that have taken millennia to form within the steppe ecosystems, constitutes about one-third of the planet's most fertile land and the production areas of its high-staple crops. This food basket has historically made Ukraine the "breadbasket of Europe," producing annually large quantities of grain for export and supplying food for the critically large numbers of its people (about 400 million) in the world's underprivileged peoples. Thus, the Russia-Ukraine war, which began in 2022, has destroyed agricultural production in various ways and where this is coupled with climatic change causing the environmental disaster of increased vagueness of precipitation, increasing soil degradation, this study will investigate this questionnaire through an extensive study of the contributions made by the chernozem belt, then the synergistic effects of climate change and political turbulence in their relationship to agricultural formations and finally their severe implications for the stability of the world grain markets. However, certain studies show that despite the great effects of climate change and of war on agriculture, there is a relatively high degree of resilience and adaptability in Ukraine with respect to its agricultural output. Farm practices changing by innovation and diversification of crop export suppliers, can help to minimize the long-term effects of the war and of climatic change, which will help for a more decentralized system of agricultural supply on a world basis with a better system of food supply for world markets.

This intricate relationship between these intertwined factors, political warfare, climatic change and adaptive agricultural practices, will require a study of how Ukraine's agricultural production output is being redefined and what the consequences of this is for food markets in the world (Chen et al., 2024; Mirzoeva 2024). The outbreaks of war have led to decreases of agricultural exports in Ukraine by 15.6 per cent in 2022 and a further decrease of 6 per cent in 2023, while 19.3 per cent of the arable land in Ukraine has been lost (Challenges and Opportunities for the Development of Ukrainian Agriculture in the Context of EU Enlargement, 2024).

### **Literature Review**

Current academic perspectives indicate that the chernozem of Ukraine is the chief factor in world agriculture and previous studies have remarked that before the war this resulted in 8 to 10% of world exports of wheat and maize. (Filho et al., 2023.) The analyses undertaken by the World Economic Forum reiterate how these fertile soils can produce a better grade of crop which in turn brings about general food protection to other less prosperous countries in Asia and Africa. (Filho et al., 2023.) The climatic studies presently issued by the EU Joint Research Centre, etc. demonstrate that there is an accelerated rate of global warming taking place in Ukraine where the temperature rise is at the rates of 1.5 to 2°C higher than the world average and the increased incidences of droughts and decreasing output are evident. (Bazhal, Koutchma, 2022.) The geopolitics of future analyses reveal the great destruction caused by the war with an apt degree of damage in agriculture put at approximately \$11.2 billion by 2024 and the consequent disruptions of the Black Sea routes of exportation (Chumachenko et al, 2022.) However more recent studies in 2025 have introduced queries as to geographical changing of places especially the abandonment of agricultural land in the eastern districts through mining and occupation, whereas irrigation etc., are schemes now adapted to the western places. (Rudyk et al., 2023.) There is, however, a substantial lack of adequate pieces of information pertaining to the integration of the date of 2025 in a full functioning into the general concept of integration of the combined influences of climatic as well as war influences which would be the purpose of this report. Alternative views profess, however, that with the great disorganisation caused by war and climatic conditions, nevertheless the Ukrainian agricultural output is very resilient and adaptable. Deliverance to newer methods of farming applications and the extension of outlets for exportation with the assistance of the desired foreign assistance may help greatly in weakening any resulted threats upon the future food supplies of the world, but these may assuredly eventuate some disadvantages threatening the food security of the world possibly an improved situation in a decentralised and stronger food supply for the world. The understanding of this complex dynamic permits us to study how these points of contact, that is, the geopolitical conflicts, the climatic change together with the adaptations to agriculture may be irrevocably altering the existing production of Ukraine and the conclusions that may affect world food supplies. Thus, e.g., the warring now going on in Ukraine has caused obviously changes in the areas cultivated and studies show that there was shown to be an average decrease of 11.50% in the average Normalised Difference Vegetation Index of the crops in 2022 as compared to the baseline of 2019 - 2021 in operation. (Chen et al., 2024.)

### **Methodology**

This qualitative analysis used secondary data collected through online research done in September 2025. The primary information came from reports of the Food and Agriculture Organization, the Center for Strategic and International Studies, and peer-reviewed academic sources. The analysis involved thematic examination of patterns of findings related to the agricultural importance of chernozem, the effects of climate change, the effects of international conflict, and the nature of future changes in geography. Limitations of this research included possible bias in information from areas of conflict, and limited usage of sources in English. Some of these limitations were overcome through cross-checking and using the same information in various publications.

### **The Role of Ukraine's Chernozem in Global Grain Security**

Ukraine's chernozem-rich soils, for which 25 to 33% of world reserves are estimated to be located in central and eastern Ukraine, lead to crop yields that are 20 to 30% greater than average soil types. This fertility permitted at least 40-50 million tons to be exported each year before 2022, thus helping areas suffering from food shortages and tending to stabilize world market conditions (Bazhal and Koutchma, 2022). The increased organic matter in these soils favors the production of food staples such as wheat, corn, and barley, which serve as food for livestock and vital ingredients in the manufacture of biofuels. Disruption, such as that caused by the termination of the Black Sea Grain Initiative in 2023, produced a rise in world commodity prices of from 20 to 30%, thus demonstrating Ukraine's insistent contribution to the international food economy (Filho et al., 2023). The long-continued state of conflict has also produced devastation of stocks of means of agricultural production and destruction of 180,000 tonnes of grain, further making unstable the state of world supply of food (Filho et al., 2023). It has been shown in recent analyses that sequelae of conditions of this sort and their influence on world supply and prices of food, are intimately dependent upon the success of the harvest in other important agricultural countries in the presence of an abiding barring to production and transportation in the lands affected by the fighting (Rudloff et al., 2024). In view of this, combinations of geopolitical evils and climatic change produce a considerable series of difficulties to the attainment of a balance in the international food situation (Zelinger and Makowski, 2023). Soil contamination which is

defined as any damaging modification of its structure, its physical nature and characteristics and of important chemical properties, has to be classed as a distinct and financially important aspect of the damage, estimated by Ukrainian officials to amount to 18 billion dollars (“The Agriculture of Ukraine amidst War and Agroecology as a Driver of Post-War Reconstruction,” 2024. Certain estimates to the contrary suggest that in spite of the tremendous difficulties of the dual nature arising from the geopolitical trouble and climatic changes, that the agriculture of Ukraine has decided capacity for resistance and adaptability. Changes in agriculture in the method of approach and in sources of supplies for the output handled abroad, with backing from foreign assistance, might tend to diminish general evil resulting from such conditions upon the global question of supply of food and thus bring about the pleasure of having a decentralized and organized agricultural food delivery. Methods such as these require the scientific inquiry as to how these factors of interdependence of the working of geopolitics and climatic changes and of the adoptive agricultural methods are together reconstructing the agricultural output in Ukraine and the wider results thereof which may give rise to troubles in the international food question.

**Climatic Conditions Altering Agricultural Geography**

Climate change is drastically changing the agriculture of Ukraine. The land is heating much faster than the average global temperature. The temperature will rise by an estimated 2-4 degrees Celsius by 2050 (Voropaj, 2020). In areas of chernozem soil, droughts are increasing, which will affect as much as 41% of arable land at a 1.5 degrees Celsius warming (МОЛДАВАН et al., 2023) and decreasing wheat yields by as much as 10-20%. The precipitation regimes are becoming less predictable, as planting zones drift towards the north, while rapidly eroding soils from extreme weather events are destroying the fertile chernozem. The less arid western areas are becoming even more important for planting the more durable crop types, causing a shift in geographical reaction away from the eastern areas which were previously a focus of cultivation. Adaptive measures such as expanded irrigation systems are important as water shortages are increasing agricultural vulnerability. Conversely, it has been suggested that despite the formidable problems produced by climate changes, there is a great deal of resilience and ability to adapt in the agricultural economy of Ukraine. Changes in methods of production and supplements of export areas actively implemented in emerging markets buttressed by international help could lessen the long-term effects of agricultural harm which might occur in the future on world grain problems, and develop a more decentralised storage of the world's lift food supply to build into the outcome a resilient and decentralised food supply trend in the world.

**Geopolitical Conditions and Impacts**

The ongoing war between Russia and Ukraine has caused major disruptions in the agricultural sector, with a whopping 30% of the farmland lying fallow because of occupations, mines, and military strikes. The eastern chernozem areas such as Kharkiv and Donetsk are seriously impacted with severe contamination from heavy metals and labour shortages due to massive rural out-migration. The exports of grains and oilseeds are down by 18% plus there has been extensive destruction of infrastructure with estimates of the damage between \$8 billion and \$11.2 billion as of the end of 2024 (Ukrainian Agriculture in Times of War: Analysis of Support Programmes, 2024). The seizing of agricultural products by the Russians, the continued blockage of shipping, requires costly re-routes for the exports via land corridors and add to the uncertainty regarding world food supplies. Some analysts, however, conclude that despite all these overwhelming problems, the agricultural sector of Ukraine has shown impressive fortitude and adaptability. New techniques in farming and an extensive diversification of export routes aided by foreign assistance may avoid depreciation of long-run gains in global grain security and possibly also lead to a more decentralized and therefore a more tough global food supply system.

**Alterations to Agricultural Geography**

The simultaneous combination of several pressures is radically changing the agricultural landscape of Ukraine. The abandonment of eastern territories has shifted agricultural production westward, where more secure conditions permit increased production despite less fertile soil (Qadir et al. 2024). Meanwhile, climate change is encouraging the production of drought-resistant crops in the regions of south-central Ukraine, while the ongoing conflict requires extensive mine clearance, together with the expansion of diversified export routes. Reports from satellite imagery verify a decrease in agricultural land, with military occupation and altered precipitation patterns as the two main causes of these geographical changes. Conversely, some analyses conclude that despite these enormous difficulties, there is a considerable degree of resilience and adaptation in the agricultural sector of Ukraine. Improved techniques and procedures of agriculture and more diversified export routes, including international assistance, may help to make good the long-term effects of these problems on the global security of grain; thus, there may be a tendency to a more decentralised and a healthier global food supply.

<b>Factor</b>	<b>Impacts on Chernozem Region</b>	<b>Geographical Shifts</b>
<b>Climate Change</b>	Droughts, yield drops (10-20%)	Northward/western migration
<b>Geopolitical (War)</b>	Mines, pollution, 30% uncultivated	Eastern abandonment, western rise
<b>Combined Effects</b>	Soil degradation, export disruptions	Rerouted trade, resilient crops

## Discussion

In contrast, some academic interpretations make the point that despite the severe hardships imposed by both geopolitical conflict and the impact of climate change, the agricultural sector in Ukraine can be very resilient and adaptive. New ways of doing agricultural business and the effective diversification of export routes, assisted by incoming foreign flows, likely and in the long term will help mitigate the consequences of loss of worldwide grain security and the emergence of a more diversified and robust world food supply chain. This complicated relationship deserves careful investigation of how these inter-related factors, the geopolitical conflict, climatic changes, and adaptive techniques of agriculture otherwise act together to change both the agricultural supply in Ukraine and its repercussion on world agricultural markets. To take an example, production of wheat and corn had increased from 2002 to 2022. This is an indication of the potential for production inherently present in Ukraine (Siankwilimba et al., 2023). Yet the damage done to energy infrastructures in Ukraine has made it difficult for grain production and exports to occur at full strength. In turn this has intensified a world food insecurity (Chen et al., 2024). Thus, diversification of agrifood systems and diversification of markets, production, crops etc. and development of technological innovation are necessary to meet these difficulties and build up a situation of resilience against possible future shocks and a food security of the world population (Neik et al., 2023). For example, we see that winter varieties of triticale were reduced in production and overall production while rapeseeds increased in both area of crop and production, although yields fell slightly (Han et al., 2024).

## Conclusion

Ukraine's fertile soils, historically of global importance for grain security, face serious challenges due to climate change and geopolitical conflict. These impacts are threatening productivity and changing the agricultural patterns of the country. Forecasts show a movement towards stronger more western based agricultural systems, meaning a need for increased international assistance towards adaptation strategies as well as peace building to more effectively combat these intensifying risks. Other assessments hold that this resiliency of the agricultural sector and its capacity to adapt are noteworthy, despite these challenges. Gradual improvements in agricultural practices and diversification of export routes, along with international assistance should work to mitigate the long-term effects on global grain security and probably will produce a more net spread out and resilient global food supply system.

## Acknowledgment

I, Rakesh Kumar, Asst. Prof and Head, Dept. of Geography, Murarka College Sultanganj, TMBU, Bhagalpur, Bihar do hereby acknowledge that no financial or any other support was provided to me. Also that I face no conflict of Interest regarding publication of these papers.

## Financial support and sponsorship

Nil.

## Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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