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RISKS OF CLIMATE CHANGE AND THEIR IMPACT ON UKRAINE'S AGRICULTURAL SECTOR

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Abstract. Climate change is one of the most significant risks affecting global development, particularly in the agricultural sector. This study examines the impact of climate change on Ukraine's agriculture, focusing on rising temperatures, shifting precipitation patterns, and the growing frequency of extreme weather events. The findings indicate that climate fluctuations influence crop yields, livestock productivity, and food security. While certain climatic changes, such as a longer growing season, may present opportunities for increased agricultural output, challenges such as heat stress, water scarcity, and soil degradation pose significant risks. The study highlights the need for adaptation measures, including conservation agriculture, improved land management, and strategic climate policies to mitigate negative effects while utilizing emerging opportunities.

Key words: climate change, agriculture, global warming, food security, crop yields, livestock productivity, greenhouse gas emissions, adaptation measures, agro-climatic conditions.

Introduction.

In today's world, climate change, characterized by rising temperatures, shifting climate zones, melting glaciers and other environmental changes, is one of the most pressing challenges facing society. Its negative impacts are widespread and multifaceted, posing serious threats that are already evident and are expected to intensify in the future. Rising average annual temperatures and greater heat waves contribute to heat stress and heatstroke, especially in densely populated urban areas. Rising temperatures also contribute to the increase in diseases such as malaria, cardiovascular or respiratory diseases [5].

In addition, climate change disrupts rainfall patterns, leaving some regions vulnerable to prolonged droughts that threaten the availability of water for drinking



and agriculture, while others face severe flooding due to heavy rains. Other negative impacts, such as extreme weather events and rising sea levels, further exacerbate these problems.

These environmental changes have serious implications for economic development and food security, leading to reduced yields and changes in the distribution of plant species. In some regions, these changes may lead to increased food shortages, food prices, disruptions in food supply chains and even famine. Therefore, the need to develop innovative strategies to adapt agriculture to these conditions and mitigate their negative impacts on the sector and related industries remains urgent [4; 6].

The current climate changes occurring on our planet at unprecedented rates in recent decades represent one of the most influential risks shaping the global development of humanity. Alterations in the climate system pose significant threats and challenges to sustainable societal development, resulting in increased risks to human health, well-being, natural ecosystems, and economic sectors. These changes necessitate comprehensive research and the development of adaptation measures [1].

The agro-industrial complex holds a critical position in the global economy. It is one of the main national economic sectors that determine the conditions for sustaining human life. Its significance lies not only in fulfilling human food needs but also in its substantial impact on employment and the efficiency of the entire national production system [2].

Ukrainian agriculture is particularly vulnerable to climate fluctuations, as the functioning of crop production and livestock farming, their specialization, and crop yields largely depend on the agro-climatic conditions of the region, primarily its temperature and moisture availability. Changes in these factors affect the rate of biochemical processes, growth, development, and productivity formation of plants, as well as the feed base for livestock, ultimately impacting the food security of Ukraine.

Main Text.

Climate change presents significant challenges for global agriculture, especially in countries where agriculture plays a central role in the economy, including Ukraine.



A key feature of climate change over the past decade is global warming, manifested in an increase in the average annual air temperature by 2 – 3 °C. This warming leads to a decline in crop yields and livestock productivity. Scientific forecasts suggest that an increase in the average annual temperature by 1 °C leads to a 10 % decrease in agricultural production. The anticipated rise in temperature by 1 – 3 °C in the near future will significantly impact cereal production [6].

At the same time, agriculture contributes to global warming through greenhouse gas emissions. The sector is responsible for nearly half of the global emissions of two of the most dangerous non-carbon greenhouse gases – nitrous oxide (58 %) and methane (47 %). It is expected that agriculture will remain the primary source of these emissions in the coming decades [1; 7].

The impact of climate change on Ukraine's agricultural sector is evident in rising temperatures. Over the last two decades, the average annual air temperature in Ukraine has increased by 0,8 °C compared to the climate norm, with the most significant temperature rise occurring in the summer and winter seasons [3]. This rise has led to increased thermal resources, allowing for the cultivation of heat-loving crops in regions previously unsuitable for them. The shift in the growing range of these crops has moved further north, improving yields [5].

The extension of the warm period has contributed to higher yields of major agricultural crops but also increased the risk of plant damage due to late frosts. Rising temperatures extend the grazing season for cattle while increasing the risk of animal diseases transmitted by insects and wild animals that are changing their range [3]. Furthermore, higher temperatures negatively impact crop photosynthesis, leading to reduced organic matter production and lower crop yields. Heat stress also affects livestock, slowing weight gain, reducing milk yield, and increasing mortality [4].

Moisture availability is another critical factor. Although the total annual precipitation in Ukraine remains unchanged, its seasonal distribution has shifted. The autumn months, particularly September and October, have seen a significant increase in precipitation (by about 30 %), while winter precipitation has decreased slightly. Spring and summer precipitation levels have remained largely unchanged, but heavy



rainfall events have become more frequent, leading to soil erosion, compaction, and silting, which negatively affect agricultural productivity [2; 5].

Projections suggest that by the end of the 21st century, continued increases in temperature, changes in moisture regimes, and more frequent extreme weather events will significantly alter Ukraine's agro-climatic resources. The boundaries of soil-climatic zones will shift, affecting crop cultivation conditions and yields. The length of the growing season will increase, as will solar radiation and total evaporation, intensifying water scarcity for plants and expanding the area of insufficient moisture, necessitating irrigation [1; 3].

According to the UK National Meteorological Service, summer drought periods in Ukraine are expected to double, while river flows will significantly decrease, leading to greater water deficits [3]. Climate change also affects plant responses to increased atmospheric carbon dioxide levels. Some crops, such as wheat, barley, and soybeans, may benefit from higher CO₂ levels, leading to accelerated maturation and increased yields. However, other crops, such as corn and millet, may experience significant yield reductions.

Overall, global warming is expected to increase winter wheat yields across Ukraine by 10 – 40 %, with the zone of guaranteed production shifting northward [4]. However, climate change will also lead to the spread of harmful insects, negatively impacting agricultural productivity [5].

Conclusions.

The impact of climate change on agriculture is multifaceted and presents significant risks to food security, economic stability, and environmental sustainability. While certain aspects of climate change may offer opportunities, such as extended growing seasons and improved conditions for specific crops, the overarching challenges far outweigh these benefits. Rising temperatures, shifting precipitation patterns, and the increasing frequency of extreme weather events necessitate urgent adaptation strategies and mitigation efforts.

For Ukraine, addressing these challenges requires scientific advancements in crop breeding, the adoption of resilient agricultural practices, investment in water



management infrastructure, and the implementation of policies aimed at reducing greenhouse gas emissions from agriculture. Key strategies include utilizing existing knowledge to manage weather variability in agricultural systems, mitigating agriculture's contribution to global warming, and advancing research to close knowledge gaps and develop innovative adaptation approaches.

Reducing the vulnerability of agricultural systems to climate change will require shifts in land use practices, including conservation agriculture, minimal soil disturbance, ecological farming, organic matter incorporation, and diverse crop rotations. Implementing these measures will be crucial to ensuring the sustainability of Ukraine's agricultural sector and maintaining food security for future generations.

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Анотація. *Зміна клімату є одним із найзначніших ризиків, що впливають на глобальний розвиток, особливо в аграрному секторі. Це дослідження розглядає вплив зміни клімату на сільське господарство України, зосереджуючись на підвищенні температур, зміні режиму опадів та зростанні частоти екстремальних погодних явищ. Результати свідчать, що кліматичні коливання впливають на врожайність сільськогосподарських культур, продуктивність тваринництва та продовольчу безпеку. Хоча певні зміни клімату, зокрема подовження вегетаційного періоду, можуть створювати можливості для підвищення аграрного виробництва, а виклики, такі як тепловий стрес, дефіцит води та деградація ґрунтів, становлять суттєві ризики. У дослідженні підкреслюється необхідність адаптаційних заходів, включаючи відновлювальне землеробство, покращене управління землями та стратегічну кліматичну політику, щоб мінімізувати негативні наслідки та водночас використати нові можливості.*

Ключові слова: *зміна клімату, сільське господарство, глобальне потепління, продовольча безпека, врожайність культур, продуктивність тваринництва, викиди парникових газів, адаптаційні заходи, агрокліматичні умови.*

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