



REGIONAL SPECIFICITY OF WHEAT GRAIN VIBRATION IN THE MINDS OF CLIMATE CHANGES AND WAR RISKS.

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The agro-industrial complex is a priority sector of the Ukrainian economy, which is the key to ensuring the country's food security with high potential. The main structural elements are: agriculture; industries that produce means of production and serve the agro-industrial complex; industries for the preservation, processing and sale of agricultural products [1].

The grain industry is strategic for the economy of Ukraine: it guarantees food security, generates foreign exchange earnings from exports, provides income for farmers and promotes the development of rural areas. The industry determines the cost of basic products, in particular grain processing and livestock (through the prices of compound feed), and also serves as the basis for the sustainable development of the agro-industrial complex [2]. The key factor in its growth is the intensification of production through technological improvement [3].

Wheat is the main food crop of Ukraine, which ranks first in terms of sown areas and makes a decisive contribution to the food security and export potential of the state [4].

The study of the Ukrainian wheat market is of fundamental importance both in the national and global dimensions. It is advisable to consider it as a complex multi-level system in which production, logistics and institutional factors function in close interaction with the world price situation, transformations of international trade and challenges of food security. Global climate change (shift of agro-climatic zones to the north) and military risks (destruction of infrastructure, mining, blocking of logistics) have radically changed the geography and technologies of crop cultivation [5].

If we consider the regional distribution of wheat production in Ukraine, we can see the following trend by region: the traditional leader in terms of sown area is the Southern region (Odesa, Mykolaiv, Kherson, Zaporizhia regions), however, in these regions there is a high risk of drought, which can affect both the yield and the quality of this crop. The Central and Eastern regions (Vinnytsia, Kirovohrad, Poltava, Kharkiv, Dnipropetrovsk regions) are distinguished by consistently high yields due to fertile black soil, and in years with moderate rainfall they provide the largest gross harvest. As for the Western and Northern regions (Khmelnyskyi, Ternopil, Volyn, Kyiv, Chernihiv regions), they have the highest yield per hectare due to sufficient moisture. Spring wheat crops are concentrated mainly here, although the total areas are smaller than in the south.Ukraine, with its strong agricultural potential, faces increasing risks associated with rising temperatures, uneven distribution of precipitation, and increased frequency of extreme weather events. This significantly affects productivity, economic efficiency of farms, and the sustainability of the agricultural sector as a whole [6].

The aim of the study is to analyze the dynamics of wheat grain production in the context of climate change and military risks in different regions of Ukraine and to visualize these changes. The task is also to identify key trends and factors that influenced them.

Climate change has significantly affected the efficiency of agricultural production in Ukraine. The main trends are the increase in average annual temperatures and uneven precipitation, which has led to fluctuations in the yield of key crops: wheat, corn, sunflower. And the increase in the frequency of droughts, floods and hailstorms negatively affects the quality and volume of the crop. The most vulnerable to climate change are the southern steppe regions, where the deficit of precipitation in summer significantly reduces yields. At the same time, the implementation of adaptation measures (the use of drought-resistant varieties, modernization of irrigation systems, optimization of crop rotations and the use of modern agricultural technologies) contributes to the stabilization of production and reduction of losses [6]. Modern conditions have formed a clear division of the regions of Ukraine by the level of yield, security and climatic factors, which are presented in Table 1.

Table 1 - Regional map of wheat production

Region / Zone	Climatic features	Military and logistical risks	Role in production (as of 2026)
Western and central regions (Khmelnyskyi, Vinnytsia, Ternopil, Khmelnytskyi region)	Increase in heat while maintaining moisture. Favorable temperate climate.	Lowest security risk; direct access to western rail and road borders.	Leaders in yield. Khmelnytskyi region demonstrates an absolute record - up to 7.3 t/ha (with an average nationwide yield of 4.92 t/ha).
Southern regions (Odesa, Mykolaiv)	Intensification of drought, critical moisture deficit. Drying of soils during the growing season.	Constant threat of shelling of port and grain elevator infrastructure. Risks of shipping in the Black Sea.	Leaders in gross harvest (crushed). Odesa region holds first place in Ukraine in terms of volume — over 3.2 million tons due to large sown areas.
Northern and northeastern regions (Sumy, Kyiv, Chernihiv)	Shift of the "corn-sunflower" and grain belt to the north of Polissya.	Frontline areas suffer from artillery shelling. Shortage of working capital and warehouses.	High technological potential. Sumy and Kyiv regions show high yields (6.0–6.28 t/ha), adapting technologies.
Eastern and deoccupied territories (Kharkiv, Dnipropetrovsk, Kherson)	Severe droughts, lowering of groundwater levels, destruction of irrigation systems.	Maximum risk. High level of mining of fields, destruction of up to 90% of storage sites.	Production reduction. Despite its proximity to the front, the Dnipropetrovsk region produces a stable harvest (~2 million tons) thanks to the resilience of farmers.

Figure 1 shows the impact of climate change on wheat grain production.

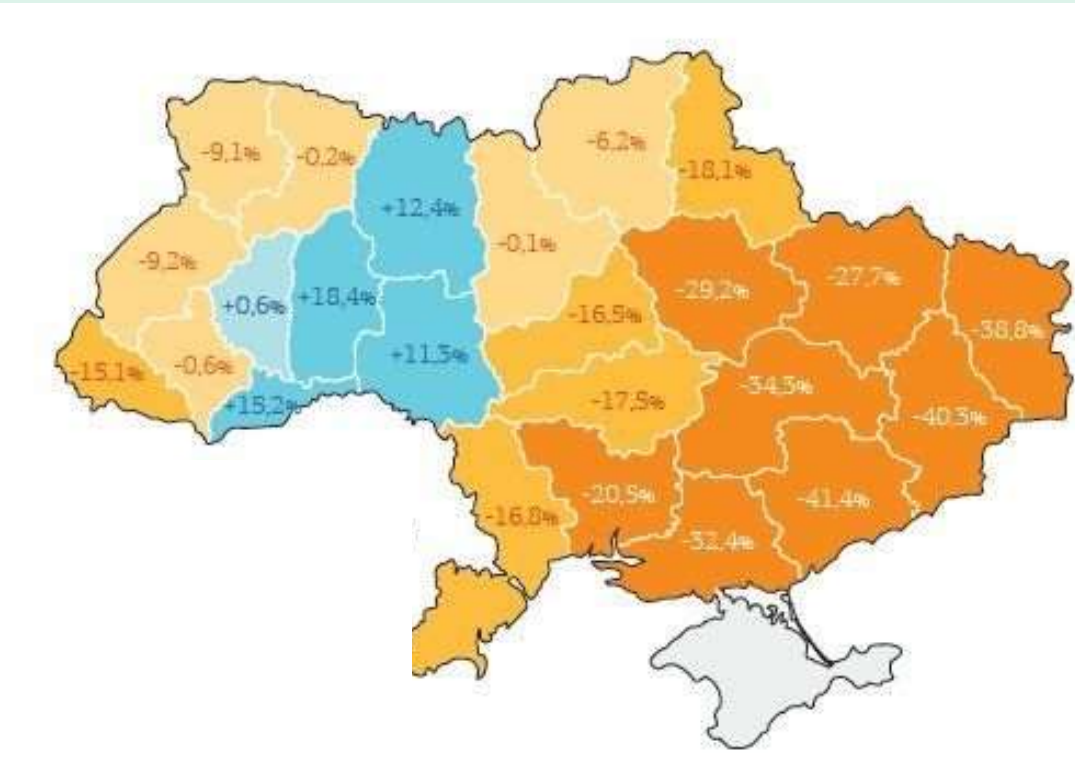


Fig. 1 - Change in average soil moisture in 2025 compared to the average value for 1990-2000 [7]

First of all, it is necessary to note the loss of potential of the South due to regular droughts. Without irrigation, stable cultivation of grain crops, including wheat, in this region becomes more difficult. Therefore, Polissya (North) and Western parts of Ukraine become more adapted and optimal in terms of climatic conditions. привабливості вирощування пшениці.

Another feature of wheat grain production in Ukraine in the recent period is military risks and economic factors.The full-scale invasion of the Russian Federation in 2022 significantly affected the crop sector, in particular wheat cultivation. Sown areas decreased, and problems with access to fertilizers and fuel led to a decrease in yields. The blockade of sea ports caused a noticeable drop in export volumes. Although the signing of the “Grain Agreement” and the creation of a “grain corridor” partially facilitated exports, high logistics costs continue to negatively affect domestic prices, limiting farmers' incomes. This, in turn, reduces the investment attractiveness of the agricultural sector and slows down the introduction of modern agricultural technologies [8].

CONCLUSIONS: The development of the agricultural sector of Ukraine demonstrates that climate change has a multi-vector impact on the production of agricultural crops, including wheat. An increase in average annual temperatures in combination with an uneven distribution of precipitation leads to a decrease in the stability of yields and an increase in the frequency of crop damage by extreme weather phenomena. In the context of such changes, traditional agricultural technologies, crop structure and the agricultural policy system require correction and implementation of new adaptive solutions. To ensure the sustainable functioning of the agricultural sector, it is necessary to combine the modernization of irrigation systems and the introduction of varietal and technological innovations with systematic information support for farmers regarding weather risks.It should also be noted that a significant reduction in the total sown area of wheat and gross harvest was caused by military operations in Ukraine.Further development of the industry depends on the integration of wheat production with innovative storage systems. State support for the modernization of the grain elevator fleet is necessary. This will minimize storage losses and ensure the rhythm of export supplies regardless of seasonal fluctuations and security risks.

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